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AQUA CULTURE

Asia Pacific

India's Shrimp Industry scales new heights

Shrimp Farms in China confront EMS

Tilapia Health Challenges in Brazil

Growing with India's Aquafeed Market

Insect Meal and Oil

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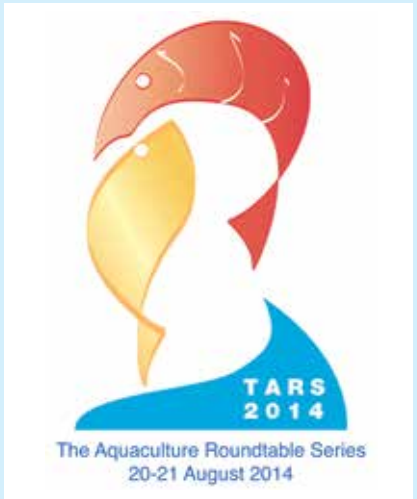

TARS 2014

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

From the editor

The middle income trap

This phrase is borrowed from global economics where emerging market economies are stuck in a trap. They cannot get out of this trap due to the legacy of being a cheap producer of export products to fuel GDP growth. Unfortunately, production costs are increasing and the country is no longer a low cost producer, yet it has not embraced industrialisation or a knowledge-based economy to advance into the next league.

Asian aquaculture seems to be facing a similiar problem. With rising local currencies and increasing labour costs, most aquaculture sectors are being apparently squeezed in the middle; where margins are narrowing and could tip into negative resulting in unsustainable business.

A good example is the marine fish sector. Margins are squeezed due to softening prices as soon as supply increases. Farmers are often attracted by high prices for live fish without realising that only the top 5% of the population can afford this. The market is also limited to the distance that fish can be transported live. By these parameters alone, the market is limited in volume. As soon as oversupply occurs, farmers look to new species hence losing focus and the support of all segments along the value chain. It is not surprising that support industries of genetics, hatcheries, feed and processing are poor as they are not able to keep up. Volume supply is driven by expansion and not productivity. The Asian seabass has shown good production as a result of better support from hatcheries to feed but it is still limited by the chilled market where the product is perishable. Processing and marketing of this fish is still in its infancy and there is no generic marketing association promoting the Asian seabass today.

A good role model may be the shrimp industry. Perhaps it is fortunate to have a strong tail wind of high prices due to demand outstripping supply as a result of diseases (EMS, etc). However, the positive driver is that as an international commodity, the demand has remained strong despite a 100% increase in price over the past year. The major contributing factor is a frozen product, widely accepted (with very little differentiation between species) and a good route to market. Another contributing factor is the industrialisation of the sector with high stocking densities, genetic improvement, and strong support segments such as feed and processing. These support segments know that the industry is here to stay and they are willing to invest in it.

The freshwater fish sector seems to lie halfway, in-between, with certain species performing better than others. The Vietnam pangasius sector was first driven by a well-developed processing segment. In a period of 10 years, Vietnam has built a new product from scratch. In the early days, the low cost of production allowed the country to introduce the fish as a cheap alternative to white fish. VASEP should be credited with the generic marketing that the marine fish sector seriously lacks. However, today, Vietnam is a victim of its own success. With increasing production, labour and financial costs and new entrants, Vietnam is finding it difficult to compete with the likes of Bangladesh in a race to the bottom. Oversupply has decreased prices from USD3.76 per kg in 2000 to less than USD2.20 per kg in 2012 according to a Vietfish International report. In October 2013, stakeholders discussed new strategies to address the situation and these ranged from production quotas to quality improvement and a single route to market (for the EU).

Our industry needs constant reminders about “staying united.” Cooperatives and associations allow for economies of scale, not only in generic marketing of species but also for technology developments. The majority of the industry comprises backyard operations and expansion can only help so much before supply exceeds demand depressing prices. Asian aquaculture should get out of the middle income trap by embracing technology to produce quality products and increase prices and industrialisation to decrease production costs.

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Living with diseases

At the Farmers day session during APA 2013, an opportunity to learn more on the efforts to combat EMS and other shrimp diseases

Franky Lee, General Manager of Uni-President Vietnam (front row, third left) and his team with speakers; Front row, from right, Wang Han-Ching, Grace Lo, Yew-Hu Chien, Donald Lightner and Nguyen Van Hao

Vietnam is one of the countries hardest hit by the early mortality syndrome (EMS) in shrimp which was first reported in April 2010 in Soc Trang province with 60% mortality after 3-7 days. EMS spread to the Mekong Delta region and to the central and northern part of Vietnam. In 2012, crop losses were from 19 coastal provinces led by Soc Trang, Bac Lieu and Ca Mau. Occurrences were reported in intensive and semi intensive farms for both vannamei and monodon shrimp. Occurrences were higher in areas with high salinity water and during the dry season with high temperatures from April to July (Oanh et al, 2013). At the regional level, the economic loss from EMS and other diseases was 87,000 tonnes or USD 484 million in 2010 and in 2011, 280,000 tonnes or USD1.26 billion (Hoang and Le Poul, 2013).

Consequently, it was *de rigueur* that the half day farmer's session at APA 2013 should focus on shrimp disease and organiser Uni-President (UP) Vietnam invited the who's who in the research in EMS or acute hepatopancreatic disease (AHPND). UP Vietnam also arranged for the presentations to be translated into Vietnamese for local farmers at the session. The focus was not confined to EMS as in many cases, white spot syndrome virus (WSSV) and other disease continue to damage crops.

In an update, **Dr Donald Lightner**, University of Arizona- Aquatic Pathology Laboratory (UAZ-APL) said the disease has crossed the Pacific and is affecting shrimp farms in western Mexico. "More recently, the UAZ-APL has obtained a number of isolates that have subsequently been confirmed to cause AHPND. Subsequent histological analyses showed that AHPND lesions were experimentally induced in the laboratory and were identical to those found in AHPND infected shrimp samples collected from the endemic areas of SE Asia and western Mexico. In all challenge studies run to date a unique strain of *Vibrio parahaemolyticus* was found to cause AHPND;. The same pathology was reproduced in experimental shrimp regardless of whether the isolates were derived from Vietnam or from Mexico."

Two presentations covered efforts to control EMS. **Dr Loc H Tran**, UAZ looked at the effects of controlling AHPND with tilapia (see page 15-18). **Dr. Nguyen Van Hao**, Research Institute for Aquaculture No.2 Vietnam (RIA2) gave some results from his farm trials for controlling the outbreak of AHPND in *P. vannamei* farming in the Mekong Delta. Hao said that in 2012 the pond areas affected by EMS were up to 47,856 ha. Most mortality occurred during the first 30 days of stocking regardless of the farming methods used. His work was to find out the appropriate techniques in intensive farming to control the risk factors, especially *V. parahaemolyticus* in the shrimp farms. The trial model was carried out in the eastern region with 10 ponds with a total area of 8 ha and 12 ponds with a total area of 2.6 ha in the western region. The study was conducted from August to December 2012. Several technical solutions were applied such as pond water quality management, shrimp health care, measurement of soil quality, quality and quantification of *V. parahemolyticus* in the environment as well as in shrimp tissues. Shrimp samples were also periodically collected for histopathological analyses.

According to **Dr Yew-Hu Chien**, National Taiwan Ocean University, there is an increase and proliferation of virulent pathogens in the environment, compounded by unfavourable and stressful culture conditions, and susceptible or poor resistance shrimp. "Good environment management should be able to lessen external stress, retard pathogen

growth and even help to improve shrimp resistance against pathogens. In practice, maintaining an overall environmental stability is more important than monitoring and keeping the concentration of certain toxic substances below threshold.

"Some research results showed that a zero water exchange technique is better that heavily treating the intake water while EMS is spreading in the adjacent area. Manipulating water pH by adding pH adjustment substances and/or phytoplankton management may create an unfavourable pH environment for the growth of *V. parahaemolyticus* and concomitantly, reduce the probability of the pathogen being infected by a virus."

Chien also listed some successful examples in applying probiotics, such as certain specific strain of *Subtilis* sp, *Pseudomonas* sp and *Lactobacilis* sp to suppress the growth of *Vibrio* sp for EMS prevention. Integrated culture with seaweed can improve and stabilise water quality. It may also increase shrimp's innate immunity with dietary sulphated polysaccharides in seaweed, although extensive trials remains to be conducted.

Dr Grace Chu-Fang Lo and **Dr Wang Han-Ching** are working in two pioneering research in shrimp disease at the National Cheng Kung University, Taiwan. In her presentation, Lo said that the white spot syndrome virus, WSSV, is a very unique virus. It replicates well in the host and has lots of anti-host defense strategies. Thus it is a very good model to study virus/ host interaction and genetic improvement of shrimp.

"If we can understand how the shrimp attempts to thwart the WSSV and how WSSV avoids or overcomes shrimp defenses, we can use the information to develop a genetic program to increase shrimp resistance to WSSV. When WSSV infects its crustacean host, host defenses such as apoptosis can be circumvented (e.g. by WSSV AAP1); host defenses can even be co-opted by IE1; the host can be overwhelmed (e.g. by ICP11). So what can we do to help the host more successfully defend itself against WSSV?

"Consequently, to understand how the host might combat WSSV successfully, our current work is on whether the genetic background of the shrimp impacts WSSV infection. We have already started to apply a systems biology approach to look for the host factors which are necessary for infection and replication. We used transcriptomic and protenomic analysis on shrimp with different infection status".

Lo said, "We have found that 100 key factors which could potentially be used as anti-WSSV genetic markers in a marker-assisted shrimp breeding program. Our goal is to provide the tools which the industry can use to move forward."

In the presentation on 'From bench top to pond side-moving basic shrimp Dscam research into industrial practices', Dr Wang Han-Ching said, "The ability of invertebrate immune adaptive response, now called 'innate immunity with specificity' is scientifically controversial. But recent research shows that shrimp and other invertebrates have an ability to have acquired immunity. Does it support anti-viral immune memory? If I can show this, one day we can use vaccines to keep shrimp healthy."

The immune factor that exhibits immune-specificity and immune-memory is Down Syndrome cell adhesion molecule (Dscam). Dr Wang showed that vannamei shrimp respond to both viral and bacterial pathogens and Dscam is secreted into haemolymph, and when it binds to a specific pathogen, the pathogen's activity becomes blocked.

"Dscam is an amazingly variable molecule, and can encode over 58,000 distinct isoforms through the process of alternative splicing. This variability allows Dscam to recognise many specific pathogens. Shrimp's Dscam variability may be a product of host-parasite co-evolution, and suggests that the important immune related alternative exons of Dscam arise in response to the host's natural pathogens.

"We isolated Dscam from these shrimp and demonstrated that Dscam recognises the pathogen. This starts at the mysis 3 stage. In shrimp challenged with *Vibrio harveyi*, the tailess Dscam is secreted into the haemolymph. Can the shrimp select the isoforms? Yes, the isoform specific to *V. harveyi* is generated after *Vibrio* challenge and acts like an antibody.

"After inducing Dscam with an initial pathogen exposure, we found the durable anti-virus immune memory lasted for 2 months. All of these pioneering research results also lead to the possibility that shrimp Dscam might also be utilised to stimulate specific pathogen resistance in conditioned, or vaccinated shrimp. Toward this end, Dscam based industrial practices have started to translate this new understanding from bench top to pond side."

Technical advisory for EMS/AHPND in India

In the wake of the hue and cry over the presence of EMS/AHPND in shrimp farms in India, the Central Institute of Brackishwater Aquaculture (CIBA) has released a technical advisory with a step by step protocol for the first time confirmation for its presence in India.

CIBA has taken this initiative as it is of the opinion that the use of histopathology as a sole diagnostic tool to declare the presence of EMS/AHPND in India may provide a biased information as at the late stage of EMS/AHPND, histopathology is similar to other bacterial infections. Similarly, the false positive with PCR will not make this method reliable enough to declare a disease status. Therefore, CIBA said that a Koch's postulate is essential at least when the disease is declared for the first time.

