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Volume 8 Number 2

AQUA CULTURE
Asia Pacific

Nursing white shrimp in cement ponds

Fish protein hydrolysates in stress resistance

Natural growth promoters for shrimp

Holistic approach to managing diseases in cage culture

Grouper farming in Philippines and Malaysia

MICA (P) 006/10/2011 PPS1699/08/2012(022811)

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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

Wake up call for health management

Shrimp and fish prices have been on the rise in the past 24 months. For commodity products, price is always a consequence of the equilibrium between demand and supply. We know that the world has 7 billion mouths to feed and China has a 200 million burgeoning middle class ready to pay for seafood and fish protein. Is supply increasing in tandem? The clear answer is no. So where is the bottleneck in aquaculture?

The critical factor is disease and in an aquatic environment, a sterile environment as in the production of land animals, is near impossible. The major species have been affected from white spot syndrome virus (WSSV) and early mortality syndrome (EMS) in shrimp to Streptococcosis and other bacterial diseases in freshwater fish to grouper iridovirus and viral nervous necrosis in marine fish. To have better control over these diseases it is necessary to understand the health management practices in the respective species and industries.

Penaeid shrimp have a primitive immune system that does not allow for the use of any workable vaccine, at the moment. The shrimp industry focuses more on prevention rather than cure as it has no solution for the latter to date. The value chain starts with the domestication of SPF (specific pathogen free) stocks which produce post larvae in a biosecure hatchery. On leaving the hatchery and introduction into the pond water, it is open to infection. Biosecurity practices include minimising the pond bottom as an incubator of pathogens and eliminating birds, crabs and humans as vectors. The processing plant could also act as an incubator, hence it is discouraged to visit the farm after the processing plant. Perhaps due to the lack of therapeutics measures, the shrimp industry has the best developed biosecurity measures.

Freshwater fish such as tilapia and pangasius catfish start with genetic stocks that have been selected for growth in the former and tend to have a higher level of inbreeding in the latter, thus reducing the resistance levels in later generations in both. There are no SPF stocks but we are fortunate that there are vaccination measures suggested for certain infections in both species to prevent the outbreak of diseases. However, there is little or no practice of biosecurity in the farms. It is unsure if this risk is taken with the confidence that vaccination provides adequate immunisation.

The marine fish industry in Asia probably has the most unsophisticated health management. Hatchery produced seed stock is from partially domesticated brood stocks and there is little genetic selection so far. It has been taken for granted that fish are naturally resistant but conversely, could be vectors of certain pathogens. It is complicated by the fact that the industry is not species specific. Both the hatchery and culture segments of the value chain tend to produce multi species of fish thus losing control and monitoring of the numerous pathogens that could be harboured but not infectious in certain species that could act as vectors. The culture of marine fish is nearly always done in cages. Individual farms are located in clusters within a certain coastal zone gazetted for the industry. It would be nearly impossible to practice biosecurity since the zone shares the same water body. It is common that the farms receive fry without documentation of disease free status. Hence it is also common to see survival rates of 30% which to farmers seem to be economically viable.

Although there are new developments with nutraceuticals such as organic acids to increase the immunity, the industry must take a holistic approach to health management and biosecurity. The comparison of the three major aquaculture industries in Asia, namely shrimp, freshwater fish and marine fish allows for learning and benchmarking. Certainly the Asian marine fish industry has a lot to learn from the salmon industry in Chile. According to Carlos Chávez, an expert in environmental economy and natural resources at the University of Concepción, the industry expanded without a regulatory framework or adequate controls to prevent and anticipate environmental problems or the development of transmittable fish diseases. The devastating health crisis cut production in half. Does this not sound similar to the current situation in marine fish farming in Asia?

The development of vaccines requires time and heavy financial resources and this has been left to the private sector today. The government and public research organisations must wake-up to this critical bottleneck and embark on finding solutions to the health problems in fish and shrimp, at least at the basic research level. How do we get the industry to be proactive?

Zuridah Merican

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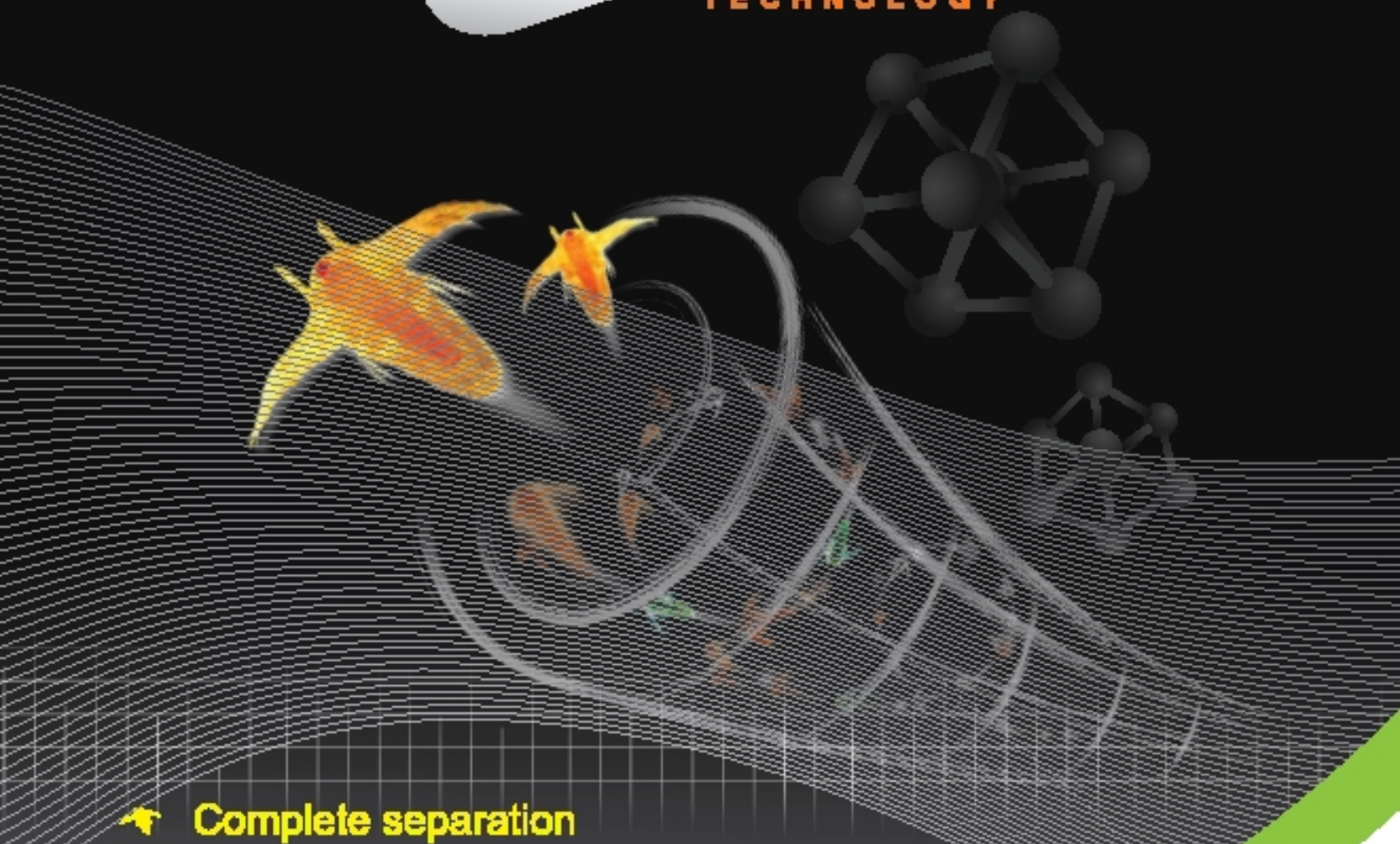

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Aquatic Food Safety Centre in Bangladesh

Seafood in Bangladesh is the third largest source of foreign exchange valued at USD 625 million and shrimp alone was valued at USD 478 million in 2010-2011. Shrimp and prawn production was 100,000 tonnes in 2011. The country's fisheries road map plans to produce 164,000 tonnes of shrimp and prawns by 2015 valued at USD 1.1 billion. The US is the largest importer of shrimp from Bangladesh.

A Private Public Partnership Program (PPP) in Bangladesh will establish an Aquaculture and Aquatic Food Safety Centre (AAFSC). This is an aquaculture research and training centre which will help to overcome the risks involved in the contamination of seafood products. A tripartite agreement of cooperation (AOC) was signed in Maryland, USA in January between the Joint Institute for Food Safety and Applied Nutrition (JIFSAN), Fishery Products Business Promotion Council (FPBPC) and Bangladesh Shrimp and Fish Foundation (BSFF).

The Government of Bangladesh has allocated BDT 40 million (USD 489,000) from its ongoing Economic Growth Program for the AAFSC which will require BDT 400 million (4.9 million) in the next five years. Organisations including USAID-PRICE, KATALYST, FAO and DANIDA have assured their support to this PPP initiative.

AAFSC will work towards ensuring food safety, environmental sustainability and social acceptability along the entire chain of aquatic food production, processing, handling and marketing for domestic consumption and export. Dr. Cheng-I Wei, Dean Agriculture and Natural Resources, University of Maryland, Syed Mahmudul Huq, Chairman BSFF and Dr Md Khairuzzaman Majumder, Coordinator, FPBPC signed the AOC on behalf of their respective organisations.

The signing ceremony was preceded by a training workshop on "Food Safety Modernization Act - 2011 and its implications for exporting countries" presented by Dr Elizabeth M Calvey.

This agreement follows the original co-operation between the University of Maryland and BSFF in March, 2010. BSFF and JIFSAN have already jointly implemented a 4-phase training of the trainers' program on Good Aquaculture Practices (GAqPs). They have created a pool of over 50 core trainers, who in their turn, will further impart training to more stakeholders along the value chain.

The centre will have a management committee comprising representatives from relevant government and private sector stakeholders. Apart from giving services to the fisheries sector AAFSC will also extend support to selected laboratories in the livestock and horticulture sectors which are two production sectors with high potential.

Bangladesh Commerce Secretary Ghulam Hussain, said that FAO has already initiated a technical cooperation Project (TCP) for developing sustainable aquaculture in Bangladesh. He hoped that JIFSAN would continue its support for their adaptation in Bangladesh to increase aquaculture production. He expects that the USFDA will continue to support Bangladesh in its efforts to increase exports of aquatic and other food items to the US.

Opportunities in aquaculture trade

SEAT or Sustaining Ethical Aquaculture Trade is a large-scale collaborative project funded by the European Union and coordinated by the University of Stirling, Scotland. The aim is to support sustainable seafood trade in key aquaculture species between South East Asia and Europe. With two years of research, SEAT is now highlighting opportunities with Action Research, and facilitating the participation of small and medium sized enterprises in key global value chains.

The program covers Bangladesh China Thailand and Vietnam geographically and shrimp, prawn, tilapia and pangasius species-wise. In China, SEAT is coordinated by Shanghai Ocean University and the output was discussed during the 9th Asian Fisheries Forum in China in April 2011. In a survey on what factors affect the value chain, stakeholders along the value chain indicated the most concerns on variable market demand and prices; input quality such as feeds, post larvae and brood stock; disease prevalence and technology innovations for productivity growth. The next step is working with businesses along the value chain to deal with sustainability concerns.

Off flavour in tilapia

Some of the current activities include improving the consistency and value of tilapia supply. The international trade was valued at USD1 billion in 2011. One of the restrictions to trade is fish susceptibility to flavour inconsistencies. In China and Thailand, the program is bringing importers, processors, farmers and input/service suppliers together to raise awareness and implement control measures to raise the quality and value of their product. It is also working with businesses in Europe on the development of testing kits to monitor the pond environment, and in Thailand on the integration of suitable finishing ponds into the value chain to avoid flavour inconsistencies.

Pond sediments

In Vietnam, the 6,000 ha of pangasius ponds produce around 8,000 cubic metres of sediment/ha in each 6 month crop cycle. SEAT is testing for any contaminant issues as well as nutrient content, and is bringing agricultural scientists, agronomists, agricultural producers, pangasius farmers and those specialising in sludge removal and transport together to add value to the sludge and integrate its use into value chains. (www.seatglobal.eu)

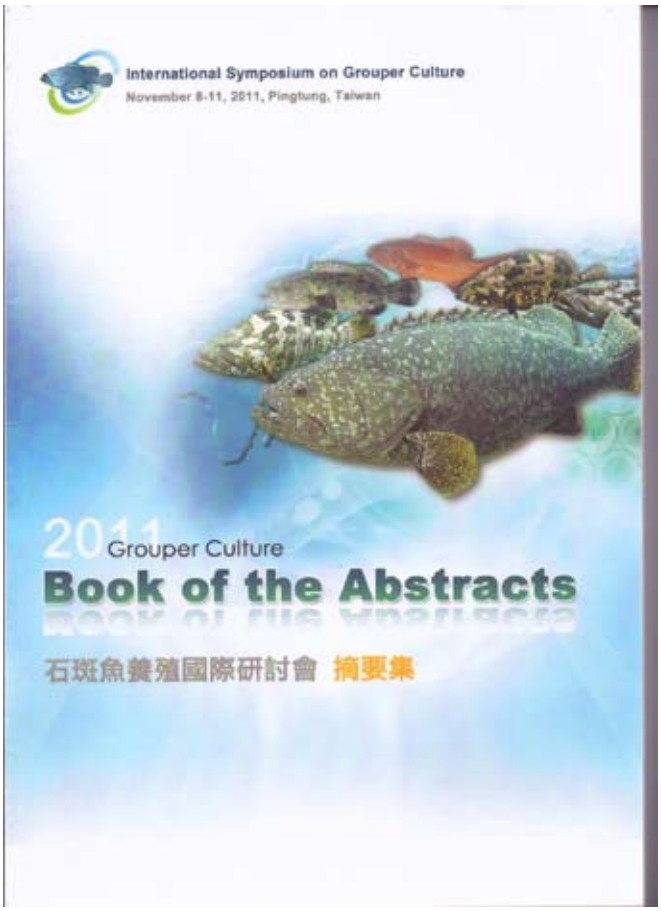
Groupers in Asia

The technological innovation and industrial development in groupers in Asia was the focus of an international symposium held from November 8-11, 2011 in Pingtung, Taiwan.

The global production of the expensive groupers has been increasing especially in China, Taiwan, Indonesia, Malaysia, Thailand and Philippines. FAO statistics indicated that the production in 2009 totalled 75,520 tonnes, valued at USD 310 million USD. Taiwan is the leader in reproduction and cultivation technologies and recently has regained itself as a major producer.

The symposium gathered international experts to exchange information such as on culture technology and to expedite the development of the grouper industry. It was organised by the Taiwan Fisheries Research Institute, Council of Agriculture (FRI, COA). Some of the topics discussed include status and problems of grouper aquaculture, reproduction and cultivation technology, disease prevention and control (including vaccine development and application), aquaculture management (including feeding management), transportation technology, bio-safety and certification of seafood products (including processing and marketing), bloodstock conservation and breeding and visions and prospects.

In his keynote address, the Deputy Minister, Council of Agriculture Taiwan said the developments in grouper aquaculture, in particular the artificial propagation of the species, have not only led to higher production volumes but also the conservation of natural resources. He listed the priorities for sustainable development of the species as improvement in selection of target species for culture, selective breeding, establishment of biosecure culture systems, vaccine development, alternative feed resources, improvement in live fish transport and effective marketing.



Taiwan's industry

Taiwan produced 23% of world production of farmed grouper in 2009 at 13,480 tonnes, according to the Taiwan Fisheries Agency, said Ching-Ta Chuang and Jun-Yu Chen, Institute of Marine Affairs and Resource Management, National Taiwan Ocean University, in their presentation on the supply chain management of Taiwan's grouper industry. After the signing of ECFA (economic cooperation framework agreement) in 2010, the export potential of Taiwan's groupers into China's live marine fish market rose. Demand continues to rise with the economic situation in China. Taiwan has responded with 'the quality agriculture program with a 'double production of grouper project'. However, it also faces a threat of a growing industry in southern China.

Recent developments

During the symposium, recent developments presented were mainly in two areas; hybridisation of groupers and vaccine development. The work in University Malaysia Sabah led by Professor Shigeharu Senoo has led to several hybrids; TGGG (tiger grouper *Epinephelus fuscoguttatus* x giant grouper *E. lanceolatus*), OGTG (orange spotted grouper *E. coioides* x tiger grouper), OGGG (orange spotted grouper x giant grouper), MGTG (humpback or mouse grouper *Cromileptes altivelis* x tiger grouper), SGTG (spotted grouper *E. polyphekadion* x tiger grouper) and SGGG (spotted grouper x giant grouper). The advantage of TGGG hybrids are high market value, resistance against diseases, fast growth whereas SGTG has the highest resistance against diseases, said Senoo. In Japan, the team from Kinki University and National Research Institute of Aquaculture, showed the production of a new cross bred species using cryopreserved sperm. This is leading to a new hybrid of kelp grouper *E. moara* X giant grouper.

Iridoviral infections are threats to industry in the Asia Pacific region. Taiwanese researchers, Hsin-yin Chou and Yeong-Torng Chu have developed control strategies in the field. They evaluated the effects of different water treatment modules; chlorine dioxide added to water, electrolytic seawater and calcined oyster shell powder (COSP). They found that COSP treated seawater and electrolytic seawater can inactivate iridovirus. They also reported on the patented aquatic multi-emulsion to improve oral delivery of vaccine and IgY in the field. Researchers from the Institute of Biotechnology, National Cheng Kung University, Taiwan have invented an effective NNV (nervous necrosis virus) oral subunit vaccine. The efficacy on larvae of *E. coioides* showed that the immune response commenced at the post larvae stage. However, the oral vaccine alone could not control the virus due to the transmission in egg, hatchery facility and poor biosecurity. Thus, the team is looking at NNV free feed, hatchery and virus containment management methods. (Source: Book of Abstracts, International symposium on grouper culture 2011, Pintung Taiwan. More on groupers in the industry review in this issue, p36-40).

News in Brief

Milkfish to China

Philippines based Alsons Aquaculture Corp. (AAC) expects to break into the China market after the success of an initial 9 tonnes of frozen milkfish for distribution in retail stores in Xiamen. The milkfish were hatched and raised in Alsons' 320ha aquaculture farm in Alabel, Sarangani and processed on-site at their state-of-the-art facility. It will be sold under the Sarangani Bay brand. The company runs the only fully integrated fish culture operation in the Philippines. Both Finfish Hatcheries Inc. and AAC are owned by the Alcantara group of companies. AAC is the single biggest, fully-integrated producer and processor of milkfish in the Philippines. The hatcheries in Mindanao provide more than half of the country's requirements for milkfish and other high value species of fry. Exports account for 70% of the company's total business and in 2011, it exported 1,800 tonnes.

Prices up with demand for pangasius catfish

In February, the price of first grade pangasius fish rose to VND26,000-27,000/kg (USD1.25-1.30/kg). This came with the surge in demand as seafood processors said that importers around the world have increased orders for pangasius fillet. Supply has been low. With the price hike, profit margins are expected to increase to VND3,000-4,000/kg (USD 0.14-0.19/kg). However, the Vietnam Association of Seafood Exporters and Producers (VASEP) said that although local firms faced many difficulties last year, pangasius exports still reached USD1.8 billion, up by 26.5% compared to 2010. In 2012, the association is targeting USD2 billion from exports.

New aquafeed mill in Andhra Pradesh

India's Shree Vijay Aqua Feeds Ltd will set up a USD 16 million (INR 80 crore) feed mill in West Godavari district, 320 km from Hyderabad in Andhra Pradesh. It will produce 180,000 tonnes per year of extruded fish feed and pelleted shrimp feeds. B.K. Murthy, Shree Vijay managing director said that they have signed a USD 6 million (INR 30 crore) order with the Muyang group of China for feed equipment and expect to commission the plant around December 2012. The Bhimavaram based company is a fully integrated aquaculture company with a hatchery of 100 million post larvae, a 120ha semi-intensive farm and satellite farms with an annual production of 1,900 tonnes and processing capacity of 40 tonnes/day.

China-Malaysia JV for 1,000ha shrimp farm

In Malaysia, Zhanjiang Guolian Aquatic Products Ltd based in Guangdong, China will invest MYR1 billion (USD 333 million) in an integrated shrimp farm in Marang, Terengganu on the east coast of Peninsula Malaysia. This is through a joint venture with Ocean Aquatic Marine (M) Sdn Bhd. The project will cover 1,000 ha and will begin in mid-2012. Zhanjiang Guolian is one of China's largest shrimp producer and exporter. It is expected that shrimp will be exported to China. The project will include a research laboratory and a shrimp hatchery, similar to the 1,000ha shrimp farm in Penarik, Terengganu and 400ha in Kerpan, Kedah under Blue Archipelago Bhd.

Taiwan helps Belize in tilapia farming

This five-year aquaculture development project being undertaken by the government of Belize with technical support from Taiwan will produce more tilapia for the domestic and export markets. The project will include a tilapia hatchery in 2012 with an initial production capacity of 200,000 fingerlings and then increasing to one million fingerlings. The second phase will be tilapia production, followed by marketing the tilapia. An aquaculture specialist from Taiwan will develop alternative feeds for tilapia culture, replacing commercial feeds by as much as 30-35%. The specialist and the ministry will organise a tilapia farmers' marketing cooperative and build a processing centre to help sell tilapia locally, creating a demand as farmers increase their production.

Tilapia in Europe

In Europe, tilapia accounted for only 7% of the total freshwater fillet market in 2011, comprising pangasius, tilapia and Nile perch. In 2010, these imports total 286,893 tonnes. The main suppliers for frozen fillet of tilapia are China, Indonesia, Thailand, Ecuador, Columbia and Brazil. In 2010, Poland is the leading market followed by Spain. Industry experts said that Spain consumed 3-4,000 tonnes and accounted for 36% of the EU consumption. China supplied 97% and Vietnam, 0.6%. In the first quarter of 2011, the EU imported 5,333 tonnes of tilapia fillet.

A niche market for air flown fresh tilapia fillet has been established in high end restaurants in France and UK. UK production from two farms is sold generally as fresh in local food service outlets and is marketed as more sustainable production than Chinese tilapia. UK tilapia is now available in Poland and Spain. The marketing campaign for UK tilapia focusses on 'a high quality, sustainable, fresh British product, which is superior to and different from a frozen import.' (Globefish 2011, CBI report).

Cautious expansion in 2012

The transformation of the aquaculture business at Indonesia's Central Proteinaprima (CP Prima) after the infectious myonecrosis virus (IMNV) outbreak in 2009, produced 55,000 tonnes of shrimp in 2011. It was 51,401 tonnes in 2010. In 2012, CP Prima, the world's largest vertically integrated shrimp producer and processor plans to produce around 60,000 tonnes of shrimp, said Arianto Yohan, general manager of export marketing in an IntraFish report. The recovery since 2009 resulted in yields increasing from 3.4 tonnes/pond in Q3 2011 to the current 4-5 tonnes/pond, according to Rubiyanto Haliman, senior manager of integrated quality assurance. It reduced stocking density to 55-65 post larvae (PL)/m^2 in the ponds on its Centralpertiwi Bahari (CPB) and Wachyuni Mandira (WM) farms. The CPB farm has 3,552 ponds of 0.5ha in size operated by individual shrimp farmers. During peak production in 2008, the stocking density was between 100-120 PL/m^2. In addition, the company stocked tilapia and milkfish in the shrimp ponds at low densities. These feed on excess feed and reduce organic loads in the shrimp ponds and improve water quality (www.vietfish.org).