CIBA together with other partners in India are conducting disease surveillance programs and in the case of EMS, they carry out targeted surveillance. So far, they have not come across any cases that has conclusively established the presence of EMS/AHPND in India. The limitations of histopathology and PCR diagnosis of EMS/AHPND were explained. Confirmation at the acute stage is necessary to differentiate AHPND from other bacterial infections. Only massive sloughing of hepatopancreas epithelial cells in the absence of bacteria can determine AHPND. On the use of PCR, it said in January 2014, Prof Flegel also provided the positive control for EMS/AHPND but no positive results were obtained in 138 sample tested by CIBA and some other institutes. This may change if primers can be designed to specifically target the key virulence factors of the isolate causing AHPND. Prior to any first confirmation of a disease, CIBA advises a revalidation of the findings of one institute or organisation by another institute or organisation. (Source: CIBA epublication series No 24)

India: new heights in shrimp production

At Aqua India 2014, sustaining production needs changes in the hatchery sector and preparedness with EMS

Shrimp production in India during 2012 to 2013 has been impressive. The volume in 2012 at 225,000 tonnes was nearly twice that of 2010 (142,000 tonnes). In 2013, production reached 292,810 tonnes. After several years of low production, India is now emerging as a leading shrimp producer for global markets. In 2013, India became the leading supplier of shrimp to the US markets, overtaking Thailand and Vietnam.

Although production was on the upward trend since mid-2012, during the latter part of 2013, high prices encouraged the development of larger and new farms, construction of new ponds and a shift from fish farming to vannamei shrimp farming in freshwater ponds. However, the joy of farmers was met by worry of industry leaders on the fast growth pace for a fragmented industry.

The vision of the non-profit, non-government organisation, Society of Aquaculture Professionals (SAP) is a holistic development of a sustainable shrimp industry. For its biennial conference Aqua India 2014, SAP chose the theme 'Sustaining Momentum & Spreading Success'. The 2-day conference, from 24-25 January was held in Vijayawada, Andhra Pradesh, the heart of shrimp farming in India. Most of the 18 presentations looked at challenges, particularly in production, and disease and health management.

Udaya Ram Jothy, SAP president said, "All stakeholders have a common cause and there are mutual areas where we can cooperate. SAP works closely with the government and the different components of industry, public research institutes and universities on aquaculture strategies to formulate policies which help the government to plan and for industry to move forward. Currently, diseases present major threats; SAP will use this conference to pave the way for a better understanding of concepts. We want all stakeholders to be on the same page and be prepared to meet future challenges, particularly in the prevention and mitigation of diseases."

From left, S. Muthukaruppan, Udaya Ram Jothy, S. Santhana Krishnan, R. Srinivasan and Ravi Kumar Yellanki.

An opportunity to lead

The scenario in global shrimp markets was described by R**avi Kumar Yellanki**, Vaisakhi Bio-Marine Pvt Ltd in his opening presentation. The global supply of shrimp in 2011 was 4 million tonnes and with the early mortality syndrome (EMS) affecting China, Vietnam, Malaysia and Thailand, supply dropped to 3.4-3.5 million tonnes in 2013.

"If we look at expected growth based on the trend since 2005, supply should be 4.6 to 4.7 million tonnes by 2014. As the global economy is on its recovery mode since the second half of 2013, we can expect spending to increase and a positive outlook in global shrimp demand in 2014. The supplies from China and Thailand are not expected to resume until 2-3 years later. This gap in supply is a huge opportunity for us in India. This should be our boom time, especially when profitability levels are highest in our history of shrimp farming. In 2014, it is likely that we can produce 367,800 tonnes and at least India can contribute 70,000 tonnes more to the global shrimp markets.

In 2010, only 33% of production was vannamei shrimp. Ravi Kumar showed how rapid was the shift to vannamei shrimp which accounted for 84.5% of total shrimp production in 2013. By 2014, monodon shrimp production will only be 50,000 tonnes, 40% of the highest production of 125,000 tonnes in 2011. In his overview on production in 2013, Andhra Pradesh led with 99% of total production, followed by Tamil Nadu at 93% and Gujarat at 77%. In West Bengal, with more traditional farming methods, the monodon shrimp dominated 71% or 12,000 tonnes of the total shrimp production. Worth a mention is that these have been achieved by an industry regulated by the Coastal Aquaculture Authority (CAA), in terms of farming areas, stocking density limited to a maximum of 60 postlarvae/m^2 and quotas on brood stock imports.

"In 2014, we can expect more production as fish farmers shift to vannamei shrimp in East and West Godavari in Andhra Pradesh and recovery of farming in West Bengal after the loss of confidence with rejections of exports to Japan due to unacceptable ethoxyquin levels in muscle tissue. We also expect farms in Gujarat to increase stocking density to 70-75 PL/m^2 in 2014 from 35-40 PL/m^2. Odisha farms did well in the second half of 2013 and we can expect only 20-25% of farms changing to vannamei shrimp production. The production in Andhra Pradesh alone will be 250,000 tonnes!".

Challenges ahead

These are expected along the supply chain. Ravi Kumar paid compliments to the constant success by farms in Gujarat which have a 4-month break between crops and cautioned those in Andhra Pradesh where culture is continuous throughout the year. In the latter, disease problems have surfaced. White spot syndrome virus (WSSV) was rampant during the second half of 2013. This was a serious outbreak, not seen before even when monodon shrimp was the major species. This could be possibly due to the use of pond bred brood stock for postlarvae production or that most farms practice continuous stocking of ponds without any breaks. Farms should collaborate and determine areas for specific dry outs to reduce the spread of WSSV.

"Although there are doubts in India on whether mortality in some ponds matched the case definition of EMS, farmers must be aware of the diease and authorities be clear on its presence or absence. Today, in India, we are in a better position and with diagnostic tools, farms should be better prepared."

With the threat of EMS, industry welcomed the enhanced regulation and ban on brood stock imports from EMS affected countries. In 2013, the sole supplier of imported brood stock was Shrimp Improvement Systems (SIS) in Florida. In 2013, the recently established Brood stock Multiplication Centre (BMC) in Visakhapatnam, under a collaborative program between the Rajiv Gandhi Aquaculture Centre (RGCA) and Oceanic Institute, Hawaii provided 14,000 pairs of broodstock.

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L. Nanda Kumar and NS Allada, Synergy Technologies, Ramesh Kumar, Salem Microbes and Anil Ghanekar, Ecosecure Systems who presented on biofloc: a possible solution to control EMS/AHPND. evidence from recent studies and applications.

From left, Dr. C Gopal, Central Institute of Brackishwater Aquaculture (CIBA), Ram Avasarala, USA and Hanumamtha Rao, CIBA. Ram spoke on `Where are the world shrimp markets going and what should India do to be a relevant market supplier?

Bridging PL supply and demand

The expansion in production is contingent on supply of quality postlarvae. An overview on the status and issues in shrimp seed production in India was given by **D. Ramraj**, Padmanabha Labs & HiBreeds Shrimp Hatchery. He said that the current production is 20 billion but estimated that some 40 billion good quality postlarvae will be required for the planned production in 2014. "Currently vannamei shrimp is farmed in 25,000 ha of ponds. However, there are 60,000 ha of ponds currently being used for monodon shrimp. Some of these are rapidly being converted to vannamei shrimp. Farm output is also expected to increase with the conversion of freshwater fish ponds to shrimp farming. This estimate of 40 billion is to cater for 50,000 ha of pond production."

India has a total of 300 hatcheries operating in 2013. Only 40% is registered with CAA which means they can import broodstock. Most of them (70%) are in Andhra Pradesh. Capacity expansion and additional hatcheries will be required to cater for the requirements beyond 2015. Ramraj estimated that the demand by 2018 based on a 20% growth in production, will be 70 billion postlarvae a year.

India is unique in that the CAA requires all imports of vannamei brood stock to be channelled through the Aquatic Quarantine Facility (AQF) in Neelankarai, Chennai for a 5-day quarantine process. Hatchery operators support this measure but worry on the capacity to cope with high volumes of imports for the main farming season. In 2013, the AQF expanded the capacity to accommodate more imports of brood stock to 118,500 pairs/year. However, in the near future, the brood stock requirement suggested by Ramraj will be 100,000 pairs in 2014 and 150,000 pairs or beyond, by 2018. Fortunately, additional supplies of brood stock could be met by the RGCA's BMC which has an annual capacity of 45,000 pairs and could be expanded.

Hatchery efficiency

According to **David Leong**, SIS, it is critical to use SPF brood stocks to ensure success and sustainability in shrimp farming. The standard for brood stock is that one pair will produce 500,000 nauplii/month and with four spawnings, there will be 2 million nauplii. These will produce one million postlarvae at 50% survival.

"The problem with locally reared brood stock is that we do not know if the brood stock comes from a biosecure environment. The fastest way to spread diseases is through infected brood stock producing infected postlarvae. In the case of EMS spreading to Mexico, there is speculation that it was through the import of genetic material from SE Asia. In Indonesia, pond reared brood stock have resulted in 30% crop failures and today all intensive farms use only SPF brood stock and postlarvae from certified hatcheries," said Leong.

"Aside from genetic pedigree, good selection and rearing conditions, are important criteria for the production of good quality brood stock. Our criteria is that brood stock should be 38 g for female and 35 g for males. We recommend acclimation of at least 4 weeks for a 40 hour transport time prior to spawning. Some bad practices are feeding brood stock with uncertified natural feeds. The use of live polychaetes could spread EMS unless there is a depuration protocol to disinfect the worms. In China, an unsustainable practice is feeding 90% of bodyweight with minimal water exchange prior to maturation."

In 2013, the number of brood stock used in India was 49,000 pairs. This should have been sufficient to meet the demand for postlarvae. However, Ramraj said, "There are allegations that pond raised brood stock are used rampantly. This implied that performance of imported brood stock or the hatchery is far from optimal. The survival rate from nauplii to postlarvae is only 30% whereas the same hatcheries were getting a survival rate of over 50% when they were producing monodon postlarvae. We need to revisit some of the protocols such as washing of eggs and nauplii. Other issues that we also need to study are the substitution of wild polychaetes with frozen or freeze-dried polychaetes. We also need to improve our knowledge on algae quality and suitable species."

All registered hatcheries adhere to a CAA regulated quota on brood stock imports. The industry looks at its removal as production capacity and efficiencies cannot be achieved due to brood stock performance etc. It has also encouraged the use of pond reared brood stock by both registered and unlicensed hatcheries for the limited production season.

"The hatchery industry also receives brood stock from the OI/RGCA multiplication centre. These are at par with imported brood stock and show excellent larva and post larval performance although mating and fecundity rates are lower," said Ravi Kumar.

"One constraint on hatchery efficiencies is the seasonal demand; there are two peak stocking seasons, in December-March and June-August. This led to a supply shortage and high prices, such as INR 900/1000 PL (USD 14.56/1000 PL) in October-December 2013 and INR 350/1000 PL (USD 5.66/1000 PL) in April-June 2013. If there are no limitations on SPF brood stock supplies, stocking will be continuous, and it will reduce the pressure on hatchery production, stabilise prices and take pressure off brood stock and AQF," said Ramraj.

"Hatchery producers tend to use brood stock 2 weeks after conditioning whereas it is usually 4 weeks in other countries. They also use all of the nauplii produced, not necessarily the best quality which in turn affect overall postlarvae quality. Now, there is a zoea2 syndrome for which there is no solution."

At the meeting, the hatchery sector asked for a liberalisation on brood stock imports which will pave the way for better quality postlarvae. The CAA should regulate the use of pond reared brood stock and allow stand alone maturation facilities and the selling of nauplii to downstream hatcheries. The set up of more BMCs to increase supply of brood stock at lower cost will benefit the sector.

From left, Alexander van Halteren, Nutriad, Manish Sharma, RNK Agro, T. Gnanamani, Kemin and R. Kumaresan, UPEC. Van Halteren presented on the disruption of quorum sensing to manage EMS/AHPND.

EMS and disease management

Concerns surrounding EMS or acute hepatopancreatic necrosis disease (AHPND) presented by several speakers gave the audience a better understanding on how to diagnose the disease, take precautions to avoid shrimp mortality before 30 days and how to be in a state of preparedness. **Loc Tran**, University of Arizona explained the research which led to the discovery of *Vibrio parahaemolyticus* as the causative agent which can be found in the stomach of shrimp (see article p14-18).

On its transmission routes, he said, "AHPND was confirmed in Mexico and the disease is still spreading to other shrimp farming countries. The horizontal transmission of the disease includes contaminated water and sediments, shrimp faeces, biofilms, cannibalism and vectors such as molluscs in shrimp ponds. Some indirect evidences suggest that vertical transmission is through contaminated brood stock and possibly live feed. AHPND bacteria develop resistance to certain antibiotics quickly. The high risks will be ponds with an EMS/AHPND history, with no biosecurity measures, lacking reservoir ponds and water disinfection protocols, and an unbalanced pond ecology."