First harvest in offshore cages

The first successful harvest of kampachi, a native yellowtail, *Seriola rivoliana* was completed in February from the Kampachi Farms LLC's Aquapod® pen drifting in eddies offshore of the Big Island of Hawaii. Some 2,000 hatchery reared fish were stocked and fed a commercial diet that replaced significantly fish meal and fish oil with soymeal and other alternative protein sources. Feed conversion rate was 1.6:1 and mortality 2%. Fish reached 5.6 lbs (2.5kg) in 6 months. This 'Velella' project was supported by the National Oceanic and Atmospheric Administration (NOAA), National Science Foundation (NSC), Lockheed Martin, the International Copper Association, Ocean Farm Technologies and Illinois Soybean Association with funding from Illinois soybean checkoff program.

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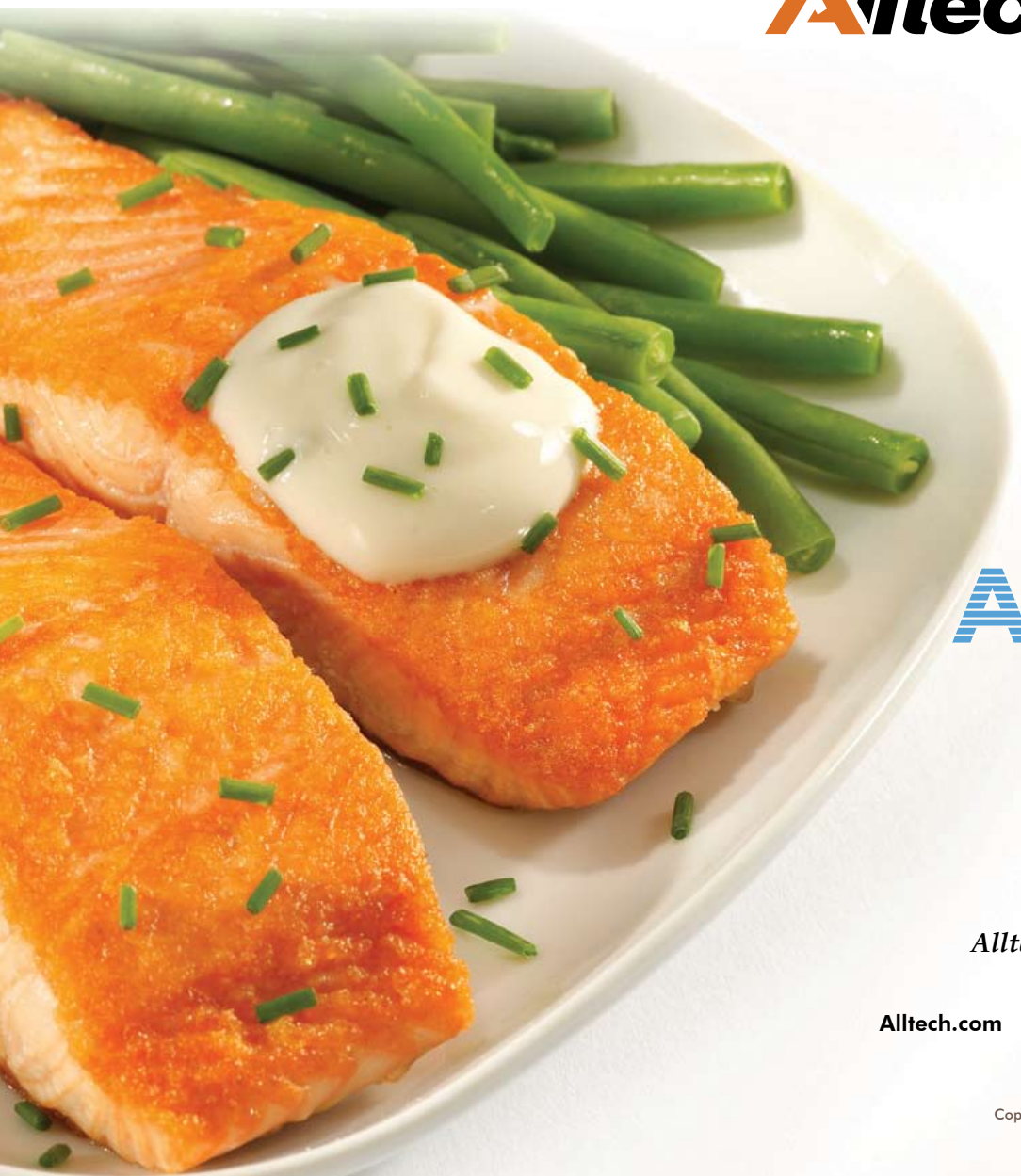

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Nursing white shrimp in cement ponds to day 55

By Soraphat Panakorn

Trials and innovations to increase yields with high density nursery rearing in Thailand.

Paisal Wongwasna

In his 20-years as a shrimp farmer, Paisal Wongwasna, a former police colonel and deputy commander, has been searching for new ways to improve productivity. Some of his innovations have worked well whilst with others he has lost money; to date he has spent almost THB10 million in experiments that have failed.

Khun Paisal has four farms located close to each other in Lam Ngob district in Trat Province, eastern Thailand. There are 32 earthen ponds of 0.5-0.7ha each with water depths ranging from 1.5 to1.8 m and 40 cement ponds. The cement ponds measure 10m wide, 13.5 m long and 1.4m deep. Aeration in the earthen ponds is with long arm aerators. One 3HP motor located in the middle of 6 ponds drives the paddle wheels, providing oxygen and water circulation.

One of his more successful innovations is nursing white *Litopenaeus vannamei* shrimp post larvae (PL) in cement ponds at 740 PL/m^2 up to approximately 55 days of culture (DOC). Post larvae of 65-67 days (PL65-67) are then transferred to grow-out earthen ponds for a further two months of culture. The stocking rate in the earthen ponds is about 60-75 PL/m^2 and production is generally 11 tonnes/ha of 50-60/kg shrimp.

Cement nursery pond without a roof which was blown away during a storm. The farm found that culture conditions were better.

Nursery culture management

Whilst Khun Paisal does not use any special technique for preparing soil or pond water for the grow-out ponds, he has developed a protocol for water for the cement ponds. These cement ponds are not painted and it was discovered that water in new cement ponds have high alkalinity and hardness levels which are toxic to shrimp. His remedy was to wash cement ponds with a solution of fermented banana trunks several times, until the right water conditions have been achieved.

"The green water for the cement ponds has to be well prepared to make sure that all the important water parameters such as alkalinity, pH, salinity, calcium, magnesium, potassium, etc. are optimal. I will prepare this water in a close-by earthen treatment pond. When ready, this water is channelled to fill up to 1.2m of the cement ponds," said Khun Paisal. "However, close monitoring of water parameters is essential. When there are signs of polluted water at the bottom of a pond, water will be drained out to treatment ponds. New enriched water from the supply ponds will be added."

Depending on the season, around 100,000-300,000 PL10-12 are stocked into each cement pond. Stocking is higher during the summer months. In comparison with feeding in earthen ponds, staff at the farm only use 200g of feed per 100,000 PL. Feed is adjusted based on sampling in feeding trays.

"Initially, we followed the same feeding regime used for shrimp cultured in earthen ponds and this was 1.5-2kg/100,000 shrimp. We almost lost the whole crop. After several trials, we derived the optimum rate of 200g/100,000 PL."

In the nursery, the same feeding protocol as that used for shrimp in earthen ponds is applied. This is feeding at 0800, 1130 and 1600 hrs. Generally, mortality is low and survival rates range from 80-90% when culture management is properly done. According to the farm manager,

This 5HP source drives paddlewheels in the cement ponds.

Earthen grow-out ponds.

no other techniques are used other than monitoring diseases and using effective microorganisms from the beginning.

Transfer

At around 50-60 DOC, shrimp will be ready for transfer to earthen ponds for further grow-out. By this time, the carrying capacity of the cement ponds would have been exceeded. Some 20-30 days prior to stocking, the farm prepares the water for the earthen ponds. A critical parameter is the salinity of the water in earthen ponds.

"In the beginning, I did not give much thought to salinity. Later I found out that if water salinity in the earthen pond is lower than the water in the cement ponds, shrimp survival rate was lower. Thus, the ideal salinity for the earthen ponds should be about the same level to 1-2 ppt higher than the water in the cement ponds," said Khun Paisal.

The farm will select a 'good day' for this transfer. It has to be one without any rain or strong winds and not too cold nor too hot. If the day is not ideal, the transfer will be postponed. The farm also avoids carrying out the transfer two days before or after moulting to avoid excessive mortalities during the process.

Transfer chamber

After several trials and errors, a perfect transfer facility was developed. This is a special mobile stainless steel tank installed behind a pick-up truck. It has several chambers inside to reduce water movements during transportation. By using this vehicle, it was possible to maximise the survival rate to almost 100%. When fully aerated from a built-in aeration system, each time this vehicle can carry about 70 kg of shrimp, size 200-300/kg or 3-5g in weight.

"My first innovation was a tank with only one chamber and coated with rust-proof paint. However, we discovered that the paint was toxic and killed all the shrimp. Then a second tank was made using stainless steel. It had only one chamber. I then found that when the truck was moving, it created too many waves, causing too much stress to the shrimp. A multi chamber tank was then developed."

The transfer will begin early in the morning. Farm staff will net the shrimp in the cement ponds, collect and load the juveniles in water from the cement ponds onto the truck. The truck is slowly driven to the grow-out ponds. The valve is opened and the juveniles are released into the grow-out ponds.

Grow-out culture management

At this stage, the most important parameter is feed management, said Khun Paisal. "If there is left over feed in 3 out of 4 feed trays, we will cancel the next meal. We always check the water temperature before feeding. If this is not ideal, we will wait for better conditions before feeding. I have found that feeding only 3 meals/day gave the same

One long arm aerator in cement ponds.

The transfer pickup truck with mobile container

Transfer container with partitions

Nang is second in command at the farm

Sutham is farm manager and looks after day to day farm operations

growth performance as 4 meals/day. We control pH by application of microorganisms. Stocking density will depend on water salinity and we need to keep to optimal levels of dissolved oxygen at all times."

As the production or outcome is quite similar to that obtained by farms practising the conventional culture technology, i.e. stocking PL10-15 direct into earthen ponds and achieving about 11 tonnes over a 3.5 month cycle, the frequently asked question is why should this farm do this?

Khun Paisal's response is that for any technology shift, it should be for the better. He listed the following advantages.

Less feed consumption

In the nursery, the feeding begins with 200g/100,000 PL/day in cement ponds from the first day. From 55 DOC in earthen ponds, shrimp normally consume about 600kg/100,000 shrimp. As only 400-450 kg are consumed in the cement ponds, the FCR is low at 1.2-1.4.

Low electricity consumption

The cement pond is smaller in area and water volume compared to the earthen ponds. It requires only 5 HP of aeration to provide enough oxygen for around 1 million shrimp in the cement ponds. In an earthen pond, double or triple the power is required to provide the same level of aeration.

Reduction in organic waste in earthen ponds

By using this technique, the earthen ponds will be used only to culture shrimp for a maximum period of only 2.5 months in each cycle. One problem in conventional systems is the overload of organic waste from waste feed and faeces as the pond is used for a prolonged period of 3 months. By shortening the culture time in the ponds, it is possible to avoid problems arising from bad water quality. Risks from diseases and toxic gases can be reduced. As water conditions remain good even at harvesting, shrimp will be healthier.

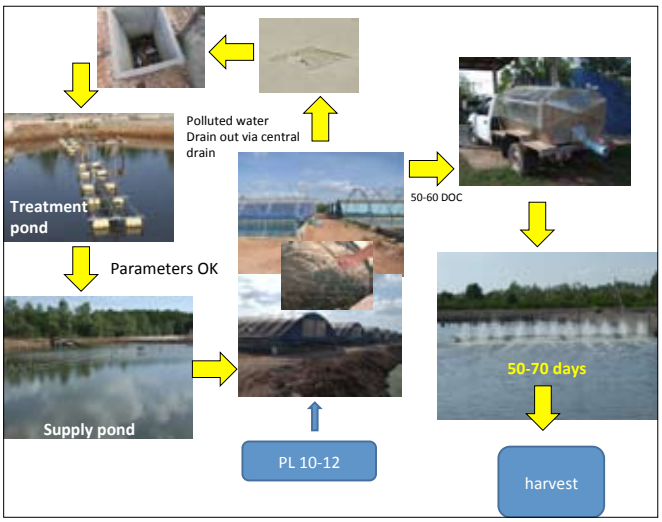
Less labour

During the first stage at around 50 days of culture, only one staff is required to manage 6 cement ponds containing a shrimp population which is equal to 3 earthen ponds. In comparison, one staff can only handle 1-2 earthen ponds.

Overall management

There is a general saving in costs of aquaculture inputs such as lime,

Treatment pond with cement ponds in the background.



Flow chart of operations.

minerals, etc. in the smaller cement ponds. Cost effectiveness is demonstrated when more of the inputs are optimally utilised. In a crisis situation, such as a disease outbreak, it will be easier to control water parameters in a cement pond. Finally, after each transfer of shrimp, the cement ponds can be quickly used for the next batch. In this way, there is the option to increase the number of crops per year and at his farm, Khun Paisal can harvest 4 crops/year whereas other farms will only manage 2.5 crops/year.

There are two successful elements demonstrated at this farm. Firstly, Khun Paisal who is keen to learn and innovate and take failures in his stride. Secondly, confident staff at the farm who have the chance to experiment and propose ideas for a better culture environment for the shrimp.

Soraphat Panakorn is Technical Sales & Support manager, Novozymes Biological Aqua Business unit, Asia Pacific Region.

Effects of dietary yeast nucleotides on the growth performance and non-specific immunity of white shrimp

By Shi Xian-wu, Lv Chi-bo and Wang Guang-jun

In these trials in China, supplementation with yeast nucleotides gave better growth but did not influence the acid phosphatase activity in the muscle.

Since its introduction into China, the farming of the white shrimp *Litopenaeus vannamei* has spread throughout China. The culture is successful, particularly in low saline areas. However, a consequence of this rapid expansion in culture has also resulted in problems such as slower growth and more serious disease occurrences. Research emphasis is now on the development of a new immunopotentiators as a means to improve growth and disease resistance of this shrimp.

In this trial, shrimp (0.37±0.12g) were fed with diets where yeast nucleotides at different concentrations have been added; Treatment 1 contained 172g/1000kg, treatment 2,344g/1000kg and treatment 3,516g/1000kg of feed. The control feed had no nucleotide supplementation. The composition of the basal diet is given in (Table 1). All feed ingredients were ground into 60 mesh particle size and mixed together. These were extruded into 1.2 mm diameter feed using a twin-screw extruder, and dried. In these trials, we used yeast nucleotides produced by Guangzhou Xintun Aquatic Technology Co., Ltd.

There were four replicates for each treatment and shrimp were fed three times a day at 8:00, 12:00 and 17:00h to apparent satiation.

Table 1. Composition and proximate analysis of basal diet (% dry diet).

Composition			
Ingredients	**%**	**Ingredients**	**%**
Fish meal	36.0	Soybean oil	1.0
soybean meal	27.0	Fish oil	1.0
Squid liver powder	4.0	$Ca(H_2PO_4)_2$	0.5
Shrimp meal	5.0	Vitamin premix	0.2
Wheat flour	22.0	Mineral premix	0.3
Beer yeast	3.0		
Proximate analysis			
Crude protein	40.0	Moisture	12.0
Crude lipid	4.0	Total calcium	4.0
Ash	15.0	Total phosphorus	1.0

Experimental procedures

Shrimp used for this 60-day trial were from the aquatic section of the Shenzhen Agricultural Centre. Shrimp were kept in tanks for a week prior to the trial. Only active individuals and those with no obvious symptoms of diseases were selected.

The trial was carried out in small cages of 2m × 2m × 0.8m, placed in indoor concrete ponds. Sea water with a salinity ranging from 32 to 34 ppt was filtered with a sand filter prior to use. Water temperatures ranged from 21°C to 27°C for the duration of the trial. Each cage contained 250 shrimp of initial weight ranging from 3.2 to 4.6g. Aeration was continuous to maintain dissolved oxygen levels at 6.0 mg/l and more. Residual feed and faecal wastes were collected once a day, and the water exchange was 30% to 50% once a week.

Floating cages in indoor tanks

Growth parameters

On completion of the trial, body weight gain, survival rates and feed conversion ratios (FCR) were determined. The data were analysed and processed with SPSS11.0 statistical software. Significant differences between treatments were tested using analysis of variance (ANOVA) at $P < 0.05$.

Non-specific immune parameters

The superoxide dismutase (SOD), acid phosphatase (ACP), peroxisome (POD) and lysozyme (LZM) activity in the muscle of three shrimp of each cage were measured. After the trial, we took samples of muscle from three shrimp in each cage, weighed and homogenised these in an ice bath. Sterile saline solution was added to a concentration of 0.1g/ml and was precipitated at 4°C, after centrifugation at 4000 rev/min for 10 minutes to obtain muscle tissue extract. SOD, ACP, LZM were determined with kits purchased from the Nanjing Jiancheng Institute of Biology. POD activity was determined according to Worthington method.

Effects on growth and survival

After 60 days of feeding the nucleotides supplemented feed, we have observed the following effects on the control and treatment groups.

Table 2. Growth performance, survival and weight gain after 60 days.

Group	Final body weight (g)	Initial body weight (g)	Feed conversion ratio	Survival rate (%)	Weight gain
Control	0.35±0.12	3.22±0.38	1.27±0.03^{a}	87.38±1.32^{a}	9.21±1.10^{a}
Treatment 1	0.38±0.09	3.94±0.59	1.25±0.10^{a}	82.13±1.93^{b}	10.36±2.07^{ab}
Treatment 2	0.37±0.13	4.33±0.58	1.23±0.09^{a}	87.00±4.53^{a}	11.72±2.52^{b}
Treatment 3	0.36±0.13	4.62±0.63	1.19±0.07^{b}	88.63±6.06^{a}	12.84±3.12^{b}

Different letters in the same column indicate significant differences at P<0.05.

Results in Table 2 showed that adding yeast nucleotides in feed increased growth of shrimp. The body weight gain in the treatment groups 2 and 3, fed diets with 344g/1000kg and 516g/1000kg, respectively, was significantly higher than the control group. In comparison with the control group, the body weight increased 39.4%. However, survival rates ranging from 87-88% in treatments 2 and 3 did not differ significantly with that of the control group. The survival rate of treatment 1 was significantly lower at 82%.

Feed conversion ratio (FCR) is an important index to evaluate the feed quality and in the case of FCR, we could see that it was 1.27 for the control group which was not significantly different from that for treatments 1 and 2. However, FCR of shrimp in treatment 3 improved and was significantly lower at 1.19. The trial demonstrated that adding 516g/1000kg yeast nucleotides in feed could improve feed efficiency.

Non-specific immune activity

Results on ACP activity in muscle tissue extract of shrimp fed diets containing yeast nucleotides were measured (Table 3) and these showed no significant differences between experimental and control groups. LZM and SOD in shrimp muscle extracts of treatment groups were significantly higher than that for the control. Between the experimental groups, there was no significant difference for LZM whereas SOD was highest for treatment 2, where shrimp were fed diets with 344g/1000kg of nucleotides. In the case of POD, differences

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were observed between treatment 1 and the control, but this was not significant. POD was higher for treatments 2 and 3 and among them, differences were significant at P<0.05.

Table 3. Effect of adding different levels of yeast nucleotides.

	Control	Treatment 1	Treatment 2	Treatment 3
ACP (King unit)	2.52±0.23[a]	2.65±0.56[a]	2.71±0.47[a]	2.68±0.31[a]
LZM (U/ml)	1.36±0.25[a]	2.47±0.14[b]	2.63±0.24[b]	2.39±0.19[b]
SOD (Nu/mg protein)	62.05±5.82[a]	70.36±9.30[b]	77.53±7.56[c]	67.1±8.51[b]
POD (U/ml)	4.31±0.34[a]	4.52±0.54[ab]	4.89±0.33[b]	5.66±0.58[c]

Different letters in the same row indicate significant differences at P<0.05.

Currently, we have evaluated the effect of adding immunopotentiator in feed on shrimp growth mainly by measuring the body length, weight gain and survival rate after culturing the aquatic animals for some time in indoor or outdoor conditions. In general, the fast growth and higher output is indicative that an immunopotentiator has a positive effect. This is also the most direct way.

The aim of adding an immunopotentiators in feeds is to increase the immune function and immune modulability of aquatic animals, which could increase their capacity against infections from communicable disease. As such, this has attracted the attention of researchers. When we evaluated the effect of immunopotentiators on the immunity of the aquatic animals, the common objectives were to see whether the immunopotentiators could increase the activity of the phagocyte and whether it could help in the division of the lymphocyte, or if it could help to produce antibodies. In this experiment, the enzyme activity such as ACP, SOD, LZM and POD were used to evaluate the effect of yeast nucleotides. These indicators have been shown as credible in the evaluation of immunity of aquatic animals, and are now widely used.

In this trial, the results showed that adding yeast nucleotides into feeds could obviously increase the activity of LZM, SOD and POD in the muscle tissue extract of *L. vannamei*. The target is to increase shrimp immunity. However, the activity of ACP did not change and a possible reason could be that the concentration of ACP varies in the different tissues.

Results from this trial showed that adding a yeast nucleotide product in feeds gave better results in terms of body weight gain, FCR and non-specific immunity in comparison to the control group. A concentration of 516g yeast nucleotides per 1000kg feed is recommended as supplement to the diet for *L. vannamei* to achieve the best growth and immunity.

Authors from left, Shi Xian-wu, Wang Guang-jun and Lv Chi-bo

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Award for new shrimp feed extruder

The machine's oblique die technology and high-shear conditioner is designed to bring new feasibilities to shrimp feed and small diameter aquatic feed production.

Victam, Grapas and FIAAP Asia was held in Bangkok from 15-17 March, 2012 and there were several nominations for the Aquafeed Innovation Award organised by aquafeed.com, the leading aqua feed portal. Wenger, USA won with its recently developed C^2 8.1 conical twin screw shrimp feed extruder.

This is the most advanced specialised machine centred on Wenger's C^2TX Conical co-rotating twin screw extruder system, which the company introduced in 2000. Joe Kearns, Aquaculture Process Engineering Manager, Wenger, USA, said, "The innovation was developed over the last 12 months following the challenges the industry and other stakeholders in Asia's aqua feed industry put forward during The Aquaculture Roundtable Series (TARS2011) in Singapore in August 2011.

"This extruder has a conical co-rotating twin screw and combined with specialised pre-conditioner which will allow us to do some intense mixing, de-aeration of the mix for maximum product density prior to the mass entering the extruder barrel. The C^2TX extruder barrel design promotes air removal and when coupled with the pressure drop through the oblique tube die this system is perfect for shrimp feed extrusion. All in all, we have a system that can give us pellets in the 700g/L range with perfect sinking characteristics."

On the shape of the preconditioning system, Kearns explained, "This is how we are able to get variable top speed at the inlet which gives us intense mixing and the conical shape moves the feed mass into the area of smaller volume removing the air. The machine uses our innovation of oblique die technology and high-shear conditioner to bring new feasibilities to shrimp feed production."