However, not every mortality at less than 30 days in ponds can be attributed to EMS, said **Ung Eng Huan**, BioValence, Malaysia. It could be co infections with white spot syndrome virus (WSSV) or with hepatopancreatic parvo virus (HPV)." In one suspected EMS outbreak in East Malaysia, we have shown that the bacterial isolates were PCR negative for the AP1 and AP2 open source amplicons from Prof. Tim Flegel, Centex Shrimp Thailand and Prof Grace Lo, National Cheng Kung University, Taiwan. These were however very strongly positive in all the samples for HPV. Depending on which PCR test is used, a false negative for HPV can easily result. We normally screen all samples with a DNA and an RNA Multiplex to rule out viral aetiology.

"In some of our samples, DOC30 samples have on the average 10^5 cfu/ml of Vibrio compared with 10^3 cfu/ml for DOC14. From a library of 19 colony types confirmed by PCR to be *V. parahaemolyticus,* we have identified 6 potentially different phage-bacteria pairings based on plaque pattern and plaque morphology and are now actively investigating evidence for lateral transfer of genes by phages."

Inbreeding and EMS

Prior to information on the causative agent of EMS, farmers put the blame on shrimp breeding companies focusing on fast growth at the expense of survival and general robustness of shrimp. In his presentation on selective breeding, **Dustin Moss**, Oceanic Institute, Hawaii (OI), said that the goal of a selective breeding program is genetic gain for traits of interest (growth being a common trait in most/all *Litopenaeus vannamei* breeding programs) and inbreeding depression may counter or offset genetic gains especially if levels of inbreeding are high (or unknown).

"As a business tool, companies only sell brood stock representing a small portion of their genetic diversity. Breeding companies are not providing inbred stocks but brood stock from a narrow base. Inbreeding and limited genetic diversity are not the same," said Moss. "These brood stock will produce offspring with low levels of inbreeding, but with a high degree of relatedness. This creates a situation (or trap) were high levels of inbreeding accumulate rapidly, if purchased stocks are bred for more than one generation."

In a study on the inbreeding at OI, Moss stated that hatch rate and hatchery survival were strongly affected by inbreeding and effects on growth and grow-out survival in good environments were minimal. However, effects of inbreeding on survival became more severe in harsher environments (i.e. environmental sensitivity). In viral challenge tests, survival to taura syndrome virus (TSV) was reduced by 8.3% to 31.4% per 10% inbreeding, depending on the virulence of the isolate used. Likewise, survival to WSSV was reduced by 38.7% per 10% inbreeding.

"What are the effects of inbreeding on EMS survival? No one knows at this point! But there is evidence that suggests inbreeding effects on EMS may be severe. For example, severity of inbreeding depression (at least for survival) appears to be sensitive to environmental quality."

PCR detection of AHPND bacteria

Su Chen, GeneReach Biotechnologies, Taiwan said that the company has been preparing the ground work for a diagnostic method for EMS for a long time. As such, after 1-2 weeks of the release of the open source sequence for PCR, it has been able to show a new iiPCR platform for detection of *V. parahaemolyticus*. Prior to Aqua India, Chen and his team carried out demonstrations on the detection of this bacteria strain in Thailand. Here in India, Chen carried out some demonstrations during a road show for farmers in Ongole together with Ramraj.

"The new PCR detection system is less complicated. The extraction is automated and farmers will be able to apply at the farm and within two hours, the results will be available. It is OIE certified. However, this new development is based on current information and as we learn more on the pathogen, the diagnostics will be revised," said Chen.

"In the meantime, this is what the industry has at its disposal. It allows us to have an idea on the presence of the bacteria in larvae prior to stocking shrimp during grow-out and in the gut of live feed. This diagnostic tool also allows us to monitor brood stock in a domestication program. Sampling is simple as in the case of postlarvae it should be the whole animal, and in the case of juvenile or adult shrimp, the hepatopancreas and stomach, and for brood stock, a faecal sample.

"What we know is that the DNA sequence of the bacteria is highly specific and highly related to EMS. We are sure that 1-2 plasmids are involved in the fast DNA transfer. However, a PCR positive result does not mean it is EMS positive and we still need to confirm with histopathology tests. The PCR helps in risk management. It can tell that the *V. parahaemolyticus* was there in the sample. The bacterial enrichment protocol helps to provide better sensitivity in detection. It will indicate to the stakeholder where the bacteria is from- brood stock, postlarvae etc."

Management strategies

Dr Pornlerd Chanratchakool, Novozymes Aquaculture discussed how feeding is related to crop failures in his presentation on shrimp farming in low salinity. He said with fast growth shrimp strains, the expectation is an average growth rate per week of 3 g with new feeding regimes recommended by feed companies.

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From left, Pornlerd Chanratchakool, Dr Dagoberto Sanchez, Novus International, USA and Ram Avasarala, USA. Sanchez presented on designing effective feeds for vannamei shrimp culture in Asia.

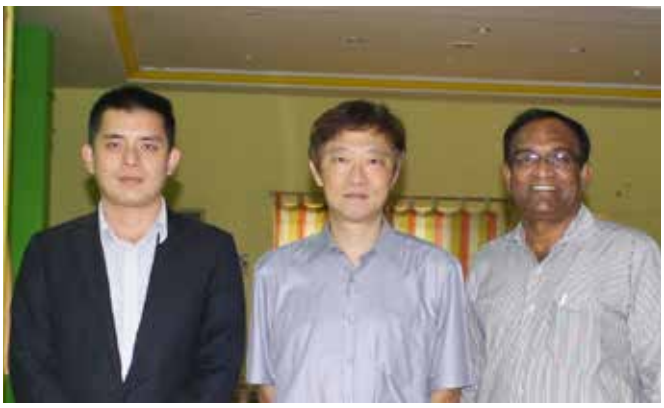
"The consequence with overfeeding is bad pond bottom conditions. Aeration will help but I believe that farmers do not provide enough dissolved oxygen for the bacteria decomposition process. Therefore, we have high hydrogen sulphide and ammonia, stressing shrimp and leading to fast deaths or chronic infection as shrimp is already in poor health. Shrimp are susceptible to EMS or loose shell or alternatively succumb to vibriosis, white faeces syndrome with low survivals but high feed conversion ratios. White muscle syndrome also occurs with poor pond conditions. The feeding tray may be empty as shrimp cannot go to the bottom with too much black soil."

Pornlerd gave a day by day feeding regime for postlarvae in grow-out ponds starting with PL10-15 for a stocking of 80-100 PL/m^2. At 28 days of culture (DOC28), the feed is 11.6 kg/100,000 PL. Feed can be reduced by 50% in the first week. The general rule is 0.5 kg for 100,000 PL/day to maintain water quality. A comparison of mean body weight (MBW) of shrimp fed a high feeding rate with that of shrimp fed a low feeding rate showed no differences.

In his take home message, Pornlerd said that to reduce risks from shrimp mortality, the ponds should be well prepared with sludge removed or completely dried, biosecurity setup particularly if ponds are located in outbreak or high risk areas, and management protocols should include disinfection of reservoir water, and treatment of viral carriers and bacteria. The selection of postlarvae is important and he recommended PL10 (with checks on hepatopancreas) from different good and reliable hatcheries.

Since EMS was first reported in China, aquaculture companies began to work on strategies to prevent and manage the disease. As more is known on the causative agent and routes of transmission, shrimp experts are proposing ways to manage the disease along the production chain.

"Seawater worms are known to concentrate vibrio and for example, mucus of worms contain 60% *V. harveyi*. The disinfection of polychaetes with irradiation is a possibility but most hatcheries continue to look for cheaper sources of live feeds," said **Dr Olivier Decamp**, Inve Aquaculture in his presentation on prevention and management of EMS/AHPN. He also asked industry to consider semi moist feeds. "There is also support for stronger postlarvae through better nutrition and treating postlarvae before leaving the hatchery. These include selling larger postlarvae (>PL10), monitor the Vibrio status, including *V. parahaemolyticus*, strengthen the animals for the transportation with immunostimulants, nutraceuticals and probiotics and disinfect the larvae with a disinfectant that is active against biofilm."



D. Ramraj (right) with the GeneReach team in Ongole, Su Chen (middle) and Cheng-Li Wang.

From left, Dustin Moss, Thampi Sam Raj, RGCA and Dr Shawn Moss, OI who presented on genetics and breeding programme for stock development of the vannamei shrimp

During the production cycle, other protocols which should be considered are; control of algae in ponds (N:P ratio), biocides to control vibrio levels such as in the Philippines, *Bacillus* to promote the immune system and biofloc technology with probiotics. Decamp showed some culture protocols which prevented EMS such as a 3 phase culture system in Vietnam, starting with co culture with tilapia (DOC 15-35), gradual shift to semi biofloc and probiotics (DOC 35-50) and finally semi biofloc and probiotics (DOC50 to harvest). He also complimented the Indonesian pond protocol of regular siphoning to remove dead shrimp.

Recently, to avoid EMS, controlled nursery culture has been introduced to produce larger and stronger postlarvae for stocking in grow-out ponds. Pornlerd described some recent practices in Thailand-indoor nursery with stocking density of 10-20 PL/L for 15-25 days, nursery culture in cages for 7-14 days or open nursery ponds with 1,000 PL/m^2. In Vietnam's central region, the stocking density is 50-80 PL/L in an indoor hatchery for a 30-day rearing period which Pornlerd said is too high. The recommended set up for tank/cage or pen nursery of vannamei postlarvae is 120 PL/m^2 depending on the pond carrying capacity (which is 1.3-1.5 kg/m^2 for vannamei shrimp in a standard pond without partial harvest).

Decamp described the 2-3 phase culture system, common in Mexico. "There is a 30-day indoor rearing to produce PL15 to 200mg juveniles for stocking into ponds. But unfortunately, this step alone would not be sufficient to prevent EMS, as this disease is also found in Mexico."

AHPND/EMS: From the academic science perspective to the production point of view

By Loc H. Tran , Kevin Fitzsimmons and Donald V. Lightner

The next step after routes of transmission are clearly defined is how can the disease be mitigated.

First of all, everyone should be on the same page when talking about the *acute hepatopancreatic necrosis disease* - AHPND, the early mortality syndrome - EMS, or the *acute hepatopancreatic necrosis syndrome* – AHPNS. We are talking about just one single disease. This disease was first recorded in China in 2009 and then subsequently confirmed in Vietnam in 2010, Malaysia and Thailand in 2011, and very recently in Mexico in 2013. For your convenience, I will use the term EMS/AHPND for this disease.

As a PhD candidate at Dr. Fitzsimmons's and Dr. Lightner's Laboratories at the University of Arizona, I was involved in the research on EMS/AHPND. As soon as the EMS/AHPND was confirmed in China and then in Vietnam, Malaysia, and Thailand causing record losses in the shrimp industry in the area, the very first question was, "what causes the disease".

First was EMS pathology

Initial analyses of infected shrimp samples from EMS/AHPND affected countries have shown that the EMS/AHPND pathology was not described before. As a request from the World Organization for Animal Health (OIE) in conjunction with the Ministry of Agriculture and Rural Development of Vietnam (MARD), Directorate of Fisheries (D-FISH), and the Department of Animal Health (DAH) of Vietnam, scientists from the University of Arizona came to Vietnam to participate in research on the determination of the causative agent of EMS since 2011. This research was supported by many Vietnamese and international groups including World Bank, FAO, Global Aquaculture Alliance, Minh Phu Seafood Corp., CP Thailand, Grobest, Uni-President, Sheng Long Biotech, and the Lasan Company.

After almost three years of research, in early 2013 we were for the first time able to demonstrate that the EMS/AHPND was due to a unique bacterial strain of a very common bacterial species, *Vibrio* parahaemolyticus. Only a rare strain of *V. parahaemolyticus* is able to cause EMS/AHPND. This means that common methods of *V. parahaemolyticus* detection will not be able to specifically detect this EMS/AHPND causing strain. These discoveries helped me complete my PhD in 2013.

There are some opinions and hypotheses stating that other bacteria can also cause EMS/AHPND. However, Koch's postulates and the same pathology descriptions similar to that of EMS/AHPND need to be completed. The international acceptance of the cause of EMS/AHPND will be a crucial step in finding solutions to control EMS/AHPND.

Then ways to mitigate its spread

The question we have often been asked is "Can this disease be cured effectively or only preventive measures are effective?" In the history of the shrimp industry, we have seen that once shrimp are sick and clinical signs are exhibited, treatments are usually not effective. The reason why treatments are usually ineffective is that shrimp lack adaptive immunity; they do not feed once infected and acute mortality sets in. Moreover, due to the concerns on consumers' health, including antibiotics and banned chemical residues in shrimp tissue, treatments available for shrimp diseases are very limited. With regards to the EMS/AHPND, our studies show that shrimp exhibit very acute mortality as early as 12 hours of exposure to the agent. In addition, the infected shrimp will be the source of infection to other shrimp via cannibalism and bacteria shedding via faeces.

Many international conferences and workshops on EMS/AHPND had the same conclusion that there would not be a 'magic bullet' for EMS/AHPND but instead a package of prevention or risk management plans for the disease. These prevention measures are based on characteristics of the agent, the routes of infection, and the bacterial dynamics in the environment.

Vertical vs horizontal transmission

In my opinion, prior to searching for viable solutions that can be widely applied, we need to understand all routes of infection of EMS/AHPND in shrimp. Based on this principle, we should be able to determine how effective each proposed solution may be in practice. My studies show that EMS/AHPND can transmit via shrimp oral route by ingestion of the agent in water, shrimp carcasses, and surfaces contaminated with the agent. These are horizontal transmissions.

Other observations show that there is a correlation between the outbreaks of the disease in a new farming region and the importation of new broodstock, suggesting that contaminated broodstock could be a source of pathogen for their offspring. This is the vertical transmission.

Based on our observations, once the pathogen is introduced to a new farming region, it appears that the vertical transmission (disease from the stock) first plays an important role (for instance, the recent outbreak of the disease in Mexico). Once the pathogen is established

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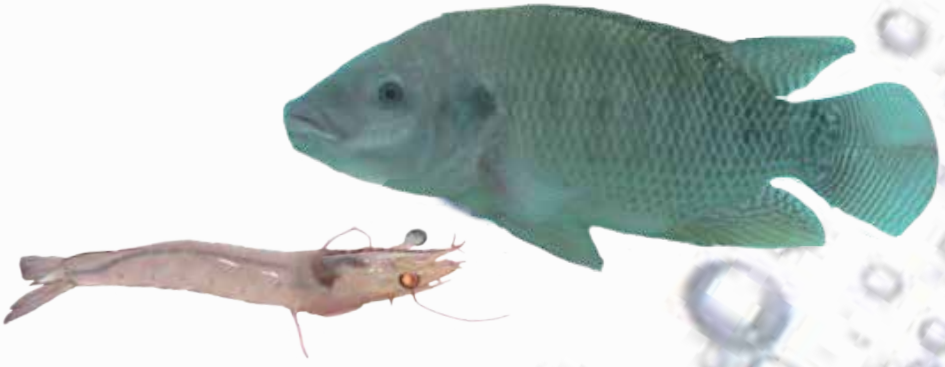

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in the farming environment, it seems that the accumulation of the pathogen can initiate the infection for future crops, making it very difficult to avoid the disease. An example was the continuous outbreaks of the disease in Soc Trang province, Vietnam in 2011 and 2012. However, after a few months of crop holidays, farmers stocked their shrimp in previously affected ponds and had a much higher chance of success. Thereby, in this case both vertical and horizontal transmissions are equally important.

In my opinion, most of the shrimp farming areas of Vietnam have now been hit by EMS/AHPND; therefore, we should consider both vertical and horizontal transmission of the disease when considering disease prevention strategies. Suggestions for disease control of the postlarvae include a set of measures including pathogen control in hatcheries, testing for disease presence in broodstock and post larvae, implementing regulations of quality control and testing for imported broodstock and post larvae. I believe that the authorities can play a very crucial role in successful control of the EMS/AHPND.

From the point of view of small scale farmers, I think we can implement some measures to control horizontal transmission including appropriate pond preparation, having sufficient water surface dedicated for water treatment and reservoirs, implementing farm biosecurity, eradicating accumulated pathogens by ploughing and drying pond bottom, rotating fish-shrimp or rice-shrimp crops, implementing polyculture, and aging water in reservoir by using tilapia. These measures appear to be efficient in suppressing and eradicating the pathogenic bacteria and enhancing the natural balance of the microbiota, thus minimizing the outbreak of the disease.

Large farm or companies with enough capital or ability to produce their own post larvae or can collaborate with hatcheries, can control their post larvae quality. By having access to technology involved in broodstock and post larvae testing, implementation of biosecurity at both hatcheries and farms, routine monitoring of the pathogens in the farming system as well as applying improved farming technology such as biofloc and indoor systems, farmers can minimize the problems of EMS/AHPND.

Tilapia in hapa nets in shrimp ponds. Loc says that the system works very well.

EMS/AHPND is a great challenge for the shrimp industry but at the same time it brings an opportunity for us to change and shift to a higher level of culture technology. In order to effectively control the disease, there are some potential collaborations among hatcheries, grow out farms, scientific agencies, and shrimp processors to create a sustainable shrimp supply chain. Minh Phu Seafood Corp's has a 'Sustainable Shrimp Supply Chain' program. In this chain, post-larvae are expected to be produced under strict biosecurity and tested for quality before supplying to grow out farms. Technical support on

biosecurity and disease control are provided to both hatcheries and farms; antibiotics use is reduced and gradually eliminated, and high quality marketable shrimp will be purchased by Minh Phu Seafood Corp at much higher prices. I think this is a very good model and will be applied rapidly because it allows stakeholders to share the profits and reduce the risks in shrimp farming. Very recently, we have completely modified the seed production protocol at Minh Phu hatchery towards prevention of AHPND in postlarvae and could produce AHPND free postlarvae with consistent results.

I do not think we will be able to control the disease simply by searching for a single miraculous solution, but instead a successful disease control should be based on 'risk management plans' in which all risk factors are taken into consideration. Depending on the capability of individuals, appropriate measures of disease control should be implemented.

Effects of tilapia (and other fishes) in disease control

We have an article on this topic published in the Global Aquaculture Alliance Advocate in January/February 2014 issue that partially explains the effects of tilapia. In that study, tilapia was shown to produce a balanced microbiota including algae and bacteria. In this ecosystem, pathogenic EMS/AHPND bacteria will have less chance to multiply and increase its density to a 'critical point' to initiate infection in shrimp, thus minimizing the spread of the disease. On the other hand, the presence of tilapia helps reduce sudden changes of the microbiota ecosystem, thus the risk of EMS/AHPND bacteria blooming will be reduced. When the microbiota ecosystem in pond is upset (e.g. through chlorination treatment or algal crash) it is very likely that the EMS/AHPND bacteria will have a chance to become dominant and cause infection in shrimp. If tilapia are stocked at low density in the shrimp pond, they can help control the benthic algae, clean the bottom, and eat dead shrimp to remove a potential source of pathogen. Other fish may produce similar effects. Other special mechanisms of disease control by tilapia should be further investigated.

Depending on individual farming experience and farming system, farmers will have different approaches in using tilapia in shrimp farms. These approaches include: tilapia in reservoir to activate the microbiota before filling the grow out ponds, tilapia in hapas or cages in shrimp ponds, tilapia together with shrimp, and shrimp-fish crop rotation.

Effects and risks from antibiotics use

Antibiotics in general can be used against many species of bacteria. In fact, antibiotics kill beneficial and pathogenic bacteria. When we refer to shrimp farming, we are dealing with beneficials and pathogens coming from different sources. If we do not have sufficient measures of pathogen control, we will be dependent on antibiotic use as the only treatment available.

Our study shows that antibiotics have been used in attempts to control the EMS/AHPND in the Mekong Delta since 2012. Oxytetracycline (OTC) is most commonly used because of its affordable price and market availability. Sometimes the antibiotics applications show some effects but the results are not reproducible. A laboratory study shows that both pathogenic and non-pathogenic *V. parahaemolyticus* can be isolated from EMS/AHPND infected shrimp. Antibiotic sensitivity tests for both pathogenic and non-pathogenic *V. parahaemolyticus* obtained from the shrimp farming region of Soc Trang province Vietnam showed that all isolates obtained in 2011 and 2012 were sensitive to OTC.

Meanwhile almost all isolates obtained in 2013 were resistant to OTC. This result indicates that the EMS/AHPND bacteria can develop resistance to OTC (and also to other antibiotics) and fairly fast making antibiotics application ineffective.

From a scientific point of view, I do not support nor reject using antibiotics to control this disease. I just want to emphasize that antibiotics should be used judiciously, at the right time and right dose of the most effective approved drug, and sufficient period of drug withdrawal observed before harvest. Antibiotics should be considered as the last resort in disease control or the last line of defense; the use of antibiotics should not be considered as prevention for the disease.

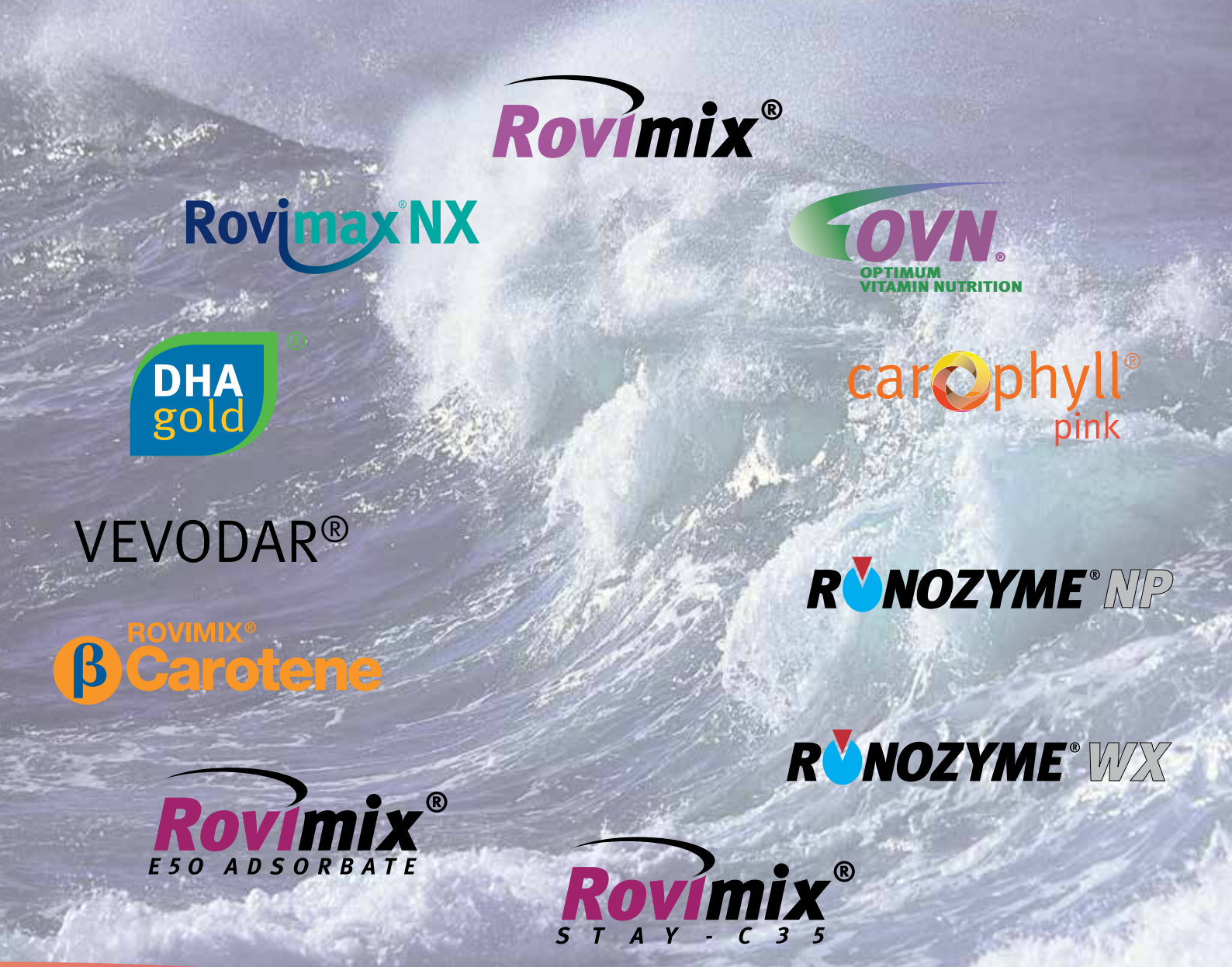
Potential of biofloc farming technology (BFT)

I think BFT is a great technology with promising potential. However, it requires high investment, reliable power supplies, and knowledge. If it is successfully applied, the benefits can be enormous. However, not many people are able to apply this technology in shrimp farming. In addition, BFT requires technicians to have skills and experience accumulated through years of practice.