The secret to the success of the model is also the high shear conditioner which increases the ratio of steam and water to the mix. This allows for a quicker penetration of heat and moisture into the feed particles compared to a conventional pre conditioner. As the diameter and volume decrease towards the smaller end of the unit, the shear rate is increased.

The extruder is tailored specifically for small diameter aquatic feeds, such the 0.6 to 0.8mm shrimp starter pellets, as demonstrated by the Wenger team in during the show. Commercial use of the extruder for this application has already begun in Korea and Vietnam, said Kearns.

Joe Kearns with the award winning shrimp feed extruder at the show.

Picture of commercial starter pellets produced by the new extruder model

High capacity small pellet production

The main strength of the extruder is the capability to produce small starter feeds at a high capacity. The current model has a capacity of up to 5 tonnes/hour which translates to 30,000 tonnes/year and is recognised as a medium size extruder line.

"Our understanding on the requirements of shrimp farmers is that there should be a range of pellet sizes which can follow the feeding regime at the farm, based on the shrimp biomass and the need for multiple feedings per day," said Kearns.

"The long cook increases the cook cycle and decreases expansion through pressure drop and retention time. The adjusted die design results in uniform cross-sectional flow and thus eliminates the capacity restrictions that we have seen previously with the extrusion of small diameter feeds."

Extrusion versus pelleting

The marine shrimp industry has been used to feeds produced through pelleting technology and Rock Chen, in charge of sales in the Asian Region understands that changing the mind set of users and feed millers is a big step. He said, "This is not only a change of processing machinery but also the feed formulation. The feed ingredients processed by extrusion will have different changes physically and/or chemically compared to those processed by a pelletizer. After the nutritionist understands the change, they can modify the formulation fairly easy. In the meantime, they will find the ingredient cost of the new formulation is significantly reduced. Most of the time, the saving from the modified formulation will more than compensate for the difference of processing cost of extrusion over pelletizing.

"I believe the shrimp farmer will quickly notice the benefit resulting from feeding extruded feed. The benefits such as better water quality and product durability with less dust are immediately evident to the farmers who use automatic feeders. I see that many people in the feed industry changing from pelleting to extrusion. The timing is good as the existing processing technologies for shrimp feed is almost 40 years old and most of the feed millers are now looking for capital investment for new technology.The acceptance of extrusion technology will be most likely with larger feed mills as well as newcomers. "

This recent development has changed perceptions. Prior to the development of the C^2TX small diameter feed extrusion system, there were defined limitations in the extrusion of sinking feeds smaller than 3mm. Pelleting was the technology for this range of pellet sizes. The introduction of Wenger's oblique tube die technology changed this. Aside from the ability to produce small feeds, the new system introduces the possibility of higher starch gelatinisation, less fines, size uniformity and increase water stability, all at higher production rates.

According to the team, the big advantage of extrusion will come into play when the capital costs are overcome by saving in ingredients and processing costs with changes in formulation.

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An evaluation of a formulated feed for the grouper *Epinephelus coioides*

By Nguyen Van Nguyen, Nguyen Van Hao and Le Xuan Hai

In Vietnam, grouper culture is expanding, especially in the southern provinces because of the economic benefits in its farming in ponds and cages.

The grouper is frequently fed with trash fish which has resulted in disease outbreaks and low survival from poor water quality in the surrounding environment. Therefore, the development of a compound feed is necessary. At the Research Institute for Aquaculture No 2 in Ho Chi Minh City, we have formulated a diet based on the nutritional requirements for grouper juvenile. Information on the nutritional requirements was obtained from many sources including the ACIAR project for grouper aquaculture (2004), Boonyaratpalin (2003), Giri et al. (2004), Tuan et al. (2007), Luo et al. (2005), Shiau and Lin (2001), Shiau and Lan (1996) and William and Ivin (2004). The nutritional balance method from Tacon (1987), Wilson and Cowey (1985), Millamena and Toledo (2004) was also used. The restricted area method for multi-objectives optimisation from Hai (2009) and feed formulation methods from Kaushik (2000) and Chow et al (1980) were also adopted.

The aim of this study was to compare the growth performance of grouper juveniles cultured in tanks and fed a formulated diet versus a commercial diet.

Formulated diets

A formulated diet (V2Feed) was prepared for *E. coioides* juveniles using different protein, lipid, carbohydrate sources and vitamin–mineral premix. A single-screw extruder was used to produce extruded pellet feed which had the characteristics of slow sinking and high water stability.

Fish were collected from the National Breeding Center for Southern Marine Aquaculture, Vietnam (NABRECSOMA) and were acclimatised for 5 days prior to the start of the feeding trials. A completely randomised block design was used for two dietary treatments with four replicates each. Grouper juveniles with initial mean body weight (10±2g) were randomly stocked at 25 fish per tank into 8 units of 500L composite tanks. Tanks were filled with seawater and PVC pipes were placed in the centre of each tank to serve as shelters for fish. Seawater used during the trial was maintained at 20-30 ppt salinity and 28-30°C. The fish were fed twice daily to satiation at a feeding rate of 2-4% of body weight for 60 days.

Physical and chemical properties of the experimental diets were analysed. The parameters measured to determine diet efficiency were growth rate, survival rate, feed conversion ratio (FCR) and specific growth rate (SGR). Feed consumption was calculated on dry matter basis.

Grouper juveniles in the experiment at the National Centre for marine breeding in Vung Tau

Physical and chemical properties of diets

Physical and chemical properties of diets were analysed and presented in Tables 1, 2, 3 and 4. Pellet size of V2feed at 4.8 to 5.4 mm was larger than that of the commercial feed. In addition, pellets of the V2feed diet were not uniform in size. Nevertheless, pellet sizes were completely suitable for the grouper juveniles used in the trial. Water stability of both diets was similar. Bulk density of V2feed is lower and correspondingly, the sinking time was longer as compared to the commercial feed. Our data showed that NFE content of V2feed was higher, but the crude fibre content was lower. NFE and fibre contents in feeds influence expansion ratio, and in particular has a close correlation with bulk density of the diets. Bulk density of feed generally decreased as the carbohydrate content increased.

The carnivorous grouper has poor digestion for carbohydrates and for ingredients with high NFE content. Therefore, the carbohydrate balance in diets formulated for grouper fish is important. Data on proximate composition showed that there were significant differences ($P<0.05$) between diets. V2feed diet had a lower crude protein and lipid content compared with the commercial diet. It followed that the feed would have lower gross energy as compared with the commercial diet.

Table 1. Physical properties of diets.

Diets	Pellet size (mm)	Bulk density (g/liter)	Water stability (hour)
V2feed	4.6 – 5.2	540 ± 3.6[a]	> 2
Commercial	4.3 – 4.7	660 ± 3.2[b]	> 2

Values in the same column with different superscripts are significantly different (P< 0.05)

Table 2. Proximate composition of the diets (% as fed basis).

Diets	Moisture (%)	Crude protein (%)	Crude fat (%)	Crude ash (%)	Crude Fibre (%)	NFE (%)
V2feed	8.63 ± 0.13[a]	45.58 ± 0.18[a]	8.56 ± 0.07[a]	12.34 ±0.11[a]	1.62 ±0.12[a]	23.27± 0.16[a]
Commercial	9.54 ± 0.09[b]	46.15 ± 0.15[b]	12.41 ± 0.09[b]	13.52 ± 0.22[b]	3.19 ±0.07[b]	15.19 ± 0.08[b]

Values in the same column with different superscripts are significantly different (P< 0.05); NFE: nitrogen free extract.

Table 3. EAAs, tyrosine and cysteine content of grouper juvenile and V2feed diet (% in 100g sample).

Amino acid	Grouper juvenile	V2feed
Arginine	1.34	2.03
Histidine	0.6	1.10
Isoleucine	0.86	1.32
Leucine	1.54	2.34
Lysine	1.77	2.68
Methionine	0.72	1.10
Phenylalanine	0.82	1.24
Threonine	0.96	1.46
Tryptophan	0.13	0.22
Tyrosine	0.77	1.32
Cysteine	0.23	0.45
Valine	0.93	1.46

Table 4. Essential fatty acid content of V2feed (% total fatty acid).

Essential fatty acids	V2feed diet
C18:2n-6 (LOA)	21.07
C18:3n-3 (LNA)	3.07
C20:4n-6 (ARA)	1.12
C20:5n-3 (EPA)	6.55
C22:5n-6 (DPA)	0.35
C22:6n-3 (DHA)	8.65
Total n - 3	18.27
Total n - 6	22.54
n - 3/n - 6	0.81
DHA/EPA	1.32

Table 5. Weight gain, survival, SCR and SGR of grouper juvenile fed the diets.

Diets	Survival (%)	FCR	SGR (%/day)	Weight gain (%)
V2feed	100 ± 0^a	0.81 ± 0.02^a	3.26 ± 0.07^a	625.6 ± 167.7^a
Commercial	99 ± 1^a	0.88 ± 0.03^b	2.87 ± 0.09^b	476.5 ± 131.0^b

Values in the same column with different superscript letters are significantly different ($P< 0.05$)

The data in Table 3 showed that essential amino acids (EAAs), cysteine and tyrosine of V2feed (45.5% protein) meet the protein requirement for grouper juveniles. The analysis of fatty acids (Table 4) showed that V2feed had high essential fatty acid levels and meet the fatty acid requirements and ratio of fatty acids n-3/ n-6 and DHA/EPA (Wu et al, 2002; Shapawi et al, 2011)

Growth performance

The results on weight gain, feed conversion, survival rate and specific growth rate of grouper juvenile after 60 days is given in Table 5.

Weight gain, FCR and SGR of the grouper juveniles fed V2feed was significantly higher ($P<0.05$) compared with the commercial diet. Weight gain, FCR, SGR of fish fed V2feed and commercial diets were 625.6%, 0.81 and 3.26 and 476.5%, 0.88 and 2.87, respectively. Fish performance was significantly influenced by the nutrients and digestibility of the diet.

Moreover, the digestibility of a diet depends on the quality and component of ingredients in the diet. Therefore, although the commercial diet was higher in protein, lipid and energy content as compared with

Nguyen talking with a farmer on the use of trash fish. Behind him are grouper ponds at Cam Ranh district, Khanh Hoa province

V2feed, the high crude fibre, ash content and quality of protein source in the commercial diet may result in lower digestibility. This could be a possible cause for the lower growth performance in fish fed with the commercial diet. Pertaining to survival rates, there was no significant difference at P>0.05 between both diets. Throughout the trial, the culture composite system was closely controlled and environmental parameters including temperature, salinity, pH, ammonia-nitrogen (NH_3N), total ammonia nitrogen (TAN), dissolved oxygen (DO) were monitored and well managed through the two-month period. This contributed to high survival rate and no significant difference (P>0.05) between the diets.

Conclusion

The formulated feed (V2feed), a slow sinking with good water stability extruded feed, meets the nutritional requirements of the grouper juveniles. The formulated diet (V2feed) contained 45.5% crude protein, 8.56 % crude lipid and 4.33 Kcal/g gross energy. In the study, the growth performance of grouper juveniles fed the V2feed diet was better as compared to fish fed a commercial diet. Our next step is to develop and evaluate the efficiency of the formulated diet for grow-out stages in ponds and cages.

Acknowledgment

The experiment was carried out at the National Breeding Center for Southern Marine Aquaculture, Vung Tau, Vietnam. The author would like to thank the technical contributions of Dr. Dang To Van Cam and Nguyen Thi Thanh Van from NABRECSOMA during the trial.

References are available on request
(Continued on page 30 - RIA2).

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Effect of dietary potassium diformate on growth of milkfish

By Christian Lückstädt

An increased average daily weight gain by more than 13% led to a faster time to market for milkfish cultured in marine cages in the Philippines. Moreover, this was achieved with a significant improvement of feed efficiency.

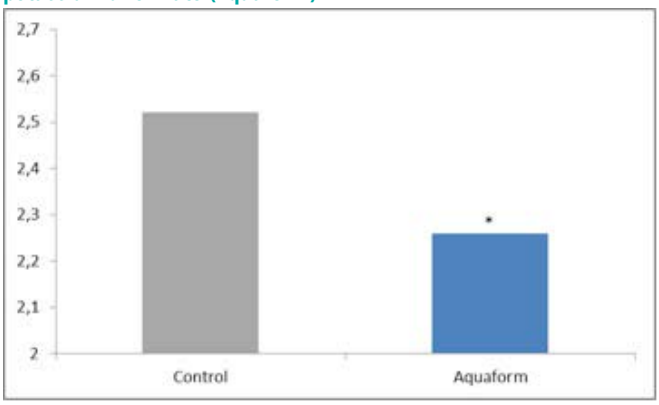
The current situation of the world food supply calls for enhanced efforts to ensure the increasing requirements of the growing world population for staple diets and high-quality food. There is also a need to bridge the widening gap in food demand and food supply especially in the developing world. More than one billion people are dependent on fish as their main protein source, and their numbers are likely to increase further with the estimated annual population growth rate of 2.0% (Lückstädt, 2004).

Recently, growing awareness from consumers and producers of aquaculture species has resulted in calls for responsible and sustainable aquaculture. Public opinion and regulation authorities in most export countries focus now on the misuse of antibiotics in aquaculture and public attention has shifted towards production methods (Lückstädt, 2005). On the other hand, the development of new aquafeeds needs to be optimised too, since the cost of feed often accounts for 50% or more

A milkfish cage farm

Milkfish in hapa nets

Figure 1. Feed conversion ratio (FCR) of milkfish fed with or without potassium diformate (Aquaform).



**statistically different from control at P=0.06*

of the operational expenses for an aquaculture facility (Encarnacao, 2008).

Due to the above mentioned facts, solutions needed to be found. Several feed additives may be a promising alternative for the use of in-feed antibiotics in aquaculture as well as optimising the feed efficiency, including enzymes, probiotics and last but not least organic acids or their salts.

From previous studies and trials, the use of organic acid salts or acid blends have shown to be an interesting option to promote the performance of a wide variety of aquaculture species worldwide. In a recent trial, this was successfully tested in the milkfish *Chanos chanos,* an important fish in the South East Asian aquaculture industry.

Trials with the milkfish

The trial was conducted at a marine fish farm in the Visayas, Philippines. The aim of the trial was to test dietary potassium diformate (AQUAFORM, ADDCON) against a commercial milkfish diet containing no acidifier under controlled conditions in marine cages. In this trial, 99,000 milkfish were randomly allocated to two experimental groups. Fish were fed a commercial milkfish diet. The treatment diet contained 0.3% of potassium diformate. Performance and mortality were regularly monitored.

As it can be seen from the Table 1, the application of potassium diformate into the milkfish diet led to an increased average daily weight gain (ADG) by more than 13%, while the feed conversion ratio (FCR) improved by more than 10% (figure 1). More importantly, this was achieved with a reduction in "time to the market" by more than 9% or in other words, the culture period was shortened by 18 days.

This demonstrates the significant beneficial and commercially important effects of potassium diformate on growth performance of milkfish. Especially in times of high raw material and feed prices the significant improvement of the feed efficiency is one step towards a profitable and sustainable aquaculture.

Table 1. The effects of potassium diformate (KDF) on milkfish reared in marine cages.

	Control	0.3% KDF	P-level
Initial body weight (g)	12	24	-
Final body weight (g)	307	311	-
Culture period (days)	193	175	-
ADG (g)	1.60	1.81	0.08

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The trial was supervised by Karsten Schroeder, consultant of ADDCON in the Philippines

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Fish protein hydrolysates enhance resistance of fish to different types of stress

By Mikaël Herault, Vincent Fournier, Magali Hervy and Nguyen Anh Ngoc

Inherent low molecular weight nitrogen compounds act directly on innate anti-oxidative and immune defenses to resume and enhance growth rate and health status.

Aquaculture production is now exceeding fisheries production in global seafood supply. However, aquaculture, through intensification of husbandry practices, also generates numerous stressful situations. These range from water deterioration from acute or chronic exposure to reduced levels of dissolved oxygen and/or increased levels of carbon dioxide, ammonia, nitrite and handling during vaccination, transfer, transport, grading, ambient noise etc. Additionally, environmental stressors, such as temperature and salinity variations, may also have detrimental consequences on farmed populations.

The improvement in husbandry practices is certainly the easiest way to reduce stress and their consequences on zootechnical performances such as reduced growth rate, by sparing energy resources in homeostasis, and increased mortality, by impairing innate immune and anti-oxidative status. Nutritional supplementation is another way to fine-tune immune and anti-oxidative defenses of aquatic species. In this context, nutrients such as free amino acids and their derivatives and nucleotides or anti-oxidants are often supplemented as immunostimulators, especially during critical periods such as weaning, wintering and seawater transfer. When produced under controlled conditions, protein hydrolysates (PH), and in particular those of marine origin (fish protein hydrolysates or FPH), are naturally rich in these nutrients. Furthermore, numerous studies have demonstrated they are also rich in bioactive peptides of nutraceutic interests (growth like hormone, antioxidants, anti-stress and anti-microbial peptides).

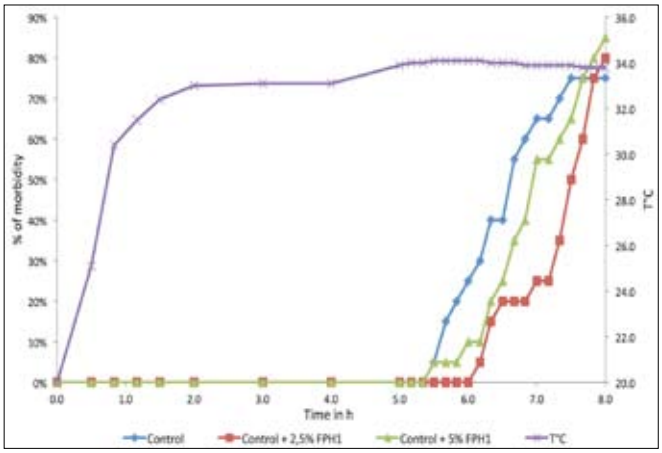
The purpose of this article is to review the benefits of protein hydrolysates on aquatic species farmed under different induced stressful conditions.

Enhancing fish resistance to climatic stressors

Temperature and salinity variations are the most frequent climatic issues in fish farming. While cold weather usually impairs feed intake and growth, it usually has less adverse effects than warm weather on the health status of fish. These include oxidative stress, oxygen availability and resistance to opportunistic pathogens.

A temperature challenge trial was carried out at the end of a feeding trial on European seabass (*Dicentrarchus labrax*) juveniles

Figure 1. Morbidity in the European seabass during a thermal lethal challenge.



of mean weight, 16.3g. Triplicate groups of fish were fed isoproteic supplemented diets (control, control+2.5% FPH1 and control+5% FPH1) for 29 days in flow through 100L tanks. At the end of the feeding trial, 10 out of the 40 initial fish were replaced in their respective tank for the duplicate thermal challenge tests. The temperature range of 33-35°C was previously determined as lethal. Thus the temperature was increased from 20°C to 33°C within 2 hours without any observed morbidity (mortality plus unbalanced fish).

As shown in Figure 1, morbidity was only observed at 34°C, after 5 hours of challenge. The thermal challenge was stopped 2 hours later when there was 80% of morbidity. It was shown that FPH1 supplementation did not reduce final morbidity but significantly delayed it (p-value<0.01, proportional hazards models). This delay is especially visible between 5.5 and 7 hours. It was observed as not dose-dependent for 2.5 and 5% supplementation levels. Without any metabolite clues, we may only assume that FPH1 has delayed the physiological process responsible for fish morbidity, possibly due to hormone-like and/or to anti-stress effects. This trial may find commercial applications for preventive feed supplementation before the summer season, especially for flow-through or cage farming systems.

Figure 2. Survival rate of Nile tilapia during ammonia NH_3 challenge trials (one way ANOVA/two way ANOVA).

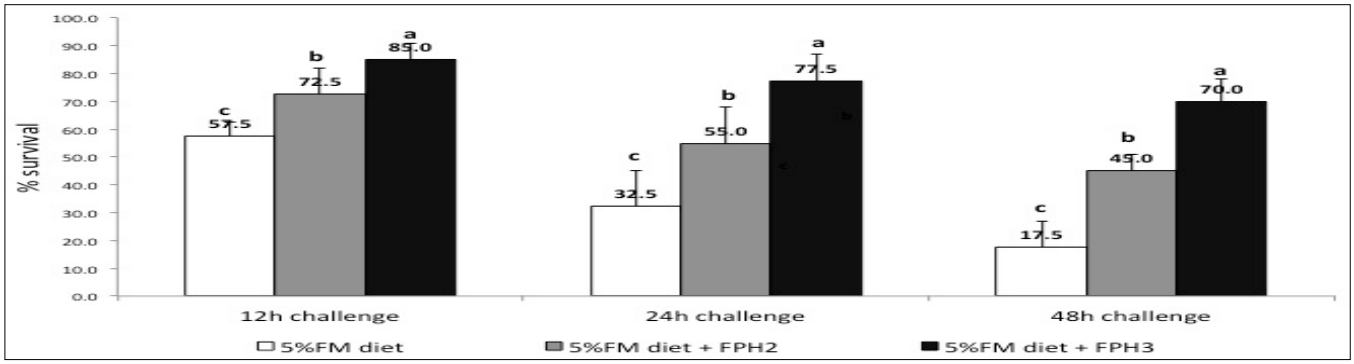
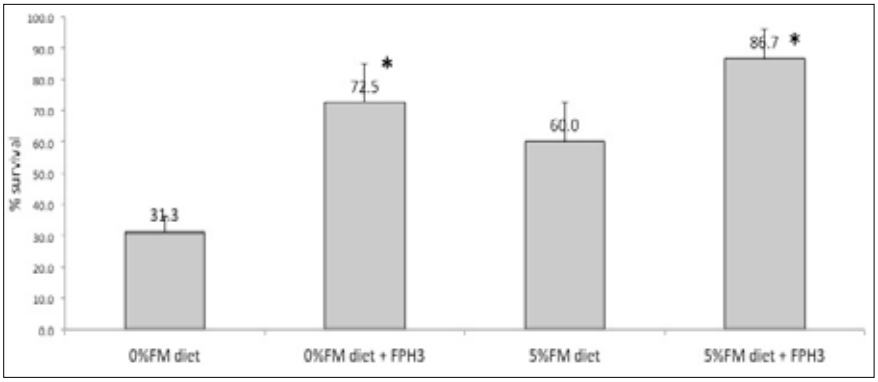


Figure 3. Survival rate of the Tra catfish during ammonia NH_3 challenge trials (one way ANOVA/two way ANOVA).



Enhancing fish resistance to water quality deterioration

In intensive culture conditions, water quality can be close to the limits tolerated by aquatic species for optimal growth. It follows that any deterioration in water quality, from overfeeding, overcrowding, low water exchange or algae blooms, may have critical consequences on the health and growth performance of farmed species.

Two ammonia challenge trials were conducted on Tra catfish (*Pangasius hypophthalmus*), and Nile tilapia (*Oreochromis niloticus*), juveniles of mean weight, 13g, to assess the impact of FPH on overall survival rates. Fish were fed for 10 weeks with commercial diets, formulated with different levels of fish meal. Treatment diets were supplemented with FPH2 and FPH3 at 1.8% in tilapia diets and 3% in catfish diets, respectively. After the feeding period, 10 tilapia and 20 catfish were placed in an aquaria (n=4 replicates) for an ammonia challenge test comprising a constant 150ppm TAN (total ammonia nitrogen) load for 48 hours with a 100%/day water exchange rate. The survival rates are illustrated in Figures 2 and 3. In terms of survival rate, both FPH2 and FPH3 showed a positive response to the high ammonia load challenge, even when supplementing a fish meal free diet. As an end product of protein metabolism, ammonia is the most common toxin in culture and live-transportation systems. It is most toxic in its unionised NH_3 form as it easily diffuses across the gill membrane reducing the outward flux of ammonia excretion. As a result, the ammonia level in fish plasma increases, causing various physiological responses which are in many ways similar to anoxia symptoms. This finally leads to neurotoxicity and fish death in serious cases. Several studies with FPH have demonstrated their biochemical functions, including potent anti-oxidative properties. Thus, it may be possible to increase the animal's own anti-oxidative defenses with FPH supplementation which as a consequence will reduce the expected adverse effects of excessive production of ROS (Reactive Oxygen Species) resulting from anoxia-like stresses induced by many chemical and physical disturbances.

Restoring feed intake and growth during stress

It is a common practice to supplement aqua feed with a palatability enhancer during critical and stress periods such as spawning, weaning, wintering and oral antibiotic treatments.

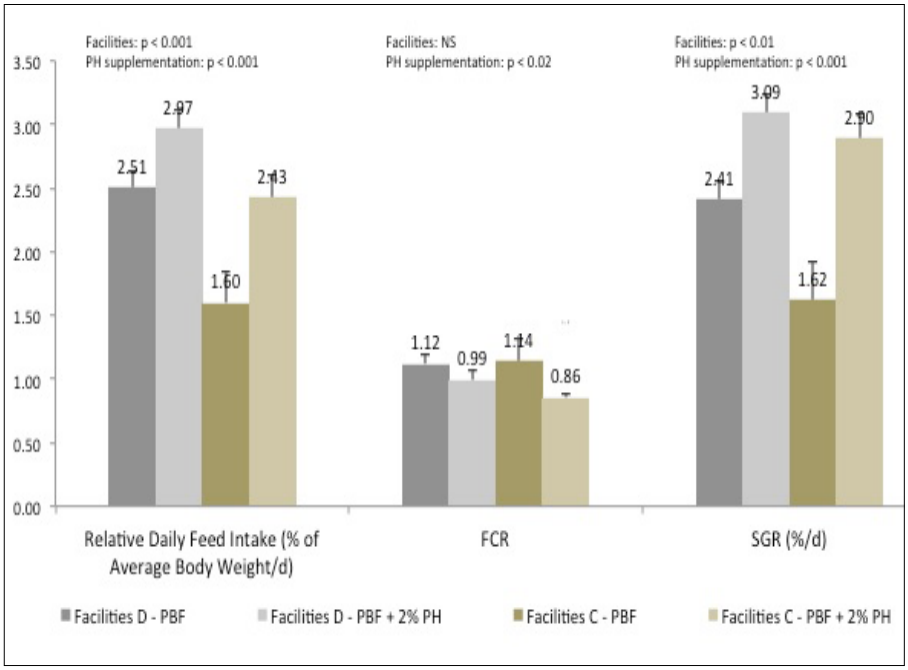
A protein hydrolysate was formulated to meet such needs and serve as an internal reference for assessing a newly developed FPH. A total of 28 short term feeding trials (13-21 days) were conducted with this internal reference which was added at 2% in a nutritionally balanced plant based feed (PBF), within two distinct experimental facilities designated 'C' and 'D'. These facilities of two series of 24 tanks, each of 100L capacity supplied with thermoregulated and filtered seawater, only differed by their tank heights. Fish in facilities 'C' were more exposed to technicians' presence and visual contacts as tank height was lower. Based on the significant differences observed for the average zootechnical performance indicators (Figure 4), the visual disturbances obviously impacted fish behaviour. Thus, growth of fish reared in facilities 'C' was only 67% of the average potential growth observed for facilities 'D'.

We have explained this growth retardation by a much lower feed intake, which may have been entirely solved by PH supplementation. In addition, with PH supplementation, growth rate was finally improved by almost 20%, because of a combined improvement in the feed conversion ratio (FCR), averaging 10%. In general, this combination resulted in a 28% improvement in growth rate under normal conditions and almost 80% increase in growth rate under visual disturbance conditions. At this macro level, the most likely assumption was that the improvement in FCR probably reflected a reduction of PBF induced gut inflammation and/or an optimisation of gut flora. Whilst the higher feed intake recorded with PH supplementation is certainly due to an enhanced palatability of feed.

Improving fish resistance to opportunistic pathogens

Chronic stress, because of the continuous secretion of cortisol, is harmful as it leads to immunosuppression and thereby increases risks of disease outbreaks.

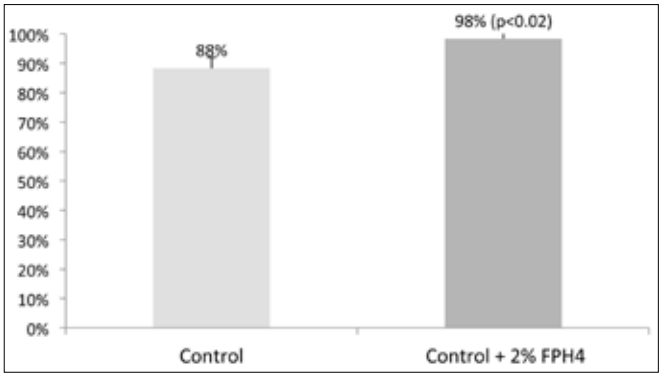
Figure 4. Zootechnical performances observed on European seabass juveniles (initial mean weight, 4.7-11.1g) over 28 trials in two facilities 'C' and 'D'.



A disease challenge was initiated with juvenile Nile tilapia (mean weight, 37.7g±2.2) following a 42-day feeding trial with control commercial feed, with or without FPH supplementation (2% dosage). One ml of a bacterial suspension containing $9x10^8$ UFC of *Aeromonas hydrophila* was injected into the fish abdominal cavity. There were 4 replicates. Fifteen fish per replicate were inoculated and then monitored for *A. hydrophila* symptoms for 10 days.

At the end of this period, the average survival rate of inoculated fish fed control feed was very high, which meant that the initial fish health status was already high at the start of the disease challenge trial. Despite this high survival rate, FPH supplementation significantly improved overall survival rates from 88% up to 98% ($p<0.02$). At this macro level, it is difficult to determine how FPH improved fish resistance to opportunistic pathogens. We may however propose two different and possibly complementary situations. First, FPH, due to its bioactive function (mainly anti-stress and immunostimulant), may have improved overall fish health status before and/or during the challenge trial. Secondly, FPH may have been a natural source of antimicrobial peptides, which may have been effective against *A. hydrophila*. Biochemical studies would be necessary to confirm one, or both, of these assumptions. Meanwhile, this assay confirms this is possible to enhance fish resistance to opportunistic bacteria by FPH supplementation.

Figure 5. Survival rate of Nile tilapia to an *Aeromonas hydrophila* challenge, 10days following injection (one way ANOVA).



Conclusion

Notwithstanding the continuous improvements in aquaculture practices, stressful situations will remain inherent, both because of climatic hazards (for non-recirculating aquaculture systems) and worker activities. Stress is a normal and adaptive process (homeostasis) comprising three chronological responses: firstly, primary responses involving the elevation of plasma catecholamines and cortisol hormone; secondly, secondary responses of hormones at the tissue level and thirdly, tertiary responses on the animals' zootechnical performances such as changes in growth and health. Minor short term stress will mostly be limited to primary and secondary responses while acute and chronic stress will often induce adverse effects from tertiary responses.

As previously illustrated, fish protein hydrolysates are ideal nutritional solutions to attenuate the effects on zootechnical performances during stressful situations. Due to the naturally high composition of low molecular weight nitrogen compounds, which include nucleotides, amino acids and its derivatives, and bioactive peptides, FPH will act directly, or indirectly, on feed acceptance, feed transformation, innate anti-oxidative and immune defenses, which will end up with restored, or enhanced, growth rate and health status.

Therefore, aside from their high nutritional value, fish protein hydrolysates are a good alternative to antibiotic treatments, especially with their anti-microbial properties. They are also alternatives for any other feed additives used as immune-stimulants or anti-oxidative agents. Lastly, because of the bioactive peptides profile, their physiological response is driven by the hydrolysis process such as type of enzyme, temperature x time schedule and pH.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The microalgae platform

By Keith Filer

Now mainly used in larval nutrition, will the future direction of microalgae be functional nutritional including improving immune systems?

Algae are a diverse group of simple organisms that range from unicellular to multicellular forms, such as giant kelp. They are photosynthetic like plants, but their tissues are not organised into distinct organs like plants. The largest and most complex algae forms are seaweeds. Microalgae refer to the numerous microscopic algae that grow in marine or freshwater. They are primary producers in the oceans that convert water and carbon dioxide to biomass and oxygen in the presence of sunlight. Microalgae are currently being utilised in a variety of applications, including nutrition and biofuel production.

The use of microalgae dates back 2,000 years, when they became a source of food during a famine in China. Other microalgae species were a common food source in Chad and Mexico as far back as the 16th century. In 1890, *Chlorella vulgaris* became the first pure culture of algae grown. In the 1950s, research started on microalgae as a source of food and medicine for humans. The research started in Japan utilising *Chlorella* species.

The first industrial production utilising a photobioreactor was constructed and run by IGV Ltd. in Germany to produce Chlorella as a nutritional supplement for poultry. Currently, heterotrophic microalgae are used in human and animal nutrition. One of the most successful of these products is the production of the long-chain, polyunsaturated fatty acid docosahexaenoic acid. The potential uses for microalgae range from producing biofuels to reducing global hunger. Although a number of these uses may someday become reality, the fact is the commercial uses of algae are much fewer than the proposed uses.

Microalgae and aquaculture

About 30% of the world algae production is used for animal feed production, with the largest applications in aquaculture. Microalgae are required in larval nutrition, either fed directly in the case of molluscs and penaeid shrimp, or indirectly as live prey food in small fish larvae. Algae are marketed for use in human nutrition in the form of tablets, capsules and liquids. They are incorporated into pastas, snack foods, candy bars and beverages, as well. The commercial applications are dominated by four strains: *Arthrospira, Chlorella, Dunaliella salina* and *Aphanizomenon flos-aquae*.

Large-scale production of algae started in the early 1960s in Japan with the cultivation of *Chlorella*. This was followed in the 1970s by the production of *Arthrospira* in Lake Texcoco in northwestern Mexico by Sosa Texcoco S.A. By 1980, 1,000 kg of algae were being produced by 46 factories in Asia. In 1986, the use of *Dunaliella salina* to produce beta-carotene was established as a commercial venture at production facilities in Australia. Commercial facilities have also arisen in Israel, the United States and India, with current annual global production estimated at 10,000 tonnes. The nutritional composition and biochemical diversity of microalgae have generated an enormous amount of interest in a variety of applications. Microalgae can have high protein content with an amino acid profile that provides essential amino acids. The lipid content can reach 70%, with a high concentration of omega 3 and omega 6 fatty acids. Microalgae can be a valuable source of vitamins and minerals, as well.

The great potential for microalgae resulted in Alltech purchasing a state-of-the-art algae facility with a fermentation capacity of over

1,000 m^3 in September of 2010. One of the main focuses of the facility will be the development of products derived from microalgae. Algae fermentation presents our latest technological platform, from which we expect, incredible opportunities in the areas of food, feed and fuel to arise, according to Alltech founder and president Dr. Pearse Lyons.

At least 800,000 different species of algae are thought to exist that have the ability to produce over 15,000 novel compounds. The enormous biodiversity within microalgae is largely untapped. The company's concept will be to develop a platform of products from algae that reflect those derived from yeast.

Yeast cells can be divided into multiple cell wall components and yeast extract that each provide a unique nutritional function. In addition, whole yeast cells in themselves provide a nutritional impact. Can a similar approach be used for microalgae? The facility will allow continued work with Alltech's carbon dioxide-sequestering microalgae strains, as well as strains grown with other carbon sources. The microalgae will then be used for value-added feed products, microalgae-derived biofuel and the production of ethanol.

The future

Research has demonstrated that microalgae can be utilised as sources of proteins, lipids, vitamins and minerals, but other than specific applications in the growth of aquaculture species, algae are not widely used in animal nutrition. In order to utilise microalgae on a wider level, greater understanding of their nutritional value is required.

What new nutritional components within algae will become available? Can microalgae influence the immune systems or improve the antioxidant status of animals, or reduce stress and improve feed conversion? These are some of the areas that need to be researched in order to take advantage of the potential benefits of microalgae.

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Maintaining health in shrimp culture

By Angela Riemensperger and Gonçalo Santos

Prevention of bacterial diseases and improvement in growth performance of white shrimp in China using a natural growth promoter.

In the 1970s, commercial shrimp farming began in order to meet the increasing demand of steadily growing markets such as the United States, Japan or Western Europe. The commercialisation of shrimp farming and the implementation of advanced technologies lead to growing shrimp at higher densities. Challenging and potentially stressful conditions make shrimp vulnerable to a series of infection agents. Among the different health issues, viruses, such as white spot syndrome virus (WSSV), taura syndrome virus (TSV) and yellow head syndrome virus (YHV), are responsible for serious economic losses to the industry.

However, shrimp are also affected by a number of bacterial diseases such as vibriosis, mycobacteriosis, streptococcosis and others. Bacterial diseases were traditionally treated by using antibiotics. However, as some countries imposed bans on the import of shrimp containing antibiotic residues, the industry is moving more towards treating the underlying problems and preventing diseases instead of treating them. There are a lot of management strategies which can help to prevent disease. In addition, the use of natural growth promoters in the feed can support the prevention of bacterial diseases in shrimp production.

The most common bacterial infections in shrimp farming are caused by the *Vibrio* species. Shrimp affected by vibriosis become weak and disoriented and exhibit dark wounds on the cuticle, dark discolouration of the gills, anorexic, etc. The mortality rate at an outbreak can exceed 70%. Another wide spread bacterial disease in shrimp is the necrotising hepatopancreatitis (NHP), which is caused by an Alfa-*Proteobacterium* (gram-negative). This microorganism infects all the four cell types found in the hepatopancreatic tubules and symptoms and clinical signs such as lethargy, reduced feed intake, anorexia and empty guts, high feed conversion ratio, soft exoskeleton, flaccid musculature, dark gills and fouling are seen in affected shrimp. Mycobacteriosis is caused by species of the genus *Mycobacterium* sp. and clinical signs of the infection include abnormally dark pigmentation and large irregular melanised lesions in the cuticle.

The biggest enemy is the water itself!

Over the last decade, shrimp production grew at a higher rate than the area of shrimp ponds, indicating that stocking density of shrimp has markedly increased over the years, especially in Asia. Admittedly, an increase in stocking density always represents a possible threat to water quality and stress to the animals. Overcrowded ponds and poor water quality are factors positively influencing bacterial growth. It has to be considered, that a major transfer vector for diseases caused either by viruses or bacteria is the water itself.

This means not only that the transfer rate for diseases is exceptionally high and increases the danger that the producer will face tremendous economic losses, but also that there is an increased risk for affecting wild shrimp and those in neighbouring farms. However, since it is difficult to treat disease outbreaks effectively, industry's effort must be put into preventing diseases. This is done by measures such as applying active water quality management in order to help avoid poor pond conditions favourable to the spread of diseases. Also natural growth promoters in the feed can help to control bacterial diseases. These include substances such as organic acids, phytochemicals or permeabilizing substances which show strong antimicrobial activities and are growth enhancing.

Effects of pathogenic bacteria on growth performance

The gut microflora is very important for the health of the animals. The so-called beneficial bacteria can protect the host from pathogenic bacteria, regulate the development of the gut or produce vitamins and hormones for the host. However, the presence of possibly harmful bacteria in the gut represents a possible threat to growth performance, which may result in decreased growth performance and ultimately in health problems. Therefore, it is not only very important to control possibly harmful bacteria, but also to keep the bacterial population within the gut well balanced.

Naturally combating bacteria

For a long time, organic acids were identified to be able to alter the gastro-intestinal microflora by reducing in particular acid-intolerant bacterial species. Often organic acids are combined with other naturally derived products such as phytochemicals in an attempt to use possible synergisms to more effectively combat pathogenic bacteria. Phytochemicals have anti-bacterial effects. In general, they serve as antioxidants, stimulate the immune system and suppress harmful microorganisms on one side but stimulate beneficial microbes on the other. They regulate the activity of certain enzymes and are known to protect the gut villi and interfere with the DNA replication of bacterial cells. However, the mode of action of different phytochemicals varies considerably. Cinnamaldehyde, a phytochemical derived from cinnamon bark oil for example, has a more complex mode of action as it targets the FtsZ protein. This protein plays a major role in the cell division of potentially harmful bacteria and if its function is constrained, cell division cannot take place and bacterial load is reduced.

However, when combating bacteria the structural differences of gram-positive and gram-negative bacteria have to be considered. The cytoplasm of the cell is surrounded by the cytoplasmic membrane, which is covered by a thick cell wall layer. This cell wall layer is significantly thinner in gram-negative bacteria compared to gram-positive bacteria. However, gram-negative bacteria are surrounded by an additional outer membrane (OM), which provides the bacteria with an inherent resistance to hydrophobic antibiotics and detergents.

Even if the OM of the gram-negative cell is acting as a protective barrier for external agents it is possible to weaken the OM by agents commonly characterised as permeabilizers. Even though permeabilizing substances have different modes of action they all weaken the outer membrane of gram-negative bacteria. If the OM of gram-negative bacteria is increased, the activity of other antimicrobials is enhanced as these can penetrate the bacterial cell very easily and inhibit or destroy cellular functions once the cell is invaded. This leads to synergistic effects when a permeabilizing substance is added to a mixture of organic acids and a phytochemical. However, if a synergism can be found, it highly depends on the right combination of organic

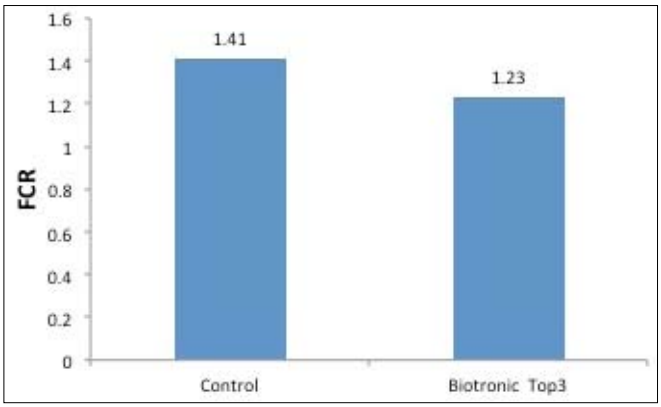
acids and permeabilizing substances, as not with all combinations a synergism will occur.

Effects on the inhibition of shrimp pathogens and performance

Synergistic effects on the inhibition of commonly found bacteria in terrestrial animals such as *E. Coli* or *Salmonella* were found when adding the Per4izer® (Biomin, Austria), a permeabilizing substance, to the formula of organic acids and a phytochemical. The synergistic effects seen with the inhibition of general pathogenic bacteria have drawn attention to the potential effects on the inhibition of pathogenic bacteria specific for aquatic farmed animals. *In vitro* tests showed that growth of *Vibrio* spp. was inhibited by an antimicrobial mixture (AM) of organic acids and the phytochemical cinnamaldehyde and the addition of the permeabilizing substance improved bacterial inhibition even further. These results obtained *in vitro* have led to the set up of an *in vivo* experiment where the combination of organic acids, a phytochemical and the Per4rizer® (Biotronic® Top3, Biomin, Austria) was included in shrimp feed.

The main objectives of this trial were to test the growth promotion effect of the natural growth promoter, Biotronic® Top3 and to test shrimp resistance to a challenge test with pathogenic bacteria. Therefore, an experiment was carried out using shrimp (*Litopenaeus vannamei*) juveniles (3-4 cm), which were stocked into 8 tanks, each of one cubic metre for a week before the start of the trial. Shrimp were fed the control feed during this acclimation period. After a week, a total of 240 juvenile shrimp were randomly grouped and body weight and body length were measured. Shrimp were assigned to two different treatments and were stocked in tanks at a density of 30 shrimp/tank.

Figure 1. Feed conversion ratio in the control and Biotronic® Top3 groups.



Treatments were either a standard diet (control) or the standard diet supplemented diet with Biotronic® Top3 at a level of 0.6 kg per tonne of feed. The trial duration was 60 days, during which feed intake was recorded. At the end of the trial, body weight and body length of each shrimp were measured. Weight gain, average body weight, feed conversion ratio and weight gain rate of each group were calculated.

At the end of the trial, shrimp of each group were graded into 3 size classes: <5g, 5.01 to 9g and >9g. Final body weight, length and total weight were significantly higher in shrimp fed the NGP supplemented diet (Table 1). A higher number of gut folds and more dense gut villi were found in shrimp fed the NGP supplemented diet indicating a better nutrient absorption. Feed conversion ratio (FCR) significantly improved in shrimp fed the NGP supplemented diet (control: 1.41 versus Biotronic® Top3: 1.23, Figure 1).

In the Biotronic® Top3 fed group a lower percentage of shrimp having a grade out of less than 5g were found compared to the control group. In contrast, the percentage of shrimp with grade out above 9g was markedly higher in the group fed the supplemented diets. The differences between groups were negligible for the grade out range from 5.01 to 9g.

At the end of the growth experiment, 36 shrimp were randomly selected from each treatment and divided in groups of 12 shrimp. These were stocked in six tanks in total for the two dietary treatments. From the control fed group, shrimp in one tank were injected with 0.2ml PBS and shrimp in the other two tanks were injected with 0.2ml of *Vibrio parahaemolyticus* at $5x10^7$ cfu/ml. A similar procedure was applied in the three tanks in which shrimp were previously fed the natural growth promoter. The half-lethal time in the control group was 10h but 96h in the group fed the NGP supplemented diet. The survival rate after 124h was 3% in the control group compared to 25% in the Biotronic® Top3 group.

An economic analysis of the inclusion of the natural growth promoter in shrimp feed was done by extrapolating the trial results for the production of 1 tonne of shrimp (Table 2). When the price of the application of the feed additive was taken into account, the application of natural growth promoter at 0.6kg/tonne feed resulted in an additional gain for the farmer of CNY 5,135 per tonne of shrimp produced.

Table 1. Growth performance of shrimp using NGP in the feed.

	Control	Biotronic®Top3
No. of shrimps/ tank	30	30
Growth performance parameters		
Initial body weight, g	4.40	4.19
Initial length, cm	1.09	1.07
Total initial weight, g	32.54	32.13
Final body weight, g	8.07[a]	8.54[b]
Final lenght, cm	7.20[a]	8.57[b]
Total final weight, g	171.0[a]	196.9[b]
Feed conversion ratio	1.41[b]	1.23[a]
Shrimp grade out, %		
>5 g	26.32	11.96
5.01-9.0 g	52.63	51.09
>9.0 g	21.05	36.96

Table 2. Economic benefit of using natural growth promoter in shrimp feeds in Chinese Yuan Renminbi (one CNY equals 0.16 USD).