With regards to the effects of biofloc in controlling EMS/AHPND infections, I have a preliminary study that shows the effects of biofloc are quite similar to that of tilapia. BFT will help create a dense community of microbiota in water that will control the EMS/AHPND from replicating in the water column. Therefore, it helps reduce the infection via water route. However, when shrimp ingests the EMS/AHPND bacteria, the infection still occurs. In addition, management of a dense microbiota in pond water is not an easy job.

Loc H Tran, PhD is a young scientist working with aquaculture, aquaculture pathology in Vietnam since 2006. He is now Assistant Professor at Nong Lam University at Ho Chi Minh City, Vietnam and working closely with the shrimp industry in his home country to control the AHPND. He is also a senior consultant for Minh Phu Seafood Corp., Vietnam, the largest shrimp company in Vietnam and founder/director of the Minh Phu AquaMekong Shrimp Vet Laboratory, the very first shrimp research centre in Vietnam. Recently, Loc developed technologies that allow to produce EMS/AHPND free post larvae and methods to control the disease in shrimp farms. Email: thuuloc@email.arizona.edu

Kevin Fitzsimmons, Ph.D is Professor, Extension Specialist & Research Scientist and **Prof Donald V. Lightner** is a pathologist at the Aquaculture Pathology Laboratory, University of Arizona, USA.



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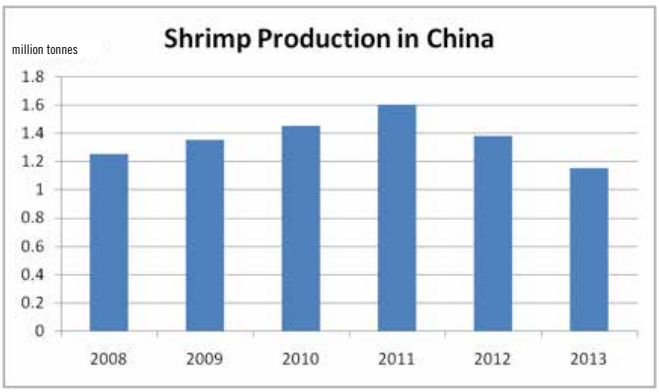
The state of shrimp production in China in 2013

By Zhong Yuming, Dong Qiufen, Zhang Song and Yang Yong

Factors behind a decline to 1.1 million tonnes in 2013 and suggestions to overcome challenges in 2014

In 2013, total shrimp production in China for both freshwater and marine environments was estimated at only 1.1 million tonnes, a decline of 20% from the 1.4 million tonnes produced in 2012. The decline was primarily due to a drop in vannamei shrimp production, which accounts for 77% of the 2013 production at about 0.85 million tonnes. Some 6% of production was monodon shrimp at about 60,000 tonnes and the rest comprised *Penaeus chinensis, P. japonicus* and other penaeids with a total production of about 190,000 tonnes.

The production in 2013 was the worst since 2008. In this article, we examine the challenges and problems encountered by the shrimp industry in 2013 and suggest some strategies to resume production in 2014.



Source: GOAL 2013

Diseases: the first challenge

In general, there are no clear signs to predict when a disease outbreak will happen. From 2010, the early mortality syndrome or EMS resulted in crop losses for farmers. In the first two years (2010-2011), EMS was confined to a few isolated areas, but in 2012 and 2013, it affected farms all over China. The worst year was 2013, when it became a nightmare for some shrimp farmers. According to the Fisheries Advance magazine of China, 50% of shrimp farms in the South of China such as in Guangxi, Hainan and Zhanjiang provinces reported crop failures. In the summer of 2013, this rose to nearly 80% of farms. Some farms could only harvest 1.5 tonnes/ha/crop of small shrimp of size 150/kg. Previously in 2009, the same farms harvested 14 tonnes/ha/crop.

To prevent EMS outbreaks, farmers tried many methods, such as improving pond conditions, increasing water exchange, decreasing stocking density, and using many pond additives for shrimp health to combat EMS. Many of these did not work. Biofloc technology is still a relatively new culture technology for most farmers. Polyculture with fish is workable but is only popular in eastern Guangdong province and in the west of Fujian province. Here, farmers stock shrimp with tilapia, grass carp, common carp, catfish and short-neck clam in brackish water pond at various densities.

Harvesting vannamei shrimp

EMS is the biggest issue for farms in South China. However, it has not been reported in the north east of China, such as Tianjin and Liaoning provinces. Here the winter is very cold and farmers have just one crop per year and the harvest is usually small at 7.5 tonnes/ha in earthen ponds and stocking density of 80-120 postlarvae (PL)/m^2.

Combating EMS: the second challenge

The second challenge is finding an effective treatment for EMS. There are many ways to treat diseases, such as maintaining adequate water quality, feeding shrimp with health additives and even using antibiotics in some farms; however, there currently is no effective method to prevent or overcome EMS. Some treatments have been successful in some ponds, but unsuccessful in others. Each farmer has an experience on one or many treatments for a particular disease, but no one farmer has been able to fully replicate a particular method proposed by another farmer successfully as pond conditions differ. For some farmers, the worst case scenario is when a farmer is unable to make a decision on what treatment to use when a disease happens and incurs high mortality as a result. There is a monetary loss from the loss of stock and cost of treatments, while there is also an opportunity cost when the farmer misses a farming season. This is especially the case in Southeast China where the culture period is limited to a few months of the year. Experienced farmers have adopted the idea that EMS cannot be treated but merely mitigated by trying to reduce losses as much as possible.

After EMS happened in the summer of 2013, farmers are taking precautions on how to prevent EMS based on their experience. According to *Fishfirst* magazine of China, there are six steps to reduce risks.

1. Using suitable postlarvae: Farmers usually choose PL10 for marine ponds and PL15 for brackish water ponds. Some may check the health condition of postlarvae with the help of service teams from pond/aquaculture suppliers or feed companies.
2. Disinfecting the pond water with high density calcium hypochlorite, followed by aeration for at least 2 days.
3. Keeping the pH between 8.0±0.2 for one month after stocking. Quick lime is used to control pH following rains.
4. Controlling feeding and reducing leftover feed to maintain good water quality.
5. Maintaining dissolved oxygen (DO) above 4mg/L for shrimp health and using probiotics when the weather is good and when DO is more than 6 mg/L.
6. Increasing minerals in pond water when shrimp are moulting.

These experiences may not completely overcome EMS, but may help reduce the risk of EMS occurring. When EMS is seen in the pond, farmers usually stop feeding, increase pH to 8.0 using quick lime, and switch on all aerators to improve water quality.

Bad weather: the third challenge

Together with diseases, farmers also face bad weather, especially in 2013. In the South, farmers were troubled by long periods of rain and colder pond water temperatures. Typhoons hit the coastal areas from the southeast to southwest of China more than 10 times in 2013. Before the arrival of a typhoon, farmers try to harvest quickly if shrimp is of marketable size. When this is not possible and shrimp are too small, they can only wait for the typhoon to pass. Usually, a typhoon leaves behind damaged shrimp ponds. The government estimated that because of disease and typhoon, occurring together, more than 80% of shrimp farmers lost money in some areas in 2013. The shrimp price was more than 50 CNY/kg (USD 8.33/kg for size 80) at the end of 2013 because there were fewer shrimp in ponds and supply was short.

Quality of postlarvae: the fourth challenge

A generally poor performance of postlarvae was reported in 2013. Most of the shrimp died at 40-50 days after stocking and farmers had to clean ponds and restock ponds. Usually, most farmers only depend on their experience to assess the condition and quality of postlarvae when purchasing. No tests are conducted. Stocking time depends on farming areas. Usually farmers stock postlarvae in April in the South, in May in the Southeast, and in June in the North. Farmers reported that both postlarvae from farm raised broodstock (second generation) as well as first generation (F1) postlarvae produced from imported broodstock performed poorly. This was common in most shrimp farming areas. Many farmers stocked postlarvae in the pond many times, but most of them lost the stock and did not know why.

This may be because most Chinese hatchery companies do not have their own specific pathogen free (SPF) broodstock supply and they have to import broodstock from the US or some other countries regularly. There is a general perception within the Chinese shrimp industry that in 2013, the quality of imported broodstock was not as good as before. According to the *Fisheries Advance* magazine of China, the performance of postlarvae produced from such low quality imported SPF broodstock was not much different from postlarvae from pond raised broodstock. Furthermore, when farming environments were unfavourable, it was observed that even postlarvae from imported broodstock easily succumbed to diseases.

A greenhouse system for vannamei shrimp ponds

Farming technology: the fifth challenge

In some older shrimp farming areas in South China, poor water quality and environmental conditions have complicated the disease situation. Most shrimp farmers are smallholders and some of them do not have adequate technical knowledge. They carry out farming based only on their experience. Some feed additive and farm suppliers and large feed companies, such as Guangdong Haid Group, have built up technical service teams to help these farmers. However, some farmers not only select feed and pond treatment products from small companies, but also do not get any technical support or any information on how the products function.

Improving production

With the above challenges and problems in China's shrimp industry, how can we overcome these? Here are some useful suggestions.

Postlarvae bottleneck

Selective breeding is key to overcoming the postlarvae bottleneck. It is important to have a balance between imported broodstock and locally selected broodstock. As imported broodstock quality is not considered stable in recent years, the government and large companies are already focusing research on selective breeding. Considerable work is still required before we can see progress. There should be a national standard on broodstock imports as well as setting a blacklist for suppliers with poor records on low survival rates and disease broodstock. A strict management of the domestic shrimp seed production is the way forward for a healthy shrimp hatchery industry in China.

Farming technology

Among Chinese shrimp farmers, there is a common saying that there are no secrets in shrimp farming technology; good postlarvae, controlling water quality and high DO are the three most important basic requirements in shrimp farming. Choosing good quality shrimp seed is key to good harvests; thus knowing how to choose quality postlarvae is the most important factor. The farmer must also know how to control water quality; ensuring a balance between algae and bacteria is a crucial factor to keep pond water in a stable condition. Finally, DO is the life-line in shrimp farming and is related to feeding, shrimp immune system, growth and many others.

Even though some experienced farmers may take all these for granted, there is still an element of scientific management. Some may have more experience and knowledge in shrimp farming than others and so we need more trained technicians and R&D units to collect and disseminate such information for others to follow. Polyculture of shrimp with various fish species has a history of more than 20 years. It has been shown as a profitable way to farm shrimp. It can be improved and tried in the high density farming areas.

A better service system for the farmers

In China, most of the small farmers still do not know how to manage the farm in a scientific way, so they need advice and help. Most aquaculture technicians are from feed and pond health/ additive product companies. But different companies have varying levels of service systems and quality of services. The suggested technology may also be different. In shrimp farming, the right environment and good pond condition is critical to avoid health problems and ensure successful crops. It is time that the support industry make improvements in their services. The companies should be seen as not only selling feed or other products, but also providing the right advice and services.

Better communications

In China, from the North to South, there are so many different shrimp farming models, some with a history of success. As successful experiences can be applied in other places, it is important to share these to improve shrimp production. In addition, many basic research results can be transferred into practical production practices in the shrimp industry. Some new technology and knowledge from other countries also can be adapted for shrimp farming in China.

Outlook in 2014

With high prices and a higher level of risks, mainly from diseases, there are both opportunities and challenges in 2014. Shrimp farming is very profitable when prices are very high as seen in 2013. It is common that high prices will encourage more farmers to start shrimp farming and even convert their fish ponds into shrimp farms. The challenges in 2013 will prepare farmers who will now pay more attention to postlarvae quality and on proper use of pond health additives and be more discerning on services provided by suppliers. A higher level of requirements from farmers will improve the standard of services and direct R&D to the needs of industry.

We expect that the 2014 shrimp production will recover to more than 1.2 million tonnes as the effective actions outlined above, such as the use of 'healthy' farming models with low farming density, good quality postlarvae, use of probiotics for water quality control and reduced usage of antibiotics become more popular. Polyculture and green house farming technology will be more accepted and in more areas. Although there are interests in biofloc technology, it still needs further research, in particular on the specifications for the various geographical conditions and culture.