	Control	Biotronic® Top3
Weight gain (g/shrimp)	6.1	7.5
Production (kg of shrimp)	1,000.0	1,227.5
FCR	1.41	1.23
Feed used (FCR * production)	1410.0	1,509.8
Sales of shrimp (CNY/production)	26,000	31,915
Feeding costs (CNY, feed + product)	10,575	11,355
Total revenue (CNY)	15,425	20,560
Additional gain (CNY)		5,135

In summary, Biotronic® Top3 had very positive growth promoting effects in shrimp. It also improved the resistance against an important *Vibrio* bacteria in a challenge test. This represents an alternative to antibiotic growth promoters as well as a sustainable and innovative strategy to act against bacteria for an improved growth performance. The gain is a higher economic output for the farmer.

Angela Riemensberger

Gonscalo Santos

Dr Angela Riemensberger is the product manager for acidifiers product line at Biomin, Austria since 2010. She has a PhD in Animal Nutrition from the University College Dublin.
Goncalo 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 (Gonçalo Santos).

Continued from page 20...

Research Institute for Aquaculture 2 (RIA2)

This is one of the three institutes in Vietnam responsible for aquaculture research. RIA2 is located in Ho Chi Minh City and is part of the Ministry of Agriculture and Rural Development. It is primarily involved in aquaculture research in several sectors from fish breeding, aquaculture technology, aquatic environment to fish and shrimp diseases. In fisheries, the research is on post-harvest technologies, inland and coastal fisheries and new technologies for fisheries production.

Members of the Research Centre for Fisheries Post Harvest. From left, Nguyen Van Nguyen, Dr Le Duc Trung, director of the centre and expert in aquafeed technology; Nguyen Thi Huong Thao, vice director and involved in fisheries post harvest technology; Nguyen Thi Quang Thuy, fish nutritionist and Tran Van Khanh, an engineer working on aquafeed technology.

The Research Centre for Fisheries Post-harvest Technology is part of RIA2 and has two major areas of research including nutrition and aqua-feed technology and fisheries post-harvest technology. The laboratory is ISO 17025 accredited for aqua-products analysis services. A feed mill and a wet laboratory for experimental research are located in Tien Giang in the south.

Other centres include the National Breeding Centre for Southern Marine Aquaculture in Vung Tau which maintains a supply of brood stock and purebreed of marine species such as *Penaeus monodon*, mud skipper *Pseudapocryptes lanceolatus* and *Proteracanthus sarissophorus*. The National Breeding Centre for Southern Freshwater Aquaculture supplies GIFT tilapia, red tilapia, freshwater prawn and Tra catfish, all of which have been selectively bred for high growth. It also conducts efficacy trials on probiotics, feeds and drugs in prophylactics and disease treatment for freshwater aquaculture.

Probiotic in trout: effects on growth and gut

By Enric Gisbert and Marisol Castillo

In addition to growth, this trial showed effects on intestinal mucosa and microbiota but not on specific digestive system functionality.

The use of probiotics is quite common in health promoting "functional foods" for humans, as well as feed additives in livestock production. Since some years ago, there is also a growing trend for probiotics in fish feed.

The common probiotics used in aquaculture belong to several genera, such as *Saccharomyces, Clostridium, Lactobacillus, Bacillus, Enterococcus, Shewanella, Leuconostoc, Lactococcus, Carnobacterium*, and *Aeromonas*. In salmonids the most commonly used probiotic bacteria are *Bacillus* spp., *Lactobacillus* spp., *Aeromonas* spp., *Pseudomonas* spp., *Carnobacterium* spp, and *Pediococcus* spp.

Previous studies on the dietary inclusion of *B. toyoi* have reported an improvement of feed conversion ratios and an increase in body weight. However, the information regarding the effects of this probiotic on digestive histological organisation and physiology is still scarce.

The aim of this study was to evaluate the effects of feed supplementation with the probiotic *B. cereus* var. *toyoi* on rainbow trout fingerlings by means of assessing its impact on fish growth performance, the morphology of the intestinal mucosa and changes in the gut microbiota.

Trials with rainbow trout

In the trial, fingerlings of rainbow trout (4.2±0.1 g) were fed two diets, a commercial diet (Aller Futura™ from AllerAqua) and the same diet containing the probiotic *B. cereus* var. *toyoi* at a final concentration of $2x10^4$UFC/g, for 93 days.

Each treatment was tested in triplicate (400-L tank, 125 fish/tank, 1.3 kg/m^3). During the trial, water temperature, conductivity, pH and dissolved oxygen were 13.2±0.2°C, 1800±200 µS/cm, 7.5±0.01 and 8.0±0.3 mg/l (mean ± S.D.), respectively. Tanks were connected to a recirculation system (IRTAmar™) which maintained adequate water quality. Fish were fed at apparent satiation (3.3%) with automatic feeders (ARVO-TEC T-Drum-2000™). The proximate biochemical composition of diets was 64% crude protein, 12% crude fat and 11% ash (2.0 mm pellet size).

At the end of the trial, all fish from each tank were measured for their body size (length and weight), and 45 specimens per condition (15 per replicate) sacrificed for histology (size of intestinal villi and number of goblet cells), assessment of digestive system functionality and quantification of the intestinal microbiota by RFLP.

At the end of the trial, fish fed the diet containing the probiotic were slightly significantly heavier at 43.9±9.1g and longer at 14.4±1.1 cm than those fed the control diet (42.5±7.6 g, 14.1±1.1, respectively; n = 276; see figure 1 and 2). The inclusion of the probiotic into the control diet did not affect the functionality of the digestive system, as indicated by the absence of significant differences in the specific activity of pancreatic (trypsin, chymotrypsin, total protease) and intestinal brush border (alkaline phosphatase, aminopeptidase-N, maltase) enzymes.

Figure 1.

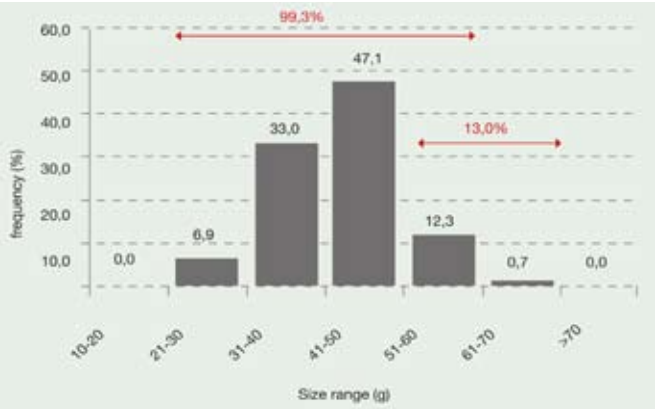


Figure 2.

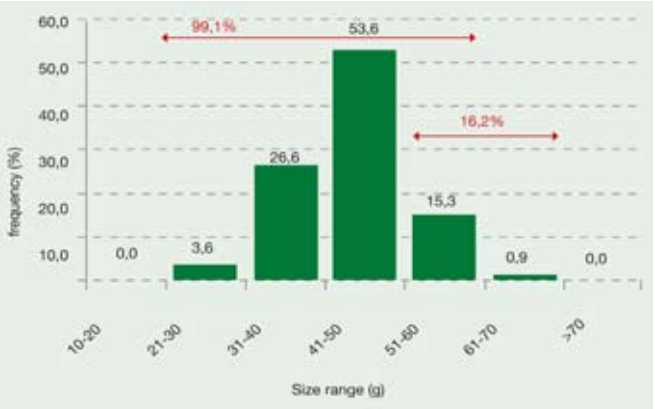


Figure 3.

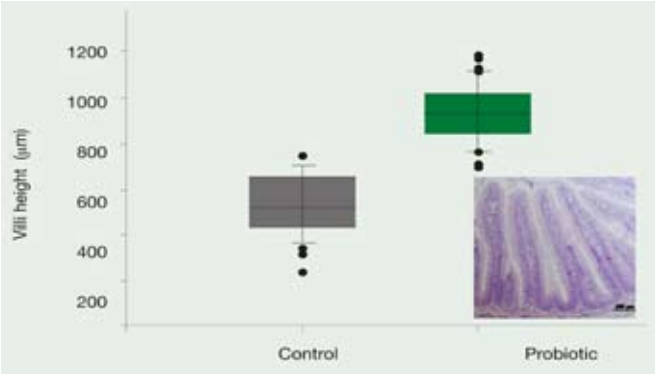
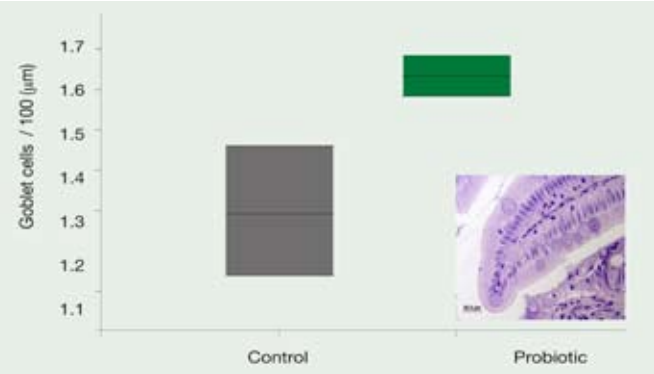


Figure 4.



However, the number of goblet cells (1.6±0.1 vs. 1.3±0.2 cells/100 µm; n = 15) and height of villi (928.5±137 vs. 527±130 µm; t-test, $P < 0.001$; n = 15) in the intestinal mucosa was significantly higher in fish fed the diet containing the probiotic. Intestinal microbiota was also affected by dietary groups, showing different RFLP results depending on the diet.

In conclusion, the inclusion of *B. cereus* var. *toyoi* at the final concentration of $2x10^4$ UFC/g in a commercial diet promoted growth in rainbow trout fingerlings, as well as the organisation of the intestinal mucosa (number of goblet cells and villi height). However, its inclusion did not affect the specific activity of selected pancreatic and intestinal digestive enzymes. Therefore, the inclusion of this probiotic in trout feeds could be beneficial and advantageous in terms of production although more studies are needed to study mode of action of *B. toyoi* in the gut as well as the correct dosage to administer.

Enric Gisbert

Marisol Castillo

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Needs for responsible & sustainable cage culture

The expanding industry in Malaysia requires a holistic approach in managing diseases and the environment. Sustainable standards and certification increase market access.

This was the message to Malaysian cage farmers at Farmer's Day held in conjunction with the Third International Symposium on Cage Aquaculture in Asia (CAA3) and Malaysian International Seafood Exposition (MISE) in November 2011. It was organised by the Malaysian Fisheries Society, Asian Fisheries Society, Department of Fisheries and Uni-President Vietnam, the Gold sponsor of CAA3. More than 250 participants attended, comprising 200 local cage fish farmers, sponsored by the Department of Fisheries, private sector and symposium participants. The four presentations covered successful marine cage aquaculture businesses in Indonesia and Malaysia, disease management and experiences from industry in Japan.

Vaccine focused biosecurity practices

In his presentation, **Neil Wendover**, technical services manager, MSD Aquatic Animal Health, based in Singapore, reviewed the current problems in aquaculture.

Diseases account for just over a third of all problems faced by commercial fish producers. Of these, more than 50% involve bacterial related problems; this is followed closely by an equal share of 20% each for viral and parasitic attacks. Fungal related problems make up a small share of less than 4%.

Therefore the use of biosecurity is an essential component to any fish production facility. The main objectives of biosecurity as a concept are to;

- Reduce the risk of disease introductions
- Minimise the spread of diseases on-farm or to new areas
- To promote fish health
- To protect economic investment
- To protect human health

"In grow out, some useful biosecurity measures are; quarantine/ isolation facilities, strict adherence to cleaning and disinfection techniques, consideration on initial facility layout design, the development of a disease testing and monitoring protocol and lastly maintaining good records," said Wendover. However much of these strategies are wasted if the 'seed source' itself is not in an optimal condition to begin with.

VPF strategy

There are now a few unique fingerlings suppliers working towards a new strategy of Vaccinated Pathogen Free seed-stock (VPF), these suppliers are focusing on quality, not cost control. They adhere to strict biosecure practices that eliminate any disease transmission, and ensure pathogen free inputs (including common vectors such as humans and foods sources). The key driver behind the VPF strategy is that many grow out farmers are now demanding that their purchased fish are sufficiently protected, clean, healthy and good quality on arrival at their open challenge environment, as opposed to simply focusing on ever cheaper seed sources to compensate for increasing cost of production. This means that the fish have been vaccinated when they are healthy and before exposure to the open challenge environment. It also means no prior or current infection of parasites, virus or bacteria and that the seed is in an optimal nutritional status. This quality of fish enables good performance during the most 'expensive' stages on the farm when cost control is a major concern and as such allows for the opportunity of a highly profitable operation.

Vaccines as preventative tools for cost reduction

"Vaccines as preventive tools should be looked at as an insurance program. The vaccine should be given when the fish is still healthy. It is to stop infection, rather than curing the problems after infection. In contrast, chemotherapy is curative, performed after the infection has occurred."

The effect of mortality and impaired growth performance affects business profitability. Fish that are already infected will normally lose appetite and will not grow to optimal FCR. In a case study on the Norwegian salmon production, early vibriosis vaccines were introduced during the 1990s, later the vaccines became more complicated with the more recent advent of oil-based vaccines. As a consequence the volume of antibiotics used, dropped dramatically whilst salmon production volumes continued to increase. The advantages of vaccination include reduction of mortalities, a long period of protection, no requirement for a withdrawal period, improved general health and feed conversion ratios and reduction in the need for chemotherapy. In salmon aquaculture the acceptable survival is now benchmarked at above 80% and production costs have reduced significantly down from approximately USD 7/kg in 1973 to recent levels of USD 2.50/kg. This has allowed for highly profitable business operations selling into competitive markets with reducing market prices.

With vaccination, the fish is given a non-infectious dose of the

The audience

Shigeharu Senoo (left) and Goh Cheng Liang (middle) with session chair, Mohd Munir, DOF

Jerome Zang, tilapia producer and Mohd Addin Hazif Mokhtar, University Malaysia Sabah

pathogen which stimulates an initial antibody response, when the fish is exposed to the actual disease the memory cells will induce a rapid antibody response which is crucial to preventing infection and mortality. "The idea of giving the vaccine before the fish is sick is that this allows for an optimal antibody titre and immune response so the fish is better able to cope with an infectious pathogen once there is an attack." added Wendover. There are many different types of vaccines, combinations of antigens and application strategies. Different strategies such as; oral, immersion or injection, give different results in terms of level of protection, stress to fish and duration of immunity.

Treatment strategies in aquaculture

Wendover stated that many diseases are not treatable. There are still no treatments for viral infections and treatment for bacterial infections are often ineffective leading to increased production costs and unnecessary residues in end product. To make sure treatments are effective it is imperative to appreciate that not all drugs work against all diseases and as such appropriate disease diagnosis strategies must precede any treatment application. Treatments should then be conducted with the appropriate medicines from approved sources at the recommended dose and duration.

Parasites in cage culture

Although parasites generally cause no problems to healthy populations, large infestations of parasites (such as *Benedinia* in pompano and barramundi), can lead to mortality, reduced feed consumption and poor feed conversion as well as compromised resistance to viruses and bacteria.

"At a low presence, the parasites show no interference on the fish. However a moderate level can lead to irritation, slow growth rates and an increased disease susceptibility. Heavy infestations will have a dramatic effect on FCR and mortality rates. To eradicate all the parasites is virtually impossible and small fish are generally more susceptible."

The idea is to have prophylactic treatment strategies. However, this requires an understanding of the particular parasite and its life cycle. Routine screenings are essential to understand how to break the life cycle and control parasite pressure. The emphasis is on the fish farmer to develop his or her own prevention strategies according to their particular infection and husbandry strategy.

Tropical marine fish production disease control

Citing barramundi as an example Wendover stated that some farms have established standard SOPs for disease control during the crucial early hatchery and pre-grow out phases of the production cycle.

The major problem in the first few days of the hatchery phase is viral nervous necrosis (VNN). In this case VNN is passed vertically from the brood-stock through infected eggs. However, ozone is effective and will prevent outbreaks when used correctly before eggs are introduced to the system. As such ozonation is the first major step.

System biosecurity of the fragile nursery phase is the second major step. This ensures the prevention of horizontal and vertical disease transmission. There are two strategies to enable a bio-secure nursery facility. The first involves complete pathogen exclusion and maintenance in a full re-circulation facility. This is often a very complex and delicate process especially in developing industries. Another option is to make sure all water entering the system is treated and sterile, made possible by using disinfectant strategies such as chlorination. Furthermore all nutritional inputs (*Artemia*, rotifer, pellets etc) should be free from possible contaminants by sourcing good quality products from reputable suppliers.

Implementation of prevention strategies such as reverse-salinity and vaccination is the third major step. Prevention of parasite outbreaks (e.g. *Benedinia* spp) and many common bacterial pathogens (e.g. *Tenacibaculum maritimum*) can be treated by the reverse salinity strategy which works very well with andronomous fish like barramundi. When the fish are big enough to be vaccinated (at approximately 12-15g) injection vaccination should be done to ensure maximum protection against the most common production diseases before the fish are sent to the 'open challenge environment'. Common marine production pathogens such as Iridovirus, *Tenacibaculum maritimum* and *S. iniae* often infect barramundi at pre-grow out and grow out phases, but the vaccination program must start at the nursery phase before the fish are sent to the growing farms.

Wendover's message was;

"We cannot run away from diseases. Many operations have failed because they have not sufficiently addressed their problems and tackled the situation in a scientific and logical manner. Applying advanced technology and equipment into developing and emerging industries does not always work, the point is to focus on the fundamentals of protein production using good farming practices and adapt those fundamentals to suit the local conditions."

"Vaccination is not an elixir, but an integral part of the health management plan. If the environment is inadequate, vaccines might still be effective but other diseases can still emerge. With collaboration and sharing of information among government, academia and private sector, the future of aquaculture in Asia is bright."

Successful cage farming of marine fish

Misai Tsai, president director of PT Lucky Samudra Pratama in Indonesia has been successful in adopting good aquaculture practices in cage farming of the pompano *Trachinotus blochii*, in Kongsi Island, Indonesia. The main product is the pompano and the fish is called marukoban in Japan which is the major export market for the company.

Tsai said, "To provide a good seafood product with a reasonable price, a farm has to start with a suitable location for cage farming, followed by good quality feed and good management practices. Being able to do fish processing is essential too.

"However, we and others in the industry face increasing production costs from rising fuel, raw materials, feed and labour costs. As a fish farmer today, I have to produce high quality and delicious tasting fish at economical prices. The most practical solution is mass production, to reduce total production cost instead of raising prices."

According to Tsai, there are six steps for a successful business: species selection by analysing the environmental requirements, educating and training of farm workers, environmental management, fish health and hygiene management, feed efficiency improvement and certification of standardised operations.

Critical to any enterprise is the education and training for on-farm labourers. The farm conducts these both in classrooms and on site. The training includes 5 steps: set-up of a standard operation procedure (SOP), education and training, examination and evaluation of labour, audit or trial run according to the standard SOP expected, and modifications to a

more advanced SOP. These steps are carried out in the farm and training is continuously repeated as the SOP is modified.

Management of the environment in marine cage farms focuses on two main aspects: water quality and pollution prevention. This is fundamental for sustainable production and to prevent diseases and injuries to fish. The routine checking of water quality and fish conditions are performed by certified laboratories. Dead fish are buried in polyethylene sheets and covered with lime to speed up decomposition. Burial areas are confined to marked locations. Inorganic waste is transported to the mainland.

Fish health and hygiene management is conducted by regularly cleaning nets to break the parasite life cycle. Normally, the nets will be replaced every week and the old nets will be washed and left to dry. Fish health is monitored through regular sampling of fish from different cages. The specimens will be dissected and the condition of their liver, intestine and blood examined.

Improvements in feed efficiency were achieved by closely monitoring the Standard Growth Curve (SGC). Every year, the growth curve data are compared to the SGC. In daily feeding, the feed amount is calculated from the SGC and from the observation of fish intake, the next daily feeding is adjusted.

"Too low [a level of] feeding will waste time whilst overfeeding will waste money. Thus, optimal conditions between feeding rate and food conversion ratios (FCR) should be analysed."

Tsai's advice to farmers in the audience was to follow the steps outlined above for a good marine cage aquaculture farm business that is profitable and sustainable. He added, *"Inducing on-farm labourers to be reactive is important. Employees should be developed and trained to handle more complicated problems as, in the future, the goals are to further improve economies of scale in commercial marine fish farming."*

Certification

"This is on the standardised operations based on customers or end user requirements. Most of the requirements are on food safety, traceability, sustainability and animal welfare. The certificate will be given to the farm after a third party (ILMO, ISO) audit on farm setup to products reaching end users," said Tsai.

In Malaysia, **Goh Cheng Liang**, managing director, GST group and president of the newly formed MFFAM (see box) said, "Our company keeps a record of data from the farm to serve as a guide in management and SOP improvements. Our farms are managed well by implementing the local certification (SPLAM) and internationally recognised certifications such as EU approved farm and Friend of the Seas (FOS) since 2010. These help us to access the EU market."

Neil Wendover (left) and Misai Tsai

Mohd Semail, DOF, Pahang (left) with catfish and tilapia cage farmers, Mohd Suhaime, Roslan Ahmad and Mat Amin Mat.

The GST group is a fully integrated marine cage fish producer. It has a hatchery centre in Batu Kawan, Penang where the annual production is 10 million fry of sea bass, golden snapper, red snapper, cobia and groupers. Brood stock maintenance and cage farming are carried out off Pangkor Island, where there are 1,500 cages with a total annual production of 500 tonnes. Farmed species comprise the cobia, tiger and giant grouper, pompano, sea bass and red snapper. The HACCP, EU, ISO 9002 and Halal Malaysia certified processing plant is located in Penang and produces 200 tonnes monthly. Products are sold in local hypermarkets and exported to Australia, USA and Europe.

Learning from Japan

"Cage systems are different in Japan, where the net cage should be very sturdy to withstand typhoons and big waves. Normally, independent owners of a shared fish farm have different types of cages. In general, today, they prefer Japanese bamboo as the main material for the cage due to its flexibility, durability and cost effectiveness. Fibreglass material was introduced to replace bamboo, but most fish farmers are reluctant to use this because it is expensive and not very flexible," said **Professor Shigeharu Senoo**, manager for UMS Hatchery in University Sabah Malaysia where he is successfully producing hybrid groupers.

Going back to the history of cage culture, Senoo said that mariculture using net cages in Japan was first pioneered by the late Prof Harada Teruo from Kinki University. He began to culture yellowtail in net cages to reduce the high cost of culture in cement tanks. At that time, others were sceptical about the idea since yellowtail is a migratory fish.

"The lesson here is that from his work and research, he was successful and developed hatcheries, focusing on yellowfin and bluefin tuna. He passed his thoughts on discipline in hatchery work to all of his students. He stressed on the basic techniques of fish production, interest in fish production and a strong sense of responsibility on the condition of fish," said Senoo.

"In Japan, the transfer of fry and fingerling is automated where a fish pump transports fish in water from the hatchery tanks to the cages, and graders sort fish based on sizes. However, human labour is still required to differentiate between normal and deformed fish.

Marine Fish Farmers Association of Malaysia (MFFAM)

Goh who has more than 20 years of experience in the marine cage culture business, formed the association with a group of grouper farmers in Johor, Selangor, and Penang on 26 June 2011. MFFAM seeks to promote and accelerate the development of a robust and eco-friendly aquaculture sector in Malaysia. It will look at key challenges to sustainable cage culture in Malaysia, in particular feed efficiency, cage culture effluents, habitat impacts and potential disease transfers. Membership is open to all marine fin-fish aquaculture related associations, companies and organisations.