Zhong Yumin

Dong Qiufen

Zhang Song

Yang Yong

From left, Zhong Yumin, Dong Qiufen, Dr Zhang Song and Dr Yang Yong are experts in aquaculture nutrition and health from Guangzhou Hinter Biotechnology Co., Ltd. As the biggest aquafeed premix supplier in China, Hinter delivers a whole range of practical solutions for aquafeed mills to help them produce high quality aquafeed. Email: qiufendong@gmail.com (Dong Qiufen).

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Insect-based protein and oil

By Franck Ducharne

The realities in the development as a new and sustainable alternative source of raw material for the compound feed industry.

With a global mean consumption of seafood per capita rising, the aquaculture industry will have to increase its production by at least 50% by 2050 to meet the foreseen demand of a growing population. Fishmeal, which is considered as one of the best protein source for feed formulation, is unfortunately limited and its production will unlikely improve as such natural resources are already considered as exploited at their maximum.

The feed industry in its entirety has already made important changes during the past decades where fishmeal use in livestock feed was drastically reduced to the benefit of plant-based products. In aquaculture important efforts have been achieved as well and plant-based feedstuff inclusion rates have increased significantly even for feeding carnivorous species. It is unlikely that fishmeal will disappear in aquafeed formulations but its inclusion rate will further decrease and optimization of its use will occur.

The need of fishmeal substitution will benefit primarily plant-based feedstuffs and will stimulate development of other alternatives with a strong focus on sustainability in production and price. Increasing competition will occur within the feed industry when livestock production is expected to double by 2050.

More supply of plant crops can be achieved by expanding cultivated land and increasing yields. This evolution will have, nevertheless, to overcome a certain number of stumbling blocks such as competition with forest and biodiversity conservation programs and urbanization for land access, competition with non-food crops and increasing water access concerns in some regions and soil degradation.

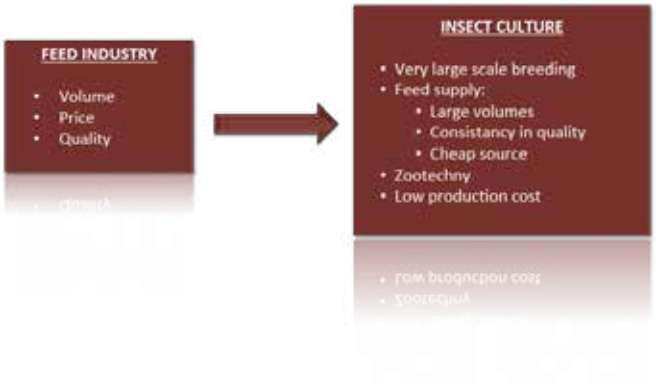
Apart from plant-based materials various new options are under development. Insect-based products recently gained growing interest among public institutions (concretized by different research programs) and private entrepreneurs. Insects, which are naturally a key source of feed for a large part of terrestrial vertebrates and fishes, are also widely consumed by humans all over the world. Therefore, mastering insect mass-culture will become a new alternative for food and feed security.

The asset of insects

Insects are the largest group of animals on the planet; they are present in all biotopes and offer a limitless possibility of feeding regimes, profiles and farming capacity. Insects can handle extremely high density, enabling very high yields and hence requiring less culture areas. Insects can be extremely efficient in converting food with very low feed conversion rate (FCR). Insects present a large choice of detritivorous species, offering great potential for feed security solutions where cost is a critical point.

Insect oil

Figure 1 *Stumbling blocks for insects mass-culture development supplying alternative source of protein and oil for the feed industry*



We have to keep in mind that for whatever solution developed, the key factors which have to be achieved to enable a new product to enter into the commercial feed industry are volume, price and quality.

Volume

It all starts with availability and consistency. The first thing the feed mill will ask is what volume can you supply. Globally, the compound feed industry is huge and hence requires volume. At a local scale, even a small mill will produce at least 10 to 20,000 tonnes of feed per year. Therefore, even considering a low inclusion rate of 5 to 10% would mean between 500 to 2,000 tonnes of product required for one single mill. So to become a reality as a new and recognized ingredient by the industry, large volumes have to be available on a year-round basis.

This will translate to the need for a very strong technical expertise on the insect species to breed and to produce a very large population on a consistent basis. Insects are generally small in size. With the chosen species, an average weight of around 100 mg at harvest and with a 60% moisture content of live animals will mean for each tonne of dry meal, 18 million individuals will be required.

Price

Large scale insect farming can end up as a costly industry. As with any other livestock/aquaculture activity, integrated systems are required including breeding unit, nursery, grow-out and processing plants.

However, at the end of the day, the market price must remain within the range of commodities commonly used by the industry, the upper limit being the best ingredient: the fishmeal. Beyond this, insect-based meal will remain an anecdotic issue and may not become a standard raw material This can be achieved with large-scale operations, strong

zootechnical support and access to a cheap source of feed. This latter point will be the main prerequisite for the success of this new industry.

Quality

Quality is of course among the most critical points when it comes to formulation. Insect nutritional profile varies from species, stage of development and feeding regime. Therefore, the first thing to do is to focus on species with a profile that suits the industry and cultured animals. For livestock and freshwater species, insects are/were originally among their natural alimentary bolus, hence insect meal and oil should match the species requirement. For seawater species, or species which are not necessarily insectivores, a limitation can come with chitin content (problematic for species which do not possess the enzyme chitinase). Other concerns will also come from the limited concentration of PUFA (poly unsaturated fatty acids) and particularly EPA (eicosapentaenoic acid) and DHA (docosapentaenoic acid) as insects are terrestrial animals.

However, these points are not limitations and the industry will adapt and develop solutions as it did and still do when replacing fish meal with plant-based products in aquaculture feeds. Several laboratory studies have been conducted on partial fishmeal substitution with insect meal with good success. With the insect species raised in our operation, trials were conducted by different institutions on species such as rainbow trout, turbot, tilapia and catfish.

Business model for mass culture

The Entofood team has been working since 2010 in developing a business model for insect mass culture to match these requirements. In species selection, different species were studied initially to select the most appropriate one for the purpose of feed security. Criteria of choice were based on the following variables:

- Type of development: preferably holometabolous species which will have low chitin content in the larval stages and which can accumulate high concentration of protein and fat to enable metamorphosis into adult
- Fecundity: due to the very large population required to commit to significant volume of production, this is a critical variable to take into account,
- Growth: fast growth and short life-cycle is targeted to optimize output, and FCR.
- Size: the larger the size the lesser population required
- Feeding regime: as mentioned previously, one of the main criteria for developing this new source of protein/fat for the industry is to become sustainable in price first but also environmentally friendly. It is not recommended, therefore, to aim at any species fed with raw materials which could be used directly by humans or livestock. Focus must be placed on detritivorous species and/or species which could be fed on non-edible products and organic side-streams. This principle is based on the fact that massive amounts of food are being wasted along the supply chain and which a recent UN report estimated at 30%, the amount of food wasted globally per year. This represents a limitless source of valuable nutrients which can be re-introduced into the food chain by the action of detritivores. Eventually, when it comes to economics, to be able to become a reality the insect culture industry must have access to cheap feed.

The species presently selected is a Diptera from the *Stratiomyidae* family: *Hermetia illucens*, or commonly known as black soldier fly. Larvae are performing detritivorous and can reach quite a large mean

Defatted insect meal

size at the end of their development (200 mg). Entofood has been raising this species for more than 3 years and has worked to master and improve its zootechny. This long development process is a prerequisite to guarantee upscaling of the operation to commercial level in total confidence, where strong information is acquired and technical and economic forecasts are based on a strong factual data base.

Since 2012 Entofood has built a pilot farm in Malaysia to prepare the groundwork for large-scale development. Over 1,000 production cycles were conducted so far and 2 billion eggs produced. Growth and FCR have significantly improved to enable a complete grow-out cycle in a week, FCR lesser than 1:1 and yield achieved in grow-out exceed 5,000 tonnes/ha per year.

The insect biomass is raised on food wastes which are traceable and collected on a daily basis and fed that same day. Specific feeding regimes and feeding rates have been developed over the years to optimize performance of the larvae which will convert the food in a few hours. This choice of production model enables the production of a very sustainable product with high nutritional profiles. The insect meal is produced from larvae which are harvested upon completion of development, and takes less than a week in grow-out ponds. Larvae accumulate protein and fats which result in a high concentration of protein and fat and low chitin (3% in whole meal).

This species presents the characteristic of being extremely rich in fat with a protein:fat ranging between 75 to 80% (basically 50-50% protein-fat). The very high fat content makes the finished product not easy to process and limits significantly the inclusion rate in aquafeeds. Therefore defatting process was developed to improve the quality of the product. Non- chemical process (solvent) was chosen to do so.

Table 1: proximate analysis whole meal vs defatted meal (% of sample). Source Entofood

Species	Protein	Fat	Ash	Fiber	Moisture
Hermetia illucens	40.4	39.1	6.4	4.2	5.3
Hermetia illucens	57.3	13.9	8.7	6.6	8.0

The meal produced from soldier fly has been tested by different research institutions over the years ascertaining the great potential of this product as a solution to fishmeal substitution. Trials have been carried out on rainbow trout, tilapia and turbot. The EU has launched an ongoing research program on insects as feed. It was reported recently in Chile that feed trials will be launched on salmon fingerlings.

However, to enter in commercial feeds formulation, more applied trials are needed to gather confidence and know-how on this raw material. Entofood is presently preparing a series of trials in partnership with the industry on a wide range of species (shrimp and fish) to gather information on best inclusion rates of the defatted insect meal and insect oil in feed formulation.

Table 2: Amino acid profile, HI defatted. Source Entofood

Aspartic acid	%	5.48
Serine	%	2.50
Glutamin acid	%	7.21
Glycine	%	2.94
Histidine	%	2.1
Arginine	%	3.27
Threonine	%	2.39
Alanine	%	4.02
Proline	%	3.49
Cystine	%	0.29
Tyrosine	%	3.89
Valine	%	3.85
Methionine	%	1.18
Lysine	%	3.53
Isoleucine	%	2.86
Leucine	%	4.11
Phenylalanine	%	2.51
Tryptophane	%	3.12
Taurine	mg/kg	1.72

Table 3: Summary fatty acid profile. HI oil. Source Entofood

Fatty acids	% relative fat
Total omega-3	1.8
Total omega-6	13.0
Total trans fat	0.3
Saturated fatty acids	57.6
Monounsatutated fatty acids (MUFA)	27.2
Polyunsaturated fatty acids (PUFA)	15.2

This work will enable it to elaborate commercial formulations while constructing the first industrial operation. Entofood intends to start its first production module in 2015 with a targeted output of 3,000 tonnes of defatted meal and 1,000 tonnes of oil. From there other modules will be built based on demand. The model developed by Entofood will enable to put on the market, a sustainable supply of a highly sustainable product at competitive price- in other words, within the range of other commodity products.

Further investigations will have to be conducted to ascertain whether there are some yet un-identified benefits that are found in insect meal (functionality characteristics).

Franck Ducarne is CEO of Entofood Sdn Bhd. After 16 years working in shrimp farming industry, Ducarne founded Entofood with his partner Frederic Viala in 2010. Entofood is now based in Malaysia.

Marine sulphated polysaccharides at the heart of innovative effects in aquaculture

By Adrien Louyer, Jean Peignon and Marie Gallissot

Using seaweed as the core ingredient for products to combat problems on animal nutrition and health.

Aquaculture is the fastest growing sector in agriculture with an average annual growth of 5% during the last decade. As a relatively new industry, aquaculture continually faces new challenges, among which feed remains the major issue faced by the industry. This implies to constantly develop new approaches and innovative solutions.

Farmed shrimp production is an important industry in South East Asia but this sector is often hit by disease outbreaks causing losses of billions of USD. Shrimp are raised in ponds where pathogens, such as Vibrio, are naturally present in the environment. More than eleven species of Vibrio have been reported to be pathogenic to shrimp; among them, *Vibrio harveyi* has been reported as one of the most pathogenic. There are solutions to limit disease outbreaks such as good management practices and biosecurity. Unfortunately, the use of antibiotics and chemical products remains the most convenient and preferred solution among farmers, leading to dramatic side effects like the development of antibiotic resistant bacteria.

As a major specialist in green chemistry, the objective of OImix is to find and develop ecofriendly solutions for these challenges. In a unique combination of clay, seaweed extracts and copper, OImix designed MFeed, an additive with beneficial effects on shrimp digestive system. The synergic action of MFeed ingredients decreases the pathogenic pressure in the intestine and allows a more efficient digestion together with a better resistance to diseases.

A recent study conducted at Kasetsart University (Thailand) evaluated the effect of MFeed on the growth and survival of *Litopenaeus vannamei* challenged with *V. harveyi*. Results have shown that shrimp fed MFeed supplemented diets during 60 days had improved survival rates (80 and 78.4% depending on dosage, compared to 67.2% for control). After that period, 30 shrimp of each group were challenged with a bath of *V. harveyi* (1.0 to 2.0 x 10^7 CFU/mL). It was observed that a few days later, Vibrio concentration in shrimp intestine was lower in groups supplemented with MFeed compared to control (graph 1). This lower concentration of intestinal Vibrio was linked with exceptional survival rate for shrimp supplemented with MFeed (graph 2), confirming the efficacy of MFeed to support digestive health of shrimp and to prevent from massive biomass loss.

These results strengthens OImix position in using seaweed as the core ingredient of products as solutions for problems on animal nutrition and health. Seaweeds appear to contain sugars in the form of polysaccharides, some of which- sulphated polysaccharides (also known as Marine Sulphated Polysaccharides, or MSP) - are complex polyanionic structures which possess various biological properties. A vast number of studies have already shown evidence of the effects of some of these sulphated polysaccharides, particularly the fucoidans, the carrageenans and the ulvans, on certain mechanisms of inflammatory response and on immunity. In shrimp, various studies have linked the use of these polysaccharides with increased resistance to various pathogens (white spot syndrome virus, Vibrio etc.).

The identification and selection by OImix of these polysaccharides extracted from suitable macroalgae is part of ULVANS research program. Started in 2012 in partnership with four other small and medium enterprises (SMEs) and several academic structures, this project aims to structure and develop the seaweed industry, from harvesting seaweed in the sea to using specific formulated products in animal and vegetal nutrition and health.

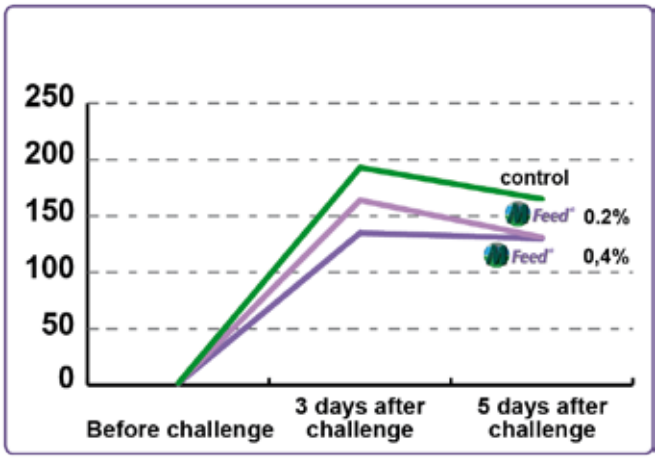
The recently held Breizh Algae Tour (OImix annual event) marked the incredible progress made on this project over the past two years, with the inauguration of the first seaweed biorefinery in the world before a panel of 350 people gathered from 26 countries in the world.

Inauguration of the first algae bio-refinery in the world

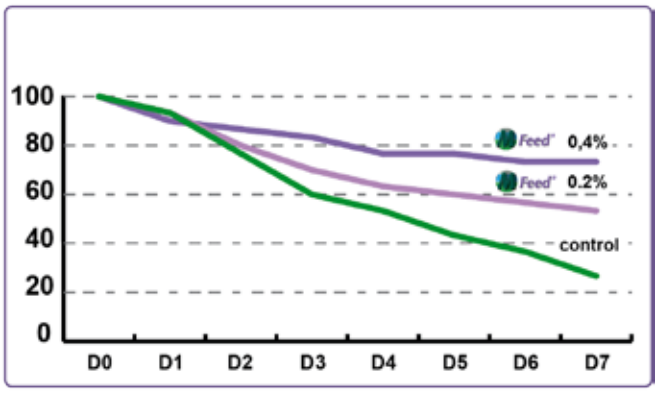
This biorefinery allows Olmix to secure its algae resources and optimise their exploitation.

New products have already been created arising from the ULVANS project, and more will be discovered next September, on the occasion of Olmix annual event. This will give more solutions to aqua and livestock producers.

Graph 1: Vibrio concentration in the intestine



Graph 2: Shrimp survival after the challenge



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A long term commitment for aqua feeds in India

After making an impact in the fish feed market in India, Growel Feeds enters into the shrimp feed segment to serve the growing aquaculture industry.

From right, MVN Sesha Chary, Victor Suresh, PS Narendra, and Sandip Ahirrao

Growel Feeds Pvt Ltd can be considered as a relatively new entrant into India's large aquafeed industry as it only began producing floating fish feeds at its factory in Chevuru village, Krishna district, Andhra Pradesh in 2010. It started with one extrusion line and added another line to double capacity in 2011.

In December 2013, as part of its overall aquafeed business plan, Growel Feeds inaugurated a new factory with five shrimp feed lines, next to its fish feed plant. This is the most modern in India with 4-pass pellet mills, the latest design in twin screw extruder and a single screw extruder with oblique tube dies. This demonstrated its long term vision in the fish and shrimp feed market, not only in India but also in the region.

In this interview at their feed factory in Andhra Pradesh, the management team, executive directors, **MVN Sesha Chary** and **PS Narendra**, technical director, **Dr Victor Suresh** and the new head of marketing, **Sandip Ahirrao**, talked to AAP on its foray into the growing fish and shrimp feed market and future plans as it grows together with aquaculture in India.

From concept to fish feed production

This began in 2006 when the US Soybean Export Council, then called the American Soybean Association (ASA), organised a visit to China for potential entrepreneurs in aqua feed production from India. The aim was to show the usage of floating feeds in other Asian countries and use of extrusion technology for fish feed production. This impressed Sesha Chary who then decided to invest into this new business venture.

"A year later, we seriously considered a project for fish feed production and started Growel Feeds in 2008. By mid-2008, we had identified the machinery supplier. By March 2010, we had our first batch of extruded feeds. This worked well and I must thank the ASA team in India, who not only introduced the technology to us, but also carried out trials with our feeds in fish farms.

"We achieved full capacity for this 10 tonnes per hour (tph) extruder in June 2010 and I am glad that Narendra pushed us to install a second extruder of 15 tph. We finished this expansion trail in September 2011. Throughout 2012, our feeds were well accepted by farmers and we could only stop operations for maintenance. Farmers were encouraged to use floating pellets when they saw the good feed conversion ratio (FCR). Dr Suresh guided us along with feed formulation. We did all this despite being bogged down by power cuts!"

Today, the company produces freshwater fish feeds, mainly for the pangasius catfish and smaller volumes for the Indian carps (rohu and catla), pacu and tilapia. According to Ahirrao, sales in 2013 reached 110,000 tonnes and Growel has a leading position in the fish feed market in Andhra Pradesh.

"However, we do enjoy healthy competition with other major players. Indian Broiler with a larger production capacity has sales all over India. Andhra Pradesh has the largest fish feed market at 500,000 tonnes. The fish feed market is estimated at only 50,000 tonnes in the northern states such as Bihar, West Bengal, Uttar Pradesh and 10-15,000 tonnes in Tamil Nadu and Odisha. In India some 98% of the fish feeds produced are used for grow-out farms. There is the practice of stocking stunted one-year old pangasius fish into grow-out ponds. This segmentation in farming results in less demand for starter feeds which account only 1-2% of feed production. The exception is in Odisha and West Bengal where both locally and imported starter feeds are used"

Growel Feeds

Growel Feeds was founded by the Chary family, Narendra and several other partners. Narendra and some partners are involved in pangasius, carp, tilapia and shrimp farming and have interests in downstream business such as seafood processing and upstream activities such as seed production. The name Growel was taken from the 20- year old Growel Formulations (P) Ltd, founded by Sesha Chary's father Dr Ranga

The new shrimp feed plant

Chary, now chairman of Growel Feeds. This new aqua feed business not only rides on the goodwill of the Growel name but also uses the well established distribution network of Growel Formulations.

Narendra said, "The forte of Growel Formulations (P) Ltd is the supply of feed supplements and health management products to fish and shrimp farmers. Years ago, ASA did feed trials in our farms and this pushed us to look at the feed segment although it took us a long time before we decided to do so. I personally feel that because of our entry first into fish farming, we have enjoyed some stability in this business.

"We believe that there is potential for growth, both for fish and shrimp feeds. The installed capacity for fish feeds in India is more than current demand, and as the market matures, there will be a need for better products."

In the case of tilapia feeds, the company markets a small volume as the growth of tilapia farming has been slower than expected. Growel has the licence to import tilapia brood stock and a hatchery operated by Narendra has completed the domestication of the Chitralada tilapia strain, imported from Thailand three years ago. It is now ready to supply fry and fingerlings to farmers. The constraint to an expansion in farming is the requirement for permits from state authorities to farm tilapia and biosecurity protocols to prevent escapees into local waterways.

"We know that in areas where the carp is the traditional fish, consumers' preferences have shifted to the tilapia. The meat is similar but without interstitial bones. This is similar to the trend in Bangladesh. But here, because of government restrictions, its farming has not taken up as fast as in Bangladesh," added Narendra.

The best for shrimp feeds

From the moment they entered into the aqua feed business, Growel had its eye set on the shrimp feed business. This is in line with the long term vision of Growel to be part of the large and growing aquaculture industry, both fish and shrimp, in India. Thus in December 2012, the team sat down to plan for its production of pelleted and extruded shrimp feeds. Subsequently, the choice of equipment demonstrate that this energetic and forward looking team wants to focus on producing the best in shrimp feed quality for the industry. It was Narendra, an engineer by training who decided that the new equipment should serve them well in the long term.

"We have made big investments in equipment. We bought three pellet mills from Muyang, China. The Wenger twin screw extruder, TX-3000 is the top of the line and the first to be installed in Asia and the Wenger single screw extruder X-185 is a proven workhorse. TX-3000 provides flexibility in controlling bulk density and we are confident that this will give us quality sinking feeds. The oblique tube dies with the single screw extruder will increase feed throughput. In shrimp feeds,

there is room for product innovation to bring out the best in formulation and physical properties of the feed. The new twin screw extruder, will also give us the opportunity to produce innovative starter feeds for the market."

Sesha Chary added, "We also planned for versatility in production with these equipment. We can go completely with shrimp feeds or if required, the single screw extrusion line will produce regular fish feed for the carps and pangasius. The twin screw is for extruded shrimp feeds but may also be used for marine fish and pet foods. Most probably, we can operate the twin screw extrusion lines at 6-7 tph. The total capacity for shrimp feed production will be 65,000 tpy."

The team has the expertise of Dr Victor Suresh who has been providing technical services in their feed development since the beginning and who runs the in-house R&D centre.

"If we look back at the pelleting technology in shrimp feed processing, we see that vast improvements in physical properties of pellets have been achieved with pre and post conditioning. Now the standard is 3-4 pass conditioning in the new pellet mills. As the next step, extrusion will allow us to include ingredients that cannot be included in pelleting and therefore create innovative products physically and nutritionally. Growel will be using a state of the art formulation technology with in-built ingredient valuation tools that would take advantage of the vast amount of ingredients that are available in India."

A major factor in the success of Growel is the management's commitment to R&D, explained Suresh. "Growel has committed to support the industry and has invested in R&D systems that provide the ability to run reliable feeding trials on fish and shrimp, and evaluate ingredients and feed additives. We are setting up a process research centre that would allow testing formulations and process parameters at a pilot scale and also produce experimental diets for feeding trials. We are already seeing greater understanding of feed management optimization which directly benefits the farmers. Our topmost priority in R&D is to provide farmers with products, services and tools to be the most productive and profitable. Most of Growel's directors are farmers themselves, so they keep challenging R&D to provide them value for their money."

In February, Growel began marketing its pelleted shrimp feeds with two brands, each for vannamei and monodon shrimp. The Marigold and Nutriva feeds for vannamei shrimp contain 36-34% crude protein whilst the Tigeron and Nutrimo feeds are for monodon shrimp with 41-38% crude protein.

Integration

A downstream integration of the group is ongoing with the construction of a processing plant, a few kilometres from the feed factory. As a feed producer, the advantage of having a processing plant is to help feed clients market their harvests. The boom in vannamei shrimp farming has resulted in demand for more processing capacity as the bulk of harvest occurs in June to August. There is a 2,500-tonnes cold storage facility to meet this small window of demand.