MFFAM's goal is to serve as the link between producers, government and other agencies to provide feedback on the development of aquaculture and related activities. It will make recommendations for the preservation and conservation of water resources to promote an environment conducive to the development of aquaculture and conservation of aquatic species. It will network with individuals and organisations at the national and international level and facilitate the exchange of information. It will assist members to obtain certification in Best Aquaculture Practices (BMP) and participate in marketing activities for sustainable aquaculture products.

Green groupers from Mindanao: KGMC in focus

By Lauro Tito C. Ilagan

Within three years, this cooperative of grouper farmers has expanded annual production of green grouper to 200 cage modules. The focus is the live grouper market in China.

In Minadanao's Zamboanga Sibugay Province, cage farmers have been culturing the green grouper *Epinephelus coioides* since 1998. USAID's Growth with Equity in Mindanao (GEM) Program started its assistance in 2008 to this group of grouper farmers. Since then, there has been not only a sharp increase in production but also a shift to the use of hatchery produced fingerlings and formulated feed instead of trash fish. Since December 2011, harvests have increased to 2.4 tonnes per month.

The KGMC: a fish story

This is the Association of Small Fisherfolk in Concepcion (or Kahugpungan sg mga Gagmayng Mangingisda sa Concepcion, KGMC) which manages a cluster of grouper fish cages in a 5 ha estuary in Zamboanga Sibugay Province. Grouper farming started in 1998 with 70 cage modules. Assisted by association president, Roberto Ballon, members learnt the fundamentals in grouper culture methodology. GEM focused on technical assistance instead of introducing modern and sustainable farming technology, use of formulated feeds and hatchery-bred fingerlings, and other forms of assistance to upgrade their operations.

Arising from comparative feed trials at the KGMC's grow-out site, GEM convinced the members that, by and large, using commercial pellets improved fish survival and substantially increased growth rates. ROI was better with formulated feeds compared to trash fish (Table 1).

Table 1. Summary of KGMC comparative feed trial results.

	Commercial Pellets	Trash Fish
Days of culture	155	150
Survival %	87	77
Average Body Weight (g)	605	560
Total Biomass (kg)	105	86
Total Feeds (kg)	251	720
Feed Conversion Ratio (FCR)	2.4	8.4
Return on Investment (ROI, %)	30	28

GEM also introduced the use of hatchery-bred juveniles sourced from existing grouper hatcheries to reduce the dependence on wild caught fingerlings. This also enabled them to stock the cages all year-round and increase stocking densities for each production cycle as uniform-sized fingerlings had become readily available in larger quantities.

The current ex-farm price for the green grouper has increased from USD 6 to USD 11/kg, for fish with an average body weight (ABW) of only 400 g. This means that farmers can increase their profit margins from a shorter production cycle (from 6 to 4 months) and still increase the total sales volume by increasing stocking numbers per cycle.

KGMC's success in grouper production earned it the Philippine Department of Agriculture (Bountiful Harvest) Award as 'Most Outstanding Fisherfolk Association' in 2002. Ballon was named the 'Most Outstanding Fisherfolk' for 2001 and 2002 consecutively. He was earlier employed by a local aquaculture company and worked his way up to become a cage technician. He introduced grouper farming to his neighbours as a cooperative enterprise when he was elected association president in 1996. Their enterprise was featured in WOW Philippines!, a prestigious national television show that endorses unique products and places in the country.

Harvested green grouper in basket

KGMC grow-out area in Kabasalan, Zamboanga Sibugay

KGMC is one of the most successful groups that GEM has been assisting in mainland Mindanao. As a USAID program, GEM is implemented exclusively in Mindanao, the second largest and southernmost island grouping in the Philippines. Home to a decades-old insurgency by Muslim separatists, Mindanao is a land rife with conflict and with municipalities with the highest poverty incidence in the country.

GEM in Mindanao

Through its Sustainable Aquaculture and Fisheries Effort (SAFE) program, GEM has been working with several fisherfolk associations, seaweed farmers, and cooperatives, mostly in island provinces such as Tawi-Tawi, Sulu, and Basilan, where their pristine waters are ideal for mariculture. Through these initiatives, GEM aims to promote development in Mindanao and uplift the economic condition of the people.

SAFE's work involves introducing and promoting high-value grouper and abalone culture as a more profitable and sustainable livelihood alternative to either fishing or seaweed farming. SAFE utilises the 'value-chain' approach in determining the gaps and deficiencies in fish farming and implements projects to address such problems. Under this endeavour, SAFE identified key requirements in Mindanao's emerging high-value aquaculture industry, such as seedstock and feeds sustainability and marketing.

KGMC president Roberto Ballon showing a green grouper from KGMC's farm

GEM aquaculture specialist, Hector Palma (left), Yllana Bay Multi-purpose Cooperative chairman, Jun Sarosa, and KGMC president, Roberto Ballon (right), showing fingerlings sold by KGMC to the Yllana Bay MPC

Nursery tanks

One of the major projects of GEM was to help establish a high-value multi-species hatchery in Tawi-Tawi Province. GEM introduced the use of floating fish cages, in offshore waters as opposed to stationary fish pens alongside the beach. It also promoted the use of commercial feeds as a cost-effective and environmentally sustainable substitute to the traditional practice of feeding with trash fish, similar to what it did for the KGMC group in Kabasalan.

A major activity of SAFE is to regularly source for hatchery-produced juveniles for sale and then to inform growers of their availability. Often, the GEM team will even facilitate transport of the fingerlings to the farm, located usually in remote coastal villages or far-flung island communities.

However, as most of the available fingerlings are from faraway Tawi-Tawi Province, GEM has provided the KGMC with facilities to start a small nursery where the Tawi-Tawi hatchery will supply KGMC with grouper larvae. KGMC will rear them up to fingerling sizes and resell to other growers.

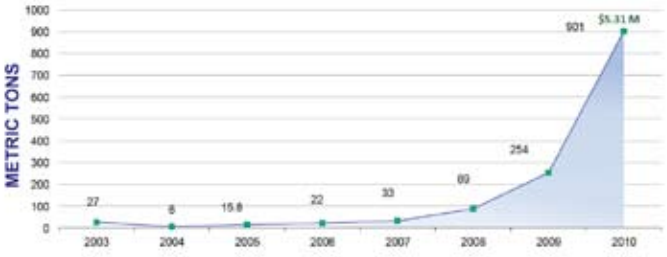
GEM also sought to improve the marketing of groupers. It recognises that the main market for groupers is China. In 2010, it partnered with the Bureau of Fisheries and Aquatic Resources (BFAR), Philippines to send a delegation to the China Fisheries and Seafood Expo, to promote farmed grouper and other seafood products from Mindanao and the adjacent islands. In 2011, GEM and BFAR again participated in the same expo which allowed local live fish exporters and other participating seafood companies from the Philippines to explore marketing agreements with major importers from all over the world.

More grouper farms

Consequently, GEM was able to contribute to the expansion of grouper farms in Mindanao and to increase grouper exports from only 89 tonnes in 2008 to 901 tonnes in 2010, worth USD 5.31 million. While a sizeable percentage of live fish going to Hong Kong and other Asian markets are still from capture fisheries, it is estimated that around 40-50% of total production are already from grouper farms.

GEM's Lauro Ilagan (left) and Export marketing specialist, Frances Granada (third from left) with exhibitors in front of the Philippines Booth during the China Fisheries and Seafood Expo 2011, Qingdao, China

Figure 1. Exports of groupers from Mindanao (tonnes), 2003-10.



Source: Bureau of Customs, Philippines

Expansion

At present, KGMC has expanded its operations to 200 units (from 70 cages) reaching an annual production of around 30 tonnes of green grouper. It has also expanded operations to the neighbouring provinces of Zamboanga del Norte and Misamis Oriental, where it has even gone into partnership with aquaculture entrepreneurs.

With GEM's assistance in introducing formulated feeds and proper feed management, feed conversation ratio (FCR) and, subsequently, production cost lowered substantially, enabling farmers to increase their income to USD2,200 per year. The average household income has increased to PHP 500/day (USD 11) for the now 200-strong association, 30% of which are women taking part in the KGMC's operations. The use of commercial pellets also allowed the KGMC to increase their production area by an additional 50 cages since it is no longer hampered by limited trash fish supply. With the increased production from the additional cage units, each member could earn as much as PHP 150,441/year (USD 3,581).

In August 2010, GEM co-sponsored the First Mindanao Mariculture Congress, which brought together all the major mariculture players in Mindanao, including growers, feed manufacturers, members of the academia, agricultural credit institutions and government agency representatives. Ballon, as a resource speaker shared the KGMC's experience in grouper farming. Networking and business linkages were established which enable KGMC to expand its range of businesses. It now has a role in helping communities to develop cage farming, sale of fingerlings from its nursery operations, rearing and sale of brood stock and training on grouper production.

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Family based industry in Malaysia

By Zuridah Merican

Opportunity with high prices for tiger and green grouper is hampered by low survival and fingerling shortage. Production is rising to meet local demand for other groupers, snappers and pompano.

Goh Yik Hwa (middle) and wife with Ngoi Si Liang (right)

Two high value species currently in demand for the live markets in China, Hong Kong and Taiwan are the tiger grouper *Epinephelus fuscoguttatus* and green grouper *E. coioides*. In 2011, prices rose to MYR 65-75/kg (USD 21.6 -25) for 600g-1kg tiger grouper and have remained high because of low supply. The ex-farm price for the green grouper is now MYR43/kg (USD 14.3) for 800g-1kg fish, down from MYR 46/kg (USD 15.3) in 2011. It was only MYR 20/kg (USD 6.7) 10 years ago. In January to September 2011, imports of live tiger and green grouper in Hong Kong were 2,308 tonnes out of the total of 5,351 tonnes of live marine fish. The annual volume of imports for the two species was 2,874 tonnes in 2010 (Pawiro, 2012).

Goh Yik Hwa, Cheong Seng Fishery in Sungai Udang in the northern state of Penang, said, "Unfortunately, since 2011, most cage farms off Sungai Udang experienced high mortality of 3-inch (7.6 cm) fingerlings. In one farm, survival rate was as low as 1%, with mortality attributed to suspected parasitic infections. In this close-knit community, we have been reluctant to restock the fish, fearing more failures. Some of us are successful in rearing fingerlings in earthen ponds and then transferring 8-inch (20.3 cm) fish for grow-out in cages. The survival was 60% in the ponds. For sizes of up to one kg, it will take 1.5 years from the fingerling stage"

Live fish for Hong Kong, China and Taiwan markets are collected from cage farms by well boats arranged by buyers. For the cage farmers, ex farm prices are the same whether fish are sold live or fresh. There is no demand for live pompano as the fish is produced in China itself. Demand from local markets for fresh fish is increasing, mainly for the pompano and snappers. These are harvested from cages and transported by boat to the landing jetties in Sungai Udang. Buyers transfer fish to cold chain trucks for retailers and markets in Kuala Lumpur and Singapore.

"Pompano prices have dropped recently and fresh fish was sold at MYR 15.50/kg (USD 5.2/kg) for 400-600g fish in February. The culture period is only 5 months from one inch (2.5cm) fingerlings. Large 800g to 2kg golden snapper *Lutjanus johni* is preferred for fillet processing and ex-farm prices are MYR 21.50/kg (USD 7.2/kg). However, in general these prices are still good for the farmers and we expect this to continue in 2013"

"In contrast, the price for the fresh green grouper of 2-4kg has fluctuated from MYR 21/kg (USD 7/kg) in early 2011 to MYR 25/kg (USD 8.3/kg) in October 2011 and then decreased to MYR 24/kg (USD 8/kg) in February 2012."

Goh is involved in the marine fish supply chain in Sungai Udang. He has a farm with 200 cages and trades in fish harvested at his own farm as well as those from other farms. He is also part of an alliance of farmers with 1,000 cages and is a shareholder in two shrimp farms. Goh is a second generation cage farmer who took over from his father 11 years ago.

Transfer of fresh fish harvests from cage farms to buyers

Extruded pellets used for larger fish

Five month old hybrid groupers

Green grouper of 800g

Family based

Similar to elsewhere in Malaysia, cage farms in the waters off Sungai Udang are family based and many farms are now managed by the second generation, now in their thirties. There are 170 farms in the area. Usually, these are multispecies farms for the grow-out of various grouper species such the tiger, green, giant *E. lanceolatus* and hybrids of tiger and giant grouper. Alongside these are the red snapper

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L. erythropterus and golden snapper, pompano *Trachinotus blochii*, golden trevally *Gnathanodon specious* and sea bass *Lates calcarifer*. There is only one single species farm with almost 80-90% of the 1,000 net cages stocked with pompano. In Penang state, there were 34,475 registered cages producing 6,662 tonnes of marine fish in 2010. Production was 17.2 kg/m^2, higher than the national average of 12.94 kg/m^2.

Ong Chin Tee manages 100 cages at the farm which he took over from his father 19 years ago. The farm initially had only 16 cages. The net cages with wooden platforms are 6m x 6m x 3m deep.

"Over the years, the only major issue we face is the deterioration of water quality with the increase in the number of farms. Some 13 years ago, there were only 9 farms. There is no monitoring of water quality except when there are cases of high mortality. Nowadays, we need to clean our nets every 10 days whereas I remember doing this every 15-20 days in the early days and at that time, we cleaned away only barnacles. Now we need to remove algae often."

"In our small community here, we exchange information on disease occurrences. At my farm, the acceptable survival is 30% from the first stocking of fingerlings. With either the tiger or green grouper, I feel that all will be well once the fish reach 100g. We do not have any treatment program for diseased fish, we merely discard them."

Culture practices are quite standard. Fingerlings, usually of 3-inch sizes, are stocked into nursery net cages. The stocking density varies with species, such as 1,500 fingerlings of the tiger grouper but only 500-700 fingerlings of the green grouper.

"The reason for the lower stocking density for the green grouper is that the fish occupies the bottom area only. The tiger grouper is very aggressive until they reach 200g in size and when they reach 500g we will transfer them to the larger net cages (12m x 6m)."

Feed management

"In general, we are seeing a transition in feeding from trash fish to extruded pellets. Today, only the pompano is fed totally on extruded feeds.

Ong Chin Tee

Feeds ready for delivery to the cages

Three month-old spotted grouper with an ex farm price of MYR 20/kg

Tiger grouper, 20 days old in the nursery cages

For the groupers, snapper and seabass, feeding frequency is twice a day. Farmers will feed with chopped trash fish for one feeding and pellets for the next one. During the nursery stages, the feed used is eel powder mixed with starter pellets, sometimes even for the pompano," said Ngoi Si Liang, Uni President's technical sales executive in the Sungai Udang area.

The company markets slow sinking extruded pellets for groupers with 40% protein which is now used to feed groupers, snappers, pompano and other species. It also sells eel mash. There are nine extruded pellet sizes, starting with 2.0-2.2 mm pellets for 5-15g fish to the largest 15.8 mm to 16.2 mm round pellets for fish larger than 500g.

"One of the problems with the cage farmers here is that there is no record on the volumes of trash fish and pelleted feeds used and thus we cannot calculate the feed conversion ratio. However, in the case of sea bass in ponds, farmers have started to keep records."

Higher fingerling prices

According to Ong and Goh, prices of fingerlings have been rising. Seed stock for the farm is purchased through brokers. Three inch (7.6 cm) and 2.5 inch (6.4cm) green grouper fingerlings are from Taiwan and Indonesia and now cost from MYR 1.45 to 3.3 (USD 0.5 to 1.1). Tiger grouper fingerlings (3-inch) from Indonesia cost MYR4.5 (USD 1.5) each. Hybrid grouper and giant grouper fingerlings of 3 to 5 inch cost MYR18 (USD 6) and MYR 16 (USD 5.3) each, respectively.

"There is a shortage in fingerling supply. Currently, prices are relatively high such that even smaller fingerlings are sold at these prices. The same applies to sea bass fingerlings for pond culture. These come from Thailand and prices have risen from MYR 0.20 (USD 0.06) to 0.60-0.70 (USD 0.2 to 0.23) each for 3-inch fingerlings.

"We get our one inch pompano fingerlings from China whereas local hatcheries in Penang and Perak supply 2-3 inch (5-7.6cm) fingerlings for the red and golden snappers, each at MYR 0.85 (USD 0.3) and MYR 1.2 (USD 0.4) respectively.

Reference
Pawiro, S. 2012. Live grouper trade, market and supply trends in Asia. Infofish International 1/2012. pp8-10

Asian seafood: changing trends

Regional trade in seafood has been active in the past year with high prices and China's role as a major importer, according to experts at this special session on trade and certification.

Cooked head on shell on shrimp (HOSO), Malaysia

Live marine fish in restaurant, China

Global seafood production has been increasing from 124 million tonnes to an estimated 152 million tonnes in 2011, said **Helga Josupeit**, senior fishery officer, FAO, Rome at this special session held on 16 November, 2011 in Kuala Lumpur, Malaysia. The session was organised by the Malaysian Fisheries Society and Department of Fisheries Malaysia and was part of the joint Malaysian International Seafood Exposition (MISE) and Third Symposium on Cage Aquaculture in Asia (CAA3).

"Aquaculture provided 51 million tonnes in 2008 and is 62 million tonnes in 2011. Shrimp is still the leading seafood trade commodity and now it is mainly from aquaculture.

Only recently, has tilapia and pangasius identified itself in the seafood international trade. The main importing region is the European Union (EU) at 24%. The top importers are Japan and USA at 14% and 13% respectively and China is slowly featuring itself as a major importer too. In general, the buying is still concentrated in the developed world whilst 80% of production comes from the developing countries.

"Although shrimp is the largest commodity at 17%, we still need to classify whether it is from aquaculture or from wild fisheries. What we do know is that the global economic situation is helping this market. High prices have been the feature in 2010 and 2011," said Josupeit. In the markets for seafood, Josupeit discussed the position of tuna, ground fish and cephalopods which are mainly from the fisheries sector. Prices of cephalopods rose in 2011. The forecast is that in 2011, the value of global seafood trade will be USD 108 billion.

"In international trade, the main change has been the sanitary requirements of the major importers (EU, USA and Japan). The trend is towards the introduction of risk-based systems in importing economies which is driving the general adoption, particularly in the larger member economies. These systems are founded on an analysis of the risks through a risk assessment as the basis for risk mitigation and management and this is followed by communication to consumers."

Another issue is tariffs. Although these have been reduced over time, today, the average tariff is 4.5 % on fish imports by developed countries. However, tariffs increase with value addition and depend on species such as 24% in Switzerland for tuna. Certification and labelling is playing a larger role but at the end of the day, little information is still available for consumers. Certification schemes are plenty now and these are also voluminous in their requirements. Many show considerable emphasis on environmental aspects.

Market trends in Japan

The market in Japan changed after March 11, 2011 with the double disaster; tsunami and post tsunami radiation threat. **Goichi Sakita**, assistant general manager, Texchem Food Sdn Bhd, Penang, Malaysia presented these as loss in supplies, changes in local consumption as well as what happened to Japan's seafood exports in world markets. He listed the damage as 22,000 fishing boats destroyed and out of 2,108 processing plants, 135 were flooded, 586 completely damaged and 106 partially damaged in 7 prefectures. Aquaculture farms in six prefectures reported a loss of JPY 131 billion. Fisheries affected were those for oyster, wakame seaweed, scallop, salmon/trout, sea urchin,

Helga Josupeit

Jean-Yves Chow

Goichi Sakita (left) and Ahmad Hazizi Aziz

squid, mackerel and koi production.

"Prior to March 2011, consumers in Japan were confident on the safety of local seafood. The fear of radiation in food pushed Japanese consumers to eat seafood at home and sales of bento lunch boxes in supermarkets and convenience stores increased whilst restaurant sales went down. Japanese consumers were so cautious on seafood from Tohoku area and chose frozen fish imports from overseas, especially from China, Taiwan.

"Consumers feel safer eating farmed fish than wild caught from the sea. Exports of fresh fish dropped following lower demand. Authorities in several countries such as Hong Kong and Malaysia, requested radiation checks on food including seafood from 7 neighbouring prefectures and also certificates of origin. Some imposed a total ban on imports.

"There was increased concern on food safety and traceability. Supermarkets took steps to show radiation readings at stores as well as specify where the fish was caught," said Sakita.

China seafood: Where will be the new value added flows?

"There are several misperceptions on the seafood industry in China. If we only scratch the surface, it could be easy to assume that China is a pure commodity market, the seafood factory of the world thanks to its cheap labour and without any value added products. However, China has entered into a new trade dynamics, "said **Jean-Yves Chow**, senior industry analyst at Rabobank International in his presentation with the above title.

"In fact, the realities are that China, will be the largest premium high end market and supply is already switching to serve the domestic market. The industry in China is rapidly moving from this simplistic model of 'factory of the world' to a 'China with value added' model integrating domestic growth and new trade flows.

"The drivers of change will be the rising population of middle class consumers, more organised channels of distribution towards supermarkets and food service outlets, and the double edged sword of China's rising income and thus labour cost. This will reshuffle China seafood industry. In such a changing environment, China's trade relationships with its neighbours definitely are changing."

Chow explained that the premium market is demonstrated by the demand for tuna and consumer's hunger for salmon currently supplied by Europe. In restaurants in Beijing and Shanghai, the high end grouper dominates the steamed fish menu. The seafood trade is moving inwards.

China has the largest savings per capita and as income increases, this will be channelled to seafood consumption, traditionally accepted as the luxury food. The 200 million migrant population within China have begun to have access to premium and westernised products in supermarkets. Quick service restaurants already serve innovative shrimp burgers on their menu. In dining out, the consumption of seafood and meat is rising. As consumers become more sophisticated, it is expected to emulate the trend in Japan and demand organic and functional foods and emphasise on food safety and hygiene.

However, the question is how long China can be the factory to the world as incomes are rising. "The majority of premium seafood such as whitefish, salmon and tuna are sourced out of China. Companies see the need to strategise to get supplies, thus leading Asian seafood players will definitely increase strategic outbound acquisitions." In China, the seafood industry is already consolidated and branded seafood is already a feature in China's seafood landscape.

Seafood trade in Asia

Global trade on fish and seafood recovered in 2010 after the dip in 2009. The direction of trade matched the economic status of various markets. Imports increased in the traditional developed markets of Japan, US, EU, and Australia compared to 2009 but at a slower pace. The upward trend continued into 2011, said **Fatima Ferdouse**, INFOFISH. Based in Kuala Lumpur, Malaysia, this non-profit intergovernmental organisation monitors international fishery trade and provides market information on global seafood trade.

"The combined import value of the 14 leading seafood markets was 18% higher than in 2010. Import growth was significantly higher at nearly 40% in Russia, 28% in Brazil and 24% in South Korea. Higher exports were reported from China, Norway, Thailand, Vietnam and India, all of which were supported by increased supplies from aquaculture.

"Evidently, it is the emerging markets in Asia, Latin America and Africa that is being explored due to the rising consumer

Figure 1. Imports in traditional emerging markets.

Major Markets	USD Billion			
	2008	2009	2010	% change 10/08
EU (Extra)	23.62	21.25	22.67	- 4.02
Japan	15.09	14.66	15.53	+ 2.92
USA	14.23	13.32	14.57	+ 2.39
China	5.19	5.04	6.27	+ 20.8
RP Korea	2.84	2.74	3.09	+ 8.80
Hong Kong	2.42	2.54	3.08	+ 27.27
Thailand	2.39	1.94	2.12	- 11.30
Russia	2.22	1.76	2.16	- 2.70
Canada	1.90	1.91	2.10	+ 10.53
Australia	1.01	1.00	1.17	+ 15.84
World Total	101.80	99.00	110.00	+ 0.20

Goichi Sakita, Fatima Ferdouse and Jean Yves Chow.

In the audience, Martin Guerin, general manager at Gold Coin Holdings, Malaysia (left) and Oliver Decamp, Inve Aquaculture, Thailand

demand and better prices compared to the traditional western markets. In 2010, imports into Hong Kong and China reached USD 3.08 billion from USD 2.4 billion in 2008 and USD 6.27 billion from USD 5.2 billion in 2008, respectively. Prices of farmed marine shrimp, pangasius catfish, tilapia and carps all increased in domestic and export markets in 2010 and this trend continued into 2011. Shrimp prices were 30-39% higher over the period from November 2007 to June 2011.

Within Asia, imports have been increasing and in particular two-digit growth rates in China, Hong Kong, South Korea, Malaysia, Singapore and India (Table 1). In China, high value food fish imports increased significantly in 2010 and that for live fish was 161% and that for fresh and frozen shrimp was 36.5%.

In 2010, Hong Kong's imports increased by USD540 million to USD 3 billion. Some significant imports were live fish at 40,857 tonnes in 2010. During January to September 2011, nearly 600 tonnes of live food fish were imported from Malaysia. Imports into South Korea, mainly fresh/frozen, crab and cephalopods increased by 20% and China dominated with a 30% market share. Vietnam, Thailand and Indonesia are the main suppliers from ASEAN in South Korea. Malaysian exports also increased to Australia in 2010 at USD 30 million, a threefold increase for the 2007 to 2010 period.

"The Asian shrimp market has been active with high demand. Imports with the region have increased with shrimp consumption of 2.5 million tonnes in China, 100,000 tonnes in Malaysia, 50,000 tonnes in Thailand and 20-25,000 tonnes in Vietnam. Consumption is rising in Indonesia but in India and Bangladesh, the preference is still the freshwater prawn. The East Asia demand is rising and South Korea imported live shrimp from China. Australia imported value added shrimp from Malaysia. China's shrimp market continues to grow but its influence as an exporter on the international market has weakened by the increasing demand from domestic markets."

"Actually it has been freshwater aquaculture which has been the main driver in national food security and foreign fishery trade," said Fatima. "Prices were higher too, such as the *Clarias* or walking catfish price in Malaysia. Tilapia also enjoyed good prices and pink tilapia has replaced red snapper in many seafood restaurants. The global export value of tilapia and pangasius catfish crossed USD 1 billion supported by increasing consumer demand in large, medium and small markets worldwide. There is increasing farming of tilapia with high value freshwater prawn in South and Southeast Asia. Some 40,000 tonnes of the pangasius fillets is sold in Asian markets.

Fatima concluded that the rising middle class in developing markets are likely to contribute to robust growth in the next five years such as South Asia's 7% annual growth. There are also small markets coming up in the developing world and with increasing domestic demand in producing countries, these will support greater inter-regional trade in Asia, Africa and Latin America.

Ecolabels and certification

According to Josupeit, the list of ecolabels is long, from those set by NGOs such as Marine Stewardship Council (MSC), Earth Island 'Dolphin-safe' tuna and International Dolphin Conservation to programs such as Friends of the Sea (FOS) and Naturland and those set by governments.

"Large scale processors whose today and future business is dependent upon the sustainability of their seafood supplies have entered into the arena for sustainability. The highest the corporate reputation and brands image are, the more intense their actions on the field. Furthermore, to overcome head-on competition with the private brands they must keep ahead with corporate social values," said Josupeit.

"In the ecolabel issue, the trend is 'if our clients want it, we will get it for them', such as with MSC certified products. Being certified is costly, when the price premium is not guaranteed and going through the full process for certification requires much effort, time and competence that may be lacking. It is also unfortunate that there are too many certifiers around proposing different standards and there are also too many labels, and the consumer is confused, what the differences are and whom to trust."

Malaysia's seafood trade to the EU has been affected by constraints in meeting requirements on food safety and traceability set by the European Commission. Certification allows for better market access said **Ahmad Hazizi Aziz**, Department of Fisheries Malaysia (DOF). In the Malaysian marine fish cage culture industry, where total production in 2010 was 34,154 tonnes valued at MYR 559.2 million, only 37 farms have been registered with the DOF. For this they need to have compliance to Good Aquaculture Practices (GAqP). The Fish Quality Certification shows that there is compliance to export to the EU.

In aquaculture, DOF has established three certification schemes based on GAqP. There is the Fish Quality Certificate (FQC), SPLAM (Malaysian Aquaculture Farm Certification Scheme) for commercial farms and SAAB (good aquaculture practices for small scale farms). The different schemes depend on the size of pond/cage areas and annual production. Under SAAB, biosecurity requirements such as reservoirs, foot bath etc. will not be required.

As there are too many certification programs, which can be confusing for industry to follow, Ahmad Hazizi believes that FAO should lead with certification. He added that the Malaysian program imposed on her industry is equivalent to several international standards and to that of Thailand, except Malaysia is not marketing

Food safety monitoring in China

Over the last two years, with the intensified emphasis on food safety, the National Centre for Quality and Testing of Aquatic Products (NCQSTAP) has received considerable funding to upgrade its facilities for the monitoring of pathogens, heavy metals and contaminants in aquatic foods in Shandong Province, North China. The centre is part of the central government.

China is a leading producer and exporter of aquaculture products. At the national level, China wants to improve its food safety record. Wang Yutang, National Fishery Technology Extension Centre, Ministry of Agriculture at the 2009 EU-China Workshop on Environmental Sustainability in Aquaculture said that with increasing concerns on environmental impact and on food safety and quality, both for exports and local consumption, China has in recent years quickened the pace in the development of relevant laws and regulations in order to ensure food quality and safety in the country.

The main laws governing food safety include those on agricultural product quality safety, food safety and fisheries as well as special provisions of the state council on strengthening the safety supervision of food and other products. Other laws relevant to the industry are on the entry and exit of animal and plant quarantine, administrative provisions on feed and feed additives, and regulations on the administration of veterinary drugs. All these laws and regulations contain specific provisions on food safety, and provide a solid base for the legitimate promotion of healthy aquaculture in China.

Servicing industry

In recent years, the need for rapid intervention in food safety and pollution monitoring has been enhanced not only because of reports on contamination in exports but also at the production level. Shandong Province is a top producer of farmed marine fish, scallops and seaweed. Some of the largest producers of scallops, sea cucumbers and marine fish are located in the province. With Liaoning Province, it leads the fish processing industry in China.

NCQSTAP is the only national quality inspection agency in China and is affiliated with the Yellow Sea Fisheries Research Institute (YSFRI) in Qingdao. It is accredited by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ) and authorised by the Ministry of Agriculture (MOA). The centre has been designated as the responsible agency for overseeing standards and specialised work in aquatic product processing. The secretariats of the Aquatic Product Processing Technical Subcommittee of the National Aquatic Standardisation Technical Committee and the Aquatic Product Processing Technical Subcommittee of the Nation Food Industry




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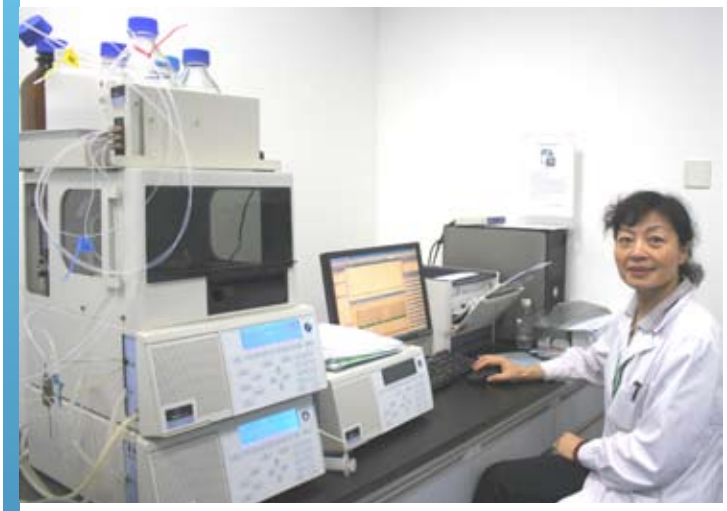


Dr Shang de Nong analyses amino acids in samples from the region's food industry.

Standardisation Technical Committee are affiliated with the centre.

"Here in Shandong Province, the main food safety issues are with shellfish poisoning and contamination from metals and microorganisms. Our responsibility at the centre is to monitor and analyse samples which come to us from seafood producers, importers or extension and enforcement agencies. In cases where there are violations in food safety and hygiene, the local Fisheries Bureau will then carry out the enforcement," said Dr Jiaxin Chen, director of the centre.

There are 20 research and technical staff working in the centre operating 40 sets of modern equipment, a business office and dedicated laboratories. Researchers at the toxin detection and risk assessment section screen pathogens in aquatic products ranging from bacteria to fungus and viruses in fish, shrimp and shellfish. With bacterial contamination, they look for *Listeria* and *Salmonella* poisoning. Some of the detection work showed viral infections in oysters harvested in the province. The centre also screens toxic metal contamination in seafood such as lead, cadmium and mercury. With atomic absorption spectrometry, the team also analyses both organic and inorganic arsenic poisoning.

The liquid chromatography/mass spectrometry (LC/MS) is used to detect contaminants including antibiotic residues such as chloramphenicol and nitrofurans and others such as malachite green. The monitoring also includes pollutants in sediments along the coast of the Yellow Sea and naturally occurring toxins such as paralytic shellfish poisoning (PSP) or red tides. An ultra high performance liquid chromatography (UHPLC) gives a faster rate of analysis as well as detection at ppb levels. A new amino acid analyser provides amino acid profiles for ingredients and products. Molecular spectrometry is used to quantify levels of food additives as well as petroleum residues in food.

Monitoring

Aside from its regular analytical work, the centre is also working with authorities to determine the limits for toxic metal contamination in sediments in the coastal areas. An interesting finding arising from the work at the centre is the high absorption levels of arsenic in kelp farmed in the Yellow Sea as compared to those in the south of the country. However, despite the long history of contamination, there have been no reports on adverse effects on the local population.

8th Philippine Shrimp Congress

Proven Technologies and Promising Innovations

20 12

May 9-12, 2012 at La Planta Hotel, Bacolod City, Philippines

The Philippines is now following a different path from its neighbours and is finding both the cultivation of *Penaeus monodo*n and *P. vannamei* as necessary for the development of its shrimp industry. The archipelago has the highest power and transport cost in Asia bringing up shrimp production cost to be highest in Asia. The strategy that is now working for the Philippines is to produce the *P. vannamei* for the domestic market, and the bigger native *P. monodon for the export market*.

It is estimated that in 2010, vannamei shrimp farmers produced for the local market at least 10,000 tonnes of shrimp with demand continuing to grow. Philippine black tiger shrimp on the other hand is increasingly becoming a high value export niche for the country as neighbouring countries in Southeast Asia are finding it more and more difficult to farm the species.

Scientific advances in grow-out and hatchery technology is regaining investor confidence in the shrimp farming. With over 160,000 ha of brackishwater farms in the country, the economic potential of the shrimp industry, as a source of export revenue and as a platform for rural aquaculture development is tremendous.

This biannual event with the theme "Proven Technologies and Promising Innovations" will feature technology successes and new developments in *P. monodon* and *P. vannamei* culture from around the region. The congress will also highlight on marketing and value adding opportunities with invited foreign resource persons. Additional topics of interest for this year's congress as requested by Philshrimp members are crop insurance and financing.

The 3-day congress will be attended by local and foreign experts and is estimated to draw no less than 400 industry leaders and practitioners engaged in grow-out farming, hatchery operations, feed milling, processing/exporting, and input supplies. It is organized and sponsored by the Department of Agriculture- Bureau of Aquatic Resources (DA-BFAR Central Office), BFAR VI, DOST Region VI, Negros Prawn Producers Marketing Cooperative Inc, SEAFDEC and UPV-CFOS. Sponsors are local and multinational companies comprising B-MEG, Biosolutions Int'l, BNH Marketing, HOCPO Feeds Corp, Charoen Phokphand Philippines, Bayer Animal Health Philippines, Santeh Feeds Corp, Uni-President Enterprises Corp and Lallemand SAS

More information: Tel: +34 433-2131 or 0920-908-4620 (Secretariat, 8th Philippine Shrimp Congress).

Gourmet tilapia

Gourmet Aquatic is a fully integrated producer and exporter of tilapia with a farming area of 100,000m² and a facility cold storage of 5,000 tonnes in Tanba, Wuchuan City. It has a processing capacity of 20,000 tonnes annually and products include whole round fish and frozen, breaded, smoked and seasoned fillets. The export markets are US, Africa and Russia.

Although its parent company, Zhanjiang Guolian Aquatic Products, based in Guangdong, has been involved in tilapia production since 2004, it is with the new Gourmet Aquatic brand that the company aims to be a leading tilapia player in the country. The company expects to reach this goal by the first half of 2012 when a new processing facility comes online.

"There will also be the expansion of the grow-out areas for the tilapia and feed production. In feed production, we will add 3 more plants to reach a capacity of 700,000 tonnes of feed for the marine shrimp and tilapia at Zhanjiang Guolian Feed Co Ltd. The feeds are for our farms, contract farms and the free market. We expect feed sales to reach 300,000 tonnes per year," said Bob Liao, president assistant.

Sales of the tilapia have been good. Tilapia is farmed in ponds and circular cages in Wuchuan City, near Zhangjiang. Demand for the tilapia is increasing and tilapia destined for export markets is produced from CIQ (China Inspection and Quarantine) registered farms. Tilapia prices rose in 2011 to USD 1.45/kg for fish weighing more than 500g and USD1.15/kg for smaller fish. Prices depend on the farming situation and market demand.

"These farms follow the new electronic supervision and management by CIQ. We also have the necessary equipment for the analysis of contaminants, bacteria and chemicals such as the LC MS-MS, Charm 117600 antibiotic residue detector and atom fluorescence photometer to ensure product quality. The Wuchuan Tilapia farming base has been certified by Best Aquaculture Practices," said Liao at the Guolian booth during the China Fisheries and Seafood Expo in November in Qingdao.

The attraction for tilapia producers is also the expanding local market. The live market is not large and demand is for value added products such as breaded and tofu coated seafood. Another popular ready-to-cook item is fish balls for the Chinese hot pot dish. The tilapia skin serves as raw material for conversion to biotechnology products at the Zhanjiang Guolian Biological Technology Company.

Southern International Aquatic Trading Centre

Working with the Zhanjiang government, Guangdong Province, Zhanjiang Guolian is promoting the South China International Aquatic Centre which is located in Haitain CBD, Zhanjiang City. The Centre is relying on the China-Asean Free Trade to draw participation from the region's seafood producers, importers and exporters.

The Centre is on 200 ha of land, of which 80 ha have been developed with a 100,000m² building equipped with a 1,000 tonne capacity ice factory and 20,000 tonnes bonded warehouse. The Centre will include zones for the wholesale trading of frozen shrimp, chilled seafood, dried shrimp and semi-finished products. In addition, there will be a business hotel, a place for gourmet seafood marketing and an international seafood exhibition hall.

To attract participation from ASEAN countries, the company will also build an ASEAN business zone, maintain a database of global seafood traders and hold an Asian aquatic products forum. It has also established a Hong Kong export centre, entry-exit joint testing centre, product testing centre and a third party logistics management.

Overall, the aim is to create an aquatic trading platform and to be the largest ASEAN seafood collection and distributing centre in China, the largest shrimp material collection centre in South China, and the largest frozen food cold chain bonded warehouse base in West Guangdong.

Strengthening the aquaculture business in Vietnam

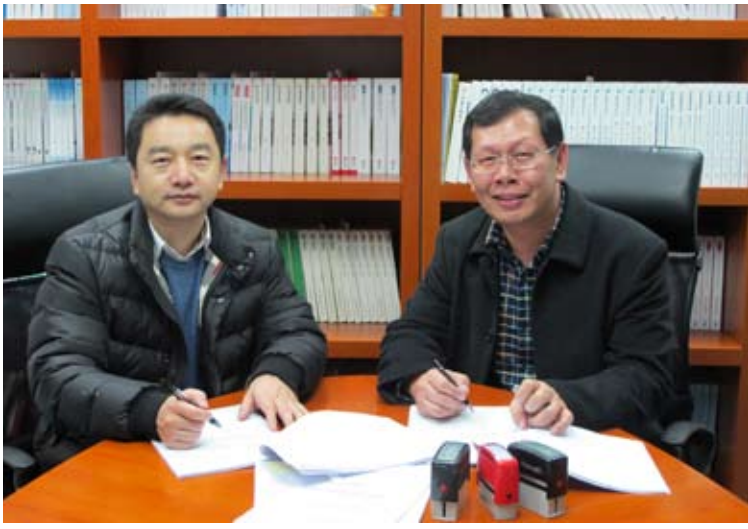
Sheng Long Bio-Tech International Co., Ltd has tied up with Guangdong Haid Group, a China-based company, to further strengthen the development of its aquaculture business in Vietnam.North China. The centre is part of the central government.

On 9 February 2012, a mutual agreement was signed by Xue Hua, president of Haid Group and Jeff, Jie-Cheng Chuang, general manager of Sheng Long Bio-Tech Int'l Co., Ltd.

Sheng Long Bio-Tech, was established in 2003 in Vietnam and is one of the leaders in aqua feed manufacturing with an annual capacity of 40,000 tonnes. It also specialises in cold storage and probiotic products. The Haid Group, is a leading agricultural business in China, employing 9,600 people in 40 subsidiaries and operates 50 fish/shrimp hatcheries, 6 research centres and 5,000ha of production areas countrywide. In 2011, the total feed production of the group reached 3.5 million tonnes, of both animal and aqua feeds. In the case of aqua feeds, annual sales volume was 1.7 million tonnes, including 1.4 million tonnes of freshwater and marine fish feeds, 300,000 tonnes of shrimp feeds and 20,000 tonnes of premix and additives. The Haid Group also produced 10.5 billion post larvae and 9 billion of fish fingerlings in 2011.

With this tie-up, Chuang said, "We are pleased to enter into this alliance with Haid Group, especially as Haid is a high-tech reputable company with diversified products, excellent technical services and marketing strategy in the aquaculture business. The cooperation will benefit both companies; it will help consolidate our position in the aquaculture business in Vietnam and create an opportunity for the Haid Group to source increasing high-value seafood for the China market in the near future."

As a result of the high demand for aqua feed in Vietnam, Sheng Long Biotech will be setting up a new feed mill with a production capacity of 130,000 tonnes of shrimp feed and 50,000 tonnes of extruded marine fish feeds in 2013. Additionally, this co-operation will extend to its aquaculture business in other Southeast Asian countries such as Malaysia.



Xue Hua, president of Haid Group and Jeff, Jie-Cheng Chuang, general manager, Sheng Long Bio-Tech Int'l Co., Ltd. (right)

"Sheng Long Bio-Tech will provide integrated functional services to its feed users including probiotic water treatment, quality shrimp seed stock and cost-effective shrimp feeds. They will also benefit from the successful experience and support from the Haid Group", said Chuang.

The 2011 meeting of Sheng Long Bio-Tech agents at Guangzhou, China.

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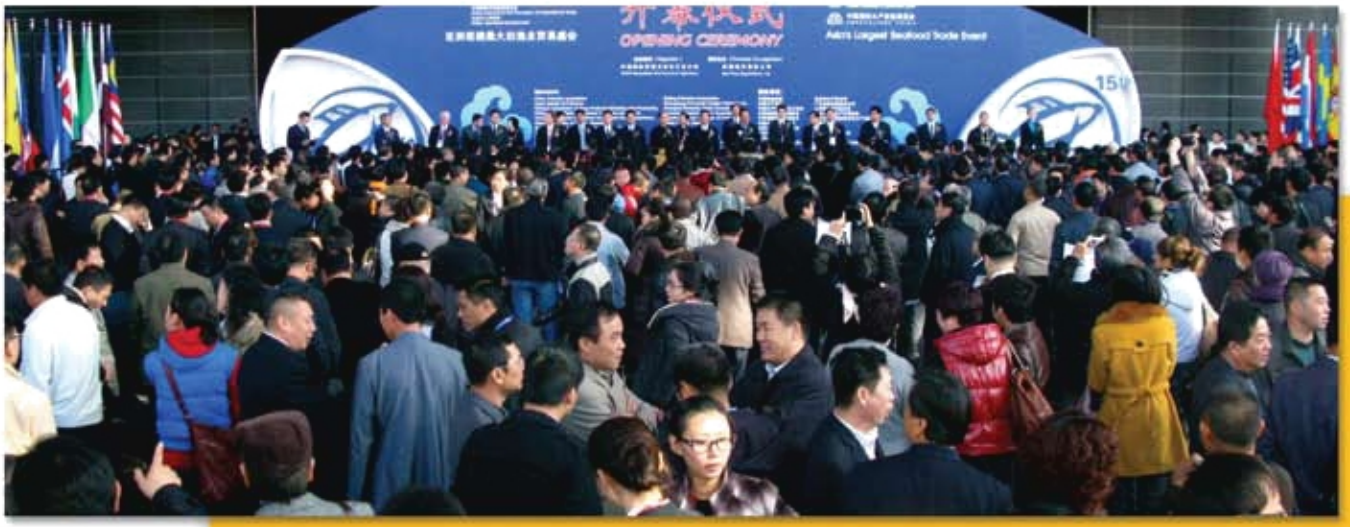

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Company strengthens the aqua team in Asia Pacific with experts

Nutriad, a global specialist in the development, manufacture and marketing of feed additives recently increased its focus on aquaculture by reinforcing its Business Unit Aquaculture with regional experts located in all major aquaculture regions.

In the Asian Pacific region, Nutriad recently appointed **Allen Ming-Hsun Wu** as regional manager Aquaculture. He will be mainly responsible for specialised technical support to customers and distributors in the Asia Pacific region for Nutriad's portfolio of aqua additives and work closely together with the commercial teams in the different countries.

Wu has a Masters of Science in food science from the Aquaculture Nutrition Laboratory of the National Taiwan Ocean University and worked for 10 years in Uni-President Enterprises Corp., Taiwan in various positions related to aqua feed formulation, R&D and overseas sales, both in Taiwan and Vietnam. Wu is a member of the World Aquaculture Society.

Nutriad offers species-specific R&D capabilities, innovative products and nutritional/technological expertise for the aquaculture industry. Its Business Unit Aquaculture emerged in 2009 from the merging of know-how and expertise from two core business units of the INVE group: INVE Aquaculture and Nutriad. The current product portfolio is focused on specialty additives developed through years of research under lab trials and field verification under production conditions in the field.

Specialties offer solutions to key issues in aquaculture and include AQUAGEST® (species specific digestibility enhancers to reduce feed cost and improve performance in different species of fish and shrimp), AQUABITE® (palatability enhancers and attractants), and a broad range of additives to support the prevention of diseases and parasitic infections (SANACORE®, AQUASTIM®, APEX®AQUA). In addition, Nutriad offers a diverse additive portfolio for aquaculture including programs for feed preservation, neutralising the effects of mycotoxins, and specialised pellet binders for aqua feeds.

"This recent incorporation of regional aquaculture specialists complements our existing scientific and technical teams to support our commercial network in the key aquaculture markets in Asia, Europe and America", said Dr Peter Coutteau, business unit manager Aquaculture for Nutriad. "The aqua feed industry is expanding extremely fast and maturing from a young, pioneering industry into a more professional feed industry. Nutritional know-how is still far more limited compared to agrifeed milling, whereas a much wider variety of fish and shrimp species is being farmed. An increasing degree of specialisation is therefore required to be able to respond to the dynamic environment of horizontal and vertical integration. To assist the feed industry for taking up these challenges, Nutriad is now in a position to offer professional and innovative products and services close to the main aquaculture customers."

New business development and market manager

Stephane Ralite has joined the aquaculture team as business development/market manager for Aquativ/Aquasea. Aquativ is part of the French group, Diana, a leader in the natural ingredients market. Diana has subsidiaries in all every continent. It is also a world leader in petfood palatability products and has more than 30 years of experience in the hydrolysis process. This unique experience allows the company to develop some new solutions and propose specific raw materials based on marine products with specific functionality in terms of nutrition, consumption enhancing effects and bioactivity.

Ralite will support the development of this activity in terms of strategy definition, product positioning, market evaluation and to develop some new subsidiaries and partnership. Ralite joined the group after 12 years working with the Evialis/Invivo group to create a new aquaculture activity under the Ocialis brand (Contact: Email: sralite@diana-aqua.com; Tel:+33 297 93 13 81 Fax : +(33) 297 93 80 41; Web :www.aquativ-diana.com; www.diana-group.com)

Following the resounding success of TARS 2011 we bring you the second in the series of

THE AQUACULTURE ROUNDTABLESERIES 2012

TARS 2012
The Aquaculture Roundtable Series
15-16 August 2012

A shared vision for aquaculture in Asia

SHRIMP AQUACULTURE – SHAPING THE VALUE CHAIN

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

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

An unprecedented opportunity for Multiple Stakeholders!

As one of the industry's foremost opinion-leading events, TARS 2012 aims to take a holistic approach to tackle these challenges. The meeting presents a neutral forum for multiple stakeholders to come together, and through shared knowledge and expertise, provide substantial input to improve the sustainability of shrimp production in Asia. This will be critical as the industry faces economic uncertainties and vulnerabilities resulting from the changing market conditions, including food safety and quality standards, and the threat of diseases.

Dialogue with Experts!

Plenary Session – Where Are We Today?

A host of international experts will present an overview of the state of the shrimp aquaculture industry, current knowledge, trends and emerging challenges impacting the various segments of the shrimp value chain in Asia and the global arena.

Breakout Session – Where Do We Want To Be Tomorrow?

Breakout groups will deliberate on challenges, identify opportunities, and propose strategic directions to steer the sector forward. The discussions will focus on:

- breeding and hatchery management
- culture and health management
- feeds and feeding
- marketing, branding and certification

Organisers:

AQUA CULTURE Asia Pacific

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The Total Communications Company

For more information on TARS 2012, visit **www.tarsaquaculture.com**

Purchase of inline analysis systems

Inline sampling and real time analysis becomes key to full integration

In February, the Wenger Extrusion Group (comprising Wenger Manufacturing, Inc., Extru-Tech, Inc., and Corporate Project Services) announced the acquisition of Source Technology A/S, the leading provider of inline analysis systems used in food and feed manufacturing.

Source Technology with its headquarters in Kolding, Denmark, supplies inline sampling and analysis systems to four key industries involving pellets and powders. The company leverages its innovative expertise to help manufacturers enhance product quality, improve energy and operational efficiencies and increase food safety regulation compliance. Typical applications for Source Technology inline analysis devices include measuring of bulk density, tap density, moisture content, product sizing, particle sizing, NIR analysis, burned particle detection, color intensity, dust testing, durability testing, floating test and much more.

The Wenger Extrusion Group, with its headquarters in Sabetha, Kansas, is a global designer, manufacturer and full service provider of extrusion processing systems. The acquisition of Source Technology will strengthen their ability to provide a full scope of automated extrusion technology systems with enhanced process control. Wenger systems are installed in over 90 countries, and are supported through 330 extrusion-specific professionals based in twelve global locations. Wenger manufactures and supports the industry's most comprehensive series of extruders, dryers and controls for the commercial production of pet food, human food, aquatic and livestock feeds. More information: L-bailey@wenger.com (Lafe Bailey, Wenger vice president of Sales and Services); www.wenger.com

Aquafeed Innovation Awards

In a ceremony during Victam Asia 2012 in Bangkok from 15-17 February, publisher of Aquafeed.com, Suzi Dominy presented the Aquafeed Innovation Award. The award recognises the creativity and ingenuity of the supply sector in meeting the very specialised needs of the aquafeed manufacturing industry. The awards were judged by a panel of feed industry professionals with a wealth of experience. They represented the industry worldwide. The first Aquafeed Innovation Award went to Wenger Manufacturing's Extrusion System for high capacity small diameter aquafeed (see page 16).

A strong field of contenders resulted in Highly Commended Awards in two categories: technology and ingredients and additives, said Dominy. The Highly Commended Award for feed technology recognised Geelen Counterflow for its Postconditioner MkII. The Highly Commended Award for feed ingredients and additives was awarded to Dr. Eckle for its product AntaPhyt Aqua, a customised combination of organic acids with special plant extracts and other components that were specially developed for their palatability and efficacy in aquaculture.

The winning entries will be describes in detail in the Spring issue of the Aquafeed.com magazine: Aquafeed: Advances in Processing & Formulation.

New Postconditioner

Geelen Counterflow's new postconditioner for pelleted shrimp feed is a new double deck postconditioner which provides high temperature conditioning after pelletising the shrimp feed, before drying and cooling. Thanks to extensive insulation, electrical heat tracing and steam injection, the product temperature inside the postconditioner is kept well above 90°C. The availability of moisture in the product (typically 16-20%), time (30-90 minutes) and temperature (over 90°C) leads to excellent starch gelatinisation and water stability. Improved water stability avoids dissolving of the feed before take-up by the shrimp. This reduces cost and decreases pollution levels of the ponds.

GLOBALG.A.P.
SUMMIT2012 Good Agricultural Practice
6 – 8 November | The 11th GLOBALG.A.P Conference | Madrid, Spain

This 11th GLOBALG.A.P conference Summit 2012 will be in Madrid, Spain from 6-8 November 2012. It will be a meeting and networking with top international retailers, food service and producer members. It will be the venue for debate on how to mainstream safety and sustainability in agricultural production for today and in the future. During the breakout sessions, there will be sharing of knowledge and participants can benefit from thought-provoking presentations from internationally reputed industry experts.

According to the organisers, plenary and breakout sessions expose participants to new ideas and perspectives on managing food safety. There will be great speakers and experienced food safety professionals sharing their knowledge and challenge the thinking in this ever changing world.

GLOBALG.A.P. is a private sector body that sets voluntary standards for the certification of production processes of agricultural (including aquaculture) products around the globe. The standards are primarily designed to reassure consumers about how food is produced on the farm by minimising detrimental environmental impacts of farming operations, reducing the use of chemical inputs and ensuring a responsible approach to worker health and safety as well as animal welfare.

New Compound Feed Manufacturing Standard Version 2.1

Recently, a new Compound Feed Manufacturing Standard Version 2.1 was launched. After an intensive multi-stakeholder consultation process, the revision of the GLOBALG.A.P. Compound Feed Manufacturing Standard has been finalised. Proposals for amendments of the version 2.0, which was published in 2010, were forwarded by various groups, including retailers, certification bodies, NGOs, and representatives from the milling industry.

These proposals were discussed and validated by the GLOBALG.A.P. Technical Committees for Livestock and Aquaculture and the public consultation finalized the process. Members of GLOBALG.A.P. Aquaculture Technical Committees include Scottish Sea Farms, Skretting/Nutreco, Seachill, Anova Food BV, Ahold, El Corte Ingles, Tesco, METRO Group, Marine Harvest Pieter, Young's Seafood, Heiploeg BV, Marine Harvest, A.Espersen, ASDA, Cumbrian Seafoods and REWE.

A new section entitled "Responsible use of natural resources" was integrated. It contains 5 control points with adherent compliance criteria. A holistic search for best proactive solutions was requested for the protection of the marine ecosystem.

Based on the intensive work performed by the National Technical Working Group of Norway, highly sophisticated and challenging solutions for this issue have been approved. The criteria for the sustainable sourcing of fishmeal and fish oil for compound feed manufacturing to feed aquaculture species and monogastric livestock species are integrated now.

The new Version 2.1 was published in December 2011. It is valid starting January 2012 and will become obligatory by June 2012. The Version 2.1 documents are available on the GLOBALG.A.P. website: www.globalgap.org. More information: Dr. Roland Aumueller (aumueller@globalgap.org)

Bioremediation in pond based aquaculture systems

AquaInTech Inc, USA, markets, microbiology based tools for bioremediation. Recently, it introduced a new and improved tablet PRO 4000X. This is a powerful tool to ensure that the quality of the culture environment during production and what is discharge post production is consistent with sustainable practices. While costs will vary upon application rates and specific marketing circumstances, the typically costs in the hatchery are far less than one USD per day for each 10 tonne of water, according to Dr Stephen Newman, President and CEO. "On the farm it is highly variable with costs ranging from as low as USD50.00/ha per cycle to as high as USD1000/ha or more per cycle. The client determines what application strategy works the best for them."

"Our clients have seen many different impacts from the use of the tablets with the most consistent being a visible reduction in organic matter. We recognise that each and every pond is a different environment in many respects (though there may be less variation between them in some production systems) and urge users of the product to appreciate that they control the use of the tablets and that they should determine what works best.

"The company supplies guidelines for use and the end user should determine how best to make the tablets work in their particular environment. From our significant experience with products of this nature we know that carbon can be limiting in some systems and the addition of a carbon source such as molasses or other simple sugars can promote the beneficial effect noted with our bacteria."

Newman said that the tablets are for target delivery to pond bottoms where the sludge accumulates and each tablet contains a consortium of *Bacillus* species that have been selected based on their enzyme profiles and ability to degrade organic matter and detoxify ammonia. No activation is required and tablets can be added to the tank or pond. Visibly affected spots make an excellent demonstration of the effectiveness of PRO 4000X. In the hatchery it works by competing against potentially harmful vibrios and other heterotrophic species. In the farm, it works by degrading organic matter and competing against existing microflora.

More information Email: sgnewm@aqua-in-tech.com or sgnewm@gmail.com Web: www.bioremediationaquaculture.com. Distributor enquiries are welcome.

Tablets weigh 16 grams each and contain a minimum (not the maximum) of 64 x 10^9 CFU a piece.

The Next Ten Years'

May 1 – 4, 2012, Melbourne Convention and Exhibition Centre, Melbourne Australia

Three days of plenary sessions

The aim of the plenary sessions is to focus on the next ten years of aquaculture in Australasia. The opening day on global research, and development and food security in China's largest aquaculture area will establish a strong footing for the conference.

Wednesday 2 May

The first plenary will be **"Direction of aquaculture R&D for the next ten years"** by **Dr Alex Obach**, managing director, Skretting Aquaculture Research Centre (ARC). Obach has a PhD in fish pathology and immunology and later worked as manager of the Marine Harvest Technical Centre and manager of the Health Department at Skretting ARC. He is highly regarded in aquaculture research, particularly on health and nutrition. He will also give a separate presentation during the Health session on functional health feeds.

Obach said, "Research in Skretting ARC continues to push back the boundaries on productivity and sustainability. R&D on feed is a prerequisite for tomorrow's aquaculture. In our 22nd year of operation, Skretting ARC prides itself on the quality of its staff with the majority of these having either a master's or doctor's degree. The head office in Stavanger boosts an international environment with expertise from 13 nations working there. When you visit Skretting ARC, you are transported into the future the moment you walk through the door, as they develop tomorrow's feeds and methods of fish farming."

Dr Chen Wen, director of Fisheries Division, Guangdong Provincial Oceanic and Fisheries Administration, China will present **"Guangdong's aquaculture for food security"**. Chen has been working on aquaculture technology extension, disease prevention and treatment for several years and received numerous technical achievements and awards. Dr Wen was the project director and key participant in many national and provincial projects. He is the member of the 4th Veterinary Drug Dictionary Committee of China, Board Member of the 6th Guangdong Province Aquaculture Society, and member of specialist group for remote diagnosis of aquatic animal disease.

Thursday 3 May

On day two, the plenary sessions will question, 'Just how good could this industry get if we had the right framework nationally and we had the right attitude? Speakers will concentrate on the challenge that food security in Australia brings and how the industry could attack its opportunities into the future.

"The Coming Famine Food Security and challenges in the next ten years" will be presented by **Julian Cribb**, principal of Julian Cribb & Associates, specialists in science communication.

Julian is a Fellow of the Australian Academy of Technological Sciences and Engineering and was previously director, National Awareness, for Australia's national science agency, CSIRO. In his latest book, The Coming Famine, Cribb lays out a vivid picture of an impending planetary crisis, a global food shortage that threatens to hit by mid-century, which, he argues, would dwarf any in our previous experience. Cribb's comprehensive assessment points to a dangerous confluence of shortages, of water, land, energy, technology, and knowledge, combined with an increased demand created by population and economic growth.

"Where will this Industry be in the Next Ten Years?" by **Paul McCarthy**, principle of the RockStar Marketing organisation, Melbourne

Paul has the rare ability to really connect with audiences and compel people to want to reignite their desire to take action. A former professional musician, Paul provides a unique blend of business savvy and first class entertainment. Paul is the acclaimed author of the book '8 Steps to a Remarkable Business'.

Friday 4 May

The Day 3 plenaries are sponsored by the Seafood CRC and in line with the theme of the conferences, two speakers look forward 10 years to provide us with their insights in two areas which the CRC sees as vitally important to the future development of the Australian seafood industry.

"Science innovation today and its potential impacts on aquaculture production challenges in the next ten years" by **Professor Ben Hayes**, Research Leader (Livestock Genomics), Department of Primary Industries, Victoria

Whole genome sequencing projects are already underway for several fish species. Some people say that the future of farming, including aquaculture could be substantially impacted by the power of this technology. Hayes is one of the leading experts in this field in livestock. His main focus has been on integration of molecular information into breeding programs, and breeding program design. At Akvaforsk in Norway, Hayes spent two years working with salmon and prawn breeding programs and aquaculture genetics.

The final plenary speaker, **Sam Guthrie**, general manager, Global Business Development at The Woolmark Company will present **"Trading with the woolmark brand– lessons for marketing Australian seafood in the next ten years"**

Guthrie's experiences have been in developing repositioning strategies for iconic brands and highly technical products with a particular focus on multi channelled trade and consumer targets. He will draw from his familiarity with managing global teams, stakeholders and media whilst implementing change management, very relevant to aquaculture. Guthrie's perspective will add value to the conference and provide some provocative thinking on seafood marketing.

More information: Email: sarah-jane.day@aquaculture.org.au (Conference Coordinator Sarah-Jane Day) or for European companies, Mario Stael, Email: mario.stael@scarlet.be Web: www.aquaculture.org.au.

Science responds to industry needs

As with all the events organised by the European and World Aquaculture Societies, AQUA 2012 in Prague in September will focus on how science plays a fundamental role in the development of the global aquaculture industry. The AQUA 2012 theme, Global Aquaculture: Securing Our Future, has obvious implications in global and regional food security and aquaculture trade, placing aquaculture products in the global fisheries market. It also refers to economic and environmental sustainability and the image of aquaculture activities.

As the latest AQUA 2012 advertisement depicts, the event will be a truly global one, including technical sessions that cover farmed fish, shellfish, algal and crustacean species from all climatic zones and all continents.

Exhibitors from around the world will therefore be present in the AQUA 2012 trade exhibition to display their latest products and services to the sector and several special events are being organised to facilitate communication between stakeholders – and especially between science and industry – through the Farmers' Days and through other special and additional events, such as those described below.

European Percid Fish Culture Workshop

The EAS thematic group on the culture of pike-perch, perch and other species of the family percidae for human consumption, stocking and conservation (European Percid Fish Culture – EPFC) will organise a workshop on September 1st, during the set-up and registration day of the AQUA 2012.

The tentative workshop schedule features a keynote presentation (to be announced) and three thematic sessions on broodstock management and fingerling production; on-growing and nutrition and marketing and training. In each thematic session, a selection of short presentations from industry and research representatives will give an overview of the current status and will pave the floor for a panel discussion. The workshop outcomes will be published in the EAS "Aquaculture Europe" magazine.

Aquaculture Technology and Markets Farmers' Day

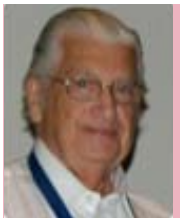
The first of the AQUA 2012 Farmers' Days will take place on Sunday, September 2nd and will focus on technology developments and market strategies. After general introductions on each of these broad topics, specific species presentations and discussions will focus on marine fish, molluscs, shrimp and tilapia.

AQUA 2012 Sponsors Aquaculture-Industry Forum

The AQUA 2012 Gold Sponsor, Biomar, the EAS Premium Sponsor MSD Animal Health and the WAS Premium Sponsor, Novus will lead a short aquaculture-industry forum that will follow the Farmers' Day, allowing them to give their inputs on the global market within the scope of the AQUA 2012 theme. This short forum will end with a special celebration, marking the 50th anniversary of Biomar.

Freshwater Fish Farmers' Day

Organised in partnership with the Czech Fish Farmers' Association, the Freshwater Farmers Day will provide a forum for presentation and discussion, focussing on the following topics: Broodstock management and reproduction; new species within inland aquaculture; new culture approach providing high quality fish product; pond carp production; sturgeon culture and biology and percid fish culture.



Message from the AQUA 2012 Steering Committee

AQUA 2012 Chairman Michael New and his hard-working team look forward to greeting you in Prague at what promises to be another of our great global aquaculture exhibitions and conferences. Abstracts are still being accepted for the conference and the provisional programme for the event will become available at the end of April.
More information: Web: www.easonline.org and www.was.org

What can you expect from Aqua Culture Asia Pacific in 2012

Volume 8 2012						
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	Sustainable & Responsible Aquaculture	Food Safety & Traceability	Culture models	Hatchery & breeding technology
Industry Review *Trends and outlook, demand & supply*	Marine Shrimp	Groupers	Catfish	Marine fish (Cobia/Sea bass)	Tilapia	Freshwater Fish/Prawn
Feeds & Processing Technology *Technical contributions influencing the final value of aqua feeds*	Feed additives Processing technology	Micro-nutrients Extrusion	Product quality Feed management	Feed enzymes Good manufacturing practices	Feed probiotics Post pellet additions	Novel feed ingredients Formulation
Production Technology *Technical information and ideas*	Pond Management & Biosecurity	Biofloc /Aeration technology	Genetic Improvement	Recirculation Aquaculture Systems	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 in prior issues*	**FIAAP Asia, VICTAM Asia & GRAPAS Asia 2012**, February 15-17, Bangkok Thailand* **Aquaculture America 2012**, February 29 - March 2, Las Vegas	**Skretting Australasian Aquaculture 2012 (AA12)**, May 1-4, Melbourne* **8th Philippines Shrimp Congress**, May 9-11, Bacolod	**Vietfish 2012**, June 26-28, Ho Chi Minh City, Vietnam	**TARS 2012 – Shrimp Aquaculture** August 15-16, Phuket, Thailand **AQUA 2012**, September 1-5, Prague, Czech Republic	**17th China Seafood & Fisheries Exposition 2012**, 6-8 November, Dalian, China	

2nd ASAIM SE ASIA AQUACULTURE CONFERENCE

Extrusion Short Course, July 8-12, Vietnam

Brings the Texas A&M Aquaculture Extrusion Short Course to Ho Chi Minh City

ASA International Marketing and the United Soybean Board organises ASAIM Southeast Asia Aquaculture Conferences. In 2012, the theme is Extrusion. Hence for the first time in Southeast Asia, ASAIM will host the Texas A&M Aquaculture Extrusion Short Course in Ho Chi Minh City, Vietnam from July 8-12, 2012.

In 2010, the first Aquaculture Conference introduced the major issues in aquaculture pertinent to the industry. Facilitated by an international group of experts, the ASAIM Southeast Asia Aquaculture Conference was the forum for sharing knowledge and experiences on improved aquaculture technologies and management systems to address food safety concerns, sustainability, and the need for eco-friendly production to maximize feed efficiency and profitability. Following this introduction, it is appropriate for future ASAIM Aquaculture Conferences to focus on specific topics, beginning with extrusion.

The 4-day training will focus on extrusion principles and application, extrusion technology, processing techniques for producing quality aqua feed, aquaculture nutrition and feed management practices. The short course will benefit large farm operators, integrators, feed manufacturers, processors, formulators and nutritionists.

More information: web: www.agri-events.com
Email: registration@agri-events.com. Registration closes on June 8, 2012.

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

February 24 - March 18
Hinter Symposium on Nutrition Feed Technology of Fish Shellfish
Email: hintermeeting@gmail.com
Web: www.hinter.com.cn

March 22-24
Ildex Vietnam
Ho Chi Minh City, Vietnam
Email: info@ildex.com
Web:www.ildex.com

March 28–31
Aquaponics Design and Technology Workshop
Apopka, Florida, USA
Email: Ponics@AquaticEco.com
Web: www.aquaticeco.com/pages/202/Institute-of-Sustainable--Farming-Aquaponic-Technology-and-Design

April 19-20
3rd Aquatech Aquaculture Expo and Convention Philippines 2012
Pampanga
Email: info@equipincinteractive.com;
Web: www.equipincinteractive.com

April 24-26
European Seafood Exposition & Seafood Processing Europe 2012
Brussels, Belgium
Email: food@divcom.com
Web: www.euroseafood.co

May 1-4
Australasian Aquaculture 2012
Melbourne, Victoria, Australia
Email: sarah-jane.day@aquaculture.org.au
Web: www.australian-aquacultureportal.com

May 9-12
8th Philippines Shrimp Congress
Bacolod, Philippines
Tel: +34 433-2131/0920-908-4620

May 20-23
Alltech 28th Annual International Animal Health and Nutrition Symposium
Lexington, Kentucky, USA
Email: symposium@alltech.com.
Web:www.alltech.com/symposium

June 7-9
Future Fish Eurasia 2012
The 6th International Fair For Fish Imports/ Exports, Processing, Aquaculture & Fisheries
Izmir, Turkey
Email: selin@eurasiafairs.com (Selin Akpinar)
Web:www.future-fish.com

June 26-28
Vietnam Fisheries International Exhibition (Vietfish) 2012
Ho Chi Minh City, Vietnam
Web: www.vietfish.com.vn

July 8-12
2012 2nd ASAIM SE Asia Aquaculture Conference
Extrusion Short Course
Ho Chi Minh City, Vietnam
Email: registration@agri-events.com
Web: www.agri-events.com

August 15-16
The Aquaculture Roundtable Series 2012 - Shrimp Aquaculture
Phuket, Thailand
Email:conference@tarsaquaculture.com
Web: tarsaquaculture.com

September 1-5
AQUA 2012
Prague, Czech Republic
Email: worldaqua@aol.com
Web: www.was.org

September 5-7
Aquamar Internacional
Cancun, Mexico
Email : coordinacion@aquamarinternacional.info
Web: www.aquamarinternacional.com

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

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