"For the moment, we start with shrimp processing but we have our roots in fish farming and always want to cater to the needs of fish farmers. So, we are also contemplating fish processing to cater to the rising demand for processed fish by the retail and food service sectors," said Narendra.

Sesha Chary added "When we process fish, it will be the fish with the best export potential such as for the Middle East. Now, our pangasius is sold whole to brokers in New Delhi who is turn retail either whole fish or fillet the fish for the chilled and frozen markets. This shows a demand for pangasius fillet or steaks for a new group of consumers who are averse to preparing fish but see its health benefits."

Competitive edge

Aside from the advantage of the farmer network and farm data of Growel Formulations (P) Ltd., it also helps that Narendra and the other directors are directly involved in aquaculture. Between them, they produce a total of 7-8,000 tonnes of fish and shrimp per year and use 10% of the fish feeds produced.

"We have been benchmarking our feeds which we believe are nutritionally better than several in the market. We are the only feed company with our own R&D ponds. Aquaculture is close to my heart, I live right in the middle of farming areas and have close relationships with the farming communities. This not only allows me to understand farming issues but also can make quick decisions. In feed marketing, we differ from other groups. I would say that we have industry's largest team of qualified field staff. We focus on having field staff rather than sales staff, such that for the marketing of the current volume of fish feeds, we only have two non-technical sales staff," said Narendra.

Growel also conducts farmer meetings, three times a year in each region. Each group will comprise 25-30 farmers. At these meetings, technical and sales staff explain the advantages of floating fish feeds especially with regards to lower pond pollution and higher productivity. They also collect field data on each farm, record harvests and analyse growth patterns and share the data via the company's cloud-based IT system. These are used to advise farms on ways to improve fish growth performance and yields.

Moving forward

As a new entrant to the shrimp feed market, the immediate challenge for the team will be marketing these to farms in India. In the case of fish feeds, there have been some enquiries from farms in Africa. The team is confident of making inroads into the export market as they have benchmarked their feed quality with those from some leading producers in Asia. However, their main challenge is to be cost competitive in export markets.

Next on the agenda is not only the production of extruded shrimp feeds but also its marketing. Extruded feeds are well accepted by shrimp farmers in Latin America but there is still some reluctance among farmers in the Asian region. This is associated with higher feed costs as there is already a general understanding on the superior physical and less dust properties of extruded feeds, particularly for

Trial packing of the Marigold pelleted vannamei shrimp feed with crude protein of 36 to 34%.

At the inauguration of the shrimp feed plant, Sesha Chary and Narendra with directors of Growel Feeds, from left, Sateesh Ravella, Janardhan P, Sudheer Chintapalli and Srinivas Potluri

the vannamei shrimp. Also, adoption of novel technologies like twin-screw extrusion is expected to create innovative products that would transform shrimp and fish feeding and justify the cost.

Growel's plan for growth also involve diversification into marine fish feeds. It has the technology and knowledge to produce marine fish feeds for the Indian market. Suresh said that in India, marine fish farming is currently constrained due to the lack of feeds. Farmers cannot produce marine fish without cost effective and performing feeds, whereas feed manufacturers cannot invest in costly technology to produce high quality feeds without a steady demand and breakeven volume.

"Our new infrastructure now resolves this chicken-and-egg problem and offers an opportunity for the marine fish feed sector to grow. After all it is in line with our commitment to serve the large and vigorously growing aquaculture industry in India with the best in products and services," said Narendra.

Growel was a sponsor at Aqua India 2014. Sandip Ahirrao with from left, Arun Kumar, Aresen Bio-Tech and Farms, B. Thiruppathi Vasagan, Candida Biosciences and D. Vijay Anand, Salem Microbes

Feed management practices in tilapia aquaculture in Malaysia

By Wing-Keong Ng, Sih-Win Teh, Kabir M.A. Chowdhury and Dominique P. Bureau

Red hybrid tilapia farmed in earthen ponds is the major culture system used by tilapia farmers in Malaysia.

In Malaysia, aquaculture industry contributed 16% to the total seafood supply and this is increasing steadily over the years. Due to very favourable government policies, the aquaculture industry has great potential for further expansion. The local aquaculture industry recorded annual growth rates of about 10% since 1993. The presence of vast bodies of inland freshwaters and the long coastlines of Peninsular Malaysia and East Malaysia augurs well for future aquaculture development. Tilapia production has been identified and targeted as a major contributor to the freshwater fish production in Malaysia. Areas known as 'Aquaculture Industrial Zones' have been designated throughout the country with several 'High Impact Projects' involving tilapia farming being launched over the last several years.

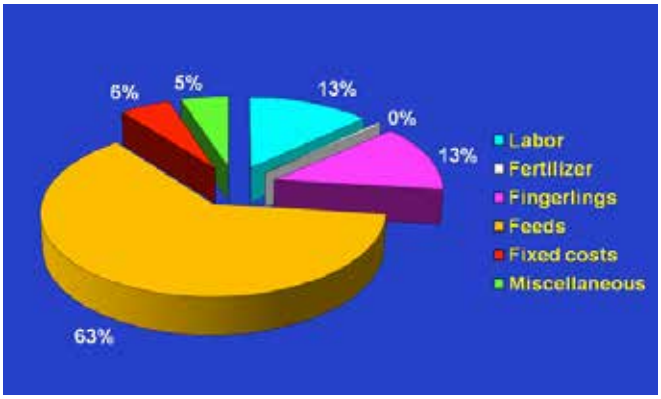
In view of this development, three organisations (Universiti Sains Malaysia, University of Guelph and the WorldFish Center) conducted a comprehensive field survey of tilapia farming in Malaysia to collect baseline information about the industry. This was the first such study carried out on the tilapia farming industry in the country. Data collected included socio-economics of farmer households, land status, water source, labour profile, support services availability, culture systems, access to tilapia fry for stocking, feed inputs, feeding practices, productions costs, marketing of tilapia, and constraints faced by farmers were collected. Data were compiled based on on-farm interviews, farm measurements, photographs taken and analysis of feed samples. It was hoped that the data collected could contribute to the formulation of appropriate policies and guidelines to further expand tilapia farming on a sustainable basis.

Surveyed farms

Over a period of 10 months in 2007, a total of 104 farms in both Peninsular and East Malaysia from the states of Negeri Sembilan, Pahang, Perak, Penang, Sabah, Sarawak, Selangor and Terengganu were surveyed. Based on the survey, the major tilapia culture systems are earthen ponds (64%), cage culture (32%) and ex-tin mining pools (24%). The dominant tilapia strain is the red hybrid tilapia of various varieties. The farm owners are predominantly male (age range between 41 and 60 years), and about 70% listed aquaculture as their major source of income. About 54% of the farmers own the land, but these are mainly small- and medium-scale producers.

Large producers in certain states operate on temporary operation licences issued by the state land office. Tilapia production occupies a small percentage of the total land available on the farm, and other agricultural activities such as livestock and vegetable farming are sometimes carried out to supplement farm income; about 76% of farm land remains underutilised in some instances. The 'temporary' and rented land status of many of the larger producers has somewhat dampened the desire of these tilapia farmers to expand their scale of production due to the perceived greater risk and loss in capital investment should the state government decide to take back the land. The lack of suitable funding was another factor given by the survey respondents as to their limited usage of the farm land for tilapia production.

Figure 1: *Average contribution of various costs to the total production cost of a tilapia farm in Malaysia.*



Feed management practices

Production function analysis suggested that cage culture was the best-performing system with the highest production yield. The average feeding costs of the surveyed farms were 62.6% of the production costs. High production cost was found to be result of the use of commercial tilapia feeds in over 90% of the farms surveyed. The three major commercial aquafeed brands used by the tilapia farmers were Cargill (33%), Star Feeds (30%) and Dindings (21%). All tilapia feeds used in Malaysia are produced locally.

Feed prices vary slightly among the different feed manufacturers and are also dependent on locality. Analysed proximate composition of various feed samples mostly tallied with the composition declared by feed manufacturers. Supplementary feed inputs such as cattle and poultry pellet feeds, farm-made feeds, copra meal, palm kernel cake, poultry intestines, animal carcasses and kitchen waste are used by small and medium producers to reduce feeding costs. Farm-made feeds varied greatly in their proximate composition depending on the ingredients used. Inorganic commercial fertilizers for pond water fertilization are not commonly used in tilapia farms in Malaysia.

The average period of tilapia culture of the surveyed grow-out farms was over 180 days. Farm-gate pricing for tilapia can be classified under three grades: Grade A (> 750g), Grade B (550-750g)

Harvesting process at a community-based tilapia farm in Malaysia.

and Grade C (<550g), based on the size of the fish. Tilapia are mainly sold live or freshly chilled in Malaysia, with some being exported to nearby Singapore. There are currently very limited local processing facilities for tilapia. However, with the entry of several new large tilapia producers in the country which target the export market, this scenario will likely change in the near future.

In conclusion, technical aspects of tilapia farming such as the use of cost-effective feeds and better tilapia strains need to be given special emphasis in order to boost the production of tilapia with maximum profitability.

Grading of tilapia during the harvesting process.

About the same time that this field survey was being conducted, a Norwegian company, GenoMar, established together with a local partner company, a major tilapia production company named Trapia Malaysia Ltd. Using state-of-the-art production facilities located at Temenggor Lake in Perak, this company is expected to be a major player in the tilapia industry, producing up to 20,000 tonnes of tilapia. The bulk of the production will be for the export market. Unlike most of the present tilapia farmers, Trapia Malaysia will be farming a fast-growing strain of Nile tilapia instead of the red hybrid tilapia.

Feed ingredients

Tilapia feeds produced in Malaysia consist mainly of soybean meal and other oilseed meals as the major protein sources. Wheat and corn flour and their by-products constitute the major carbohydrate sources. Soybeans, rapeseed and wheat are not cultivated in Malaysia, and local production of corn is very limited. These ingredients are therefore

imported from various countries for the local production of tilapia feeds. Fishmeal and fish oil are also mainly imported, as are various feed additives. With increasing demand and rising global prices of these aquafeed ingredients, to remain competitive, the local tilapia feed producers need to further explore the use of alternative locally available agricultural products and related waste materials in their feed formulations. Two industries identified as having the potential to supply much needed locally available alternative feed ingredients are the oil palm and poultry industries.

To date, research conducted by Universiti Sains Malaysia has indicated that various palm oil fractions can replace up to 100% of added fish oil in tilapia diets without any marked negative effects on fish growth, feed utilization efficiency or survival. The use of farmed tilapia as biological agents to extract residual palm oil adsorbed onto spent bleaching clay is a novel way of converting waste into wealth and is expected to benefit the oil refining and aquaculture industries as well as the environment. We also evaluated the use of palm kernel meal as an alternative to soybean meal in tilapia diets and found that despite its high fibre and the presence of indigestible non-starch polysaccharides, low amounts can be used in tilapia diets.

Malaysia has a large poultry farming industry with a sizeable number of integrated poultry farming operations. There is currently a great demand for dead chickens and their discarded body parts and offal by small- and medium-scale freshwater fish farmers for use as supplementary feed inputs. The high demand for these poultry by-products has resulted in some enterprising larger poultry companies (such as Kentucky Fried Chicken/Ayamas) investing in basic equipment to process them into ground and dried or frozen forms before packing and selling to the fish farmers at a higher price. A much more hygienic way to utilize these discarded poultry parts is to render them into useful protein meals and fats.

However, Malaysia currently does not have an established animal rendering industry. It is recommended that a coordinated effort be made by the relevant local authorities to centralize the collection of discarded poultry parts and to set up large rendering facilities to provide high-value feed ingredients for the thriving aquaculture sector.

Authors' note: This overview is based on a paper by Ng W.K., Teh S.W., Chowdhury K.M.A., Bureau D.P. (2013). On-farm feeding and feed management in tilapia in Malaysia. In: FAO Fisheries and Aquaculture Technical Paper No. 583. (Hasan M.R. and New M.B., Editors). Food and Agricultural Organization, United Nations, Rome, pp. 407-431.

This recently published FAO book can be downloaded from the following address: http://www.fao.org/docrep/019/i3481e/i3481e.pdf and the full CD version can be downloaded from the following link: ftp://ftp.fao.org/FI/CDrom/T583/index.htm

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Health challenges in tilapia culture in Brazil

By Santiago Benites de Pádua and Claudinei da Cruz

In line with the level of investment, changes in concepts with regards to sanitary and health management can ensure stable and efficiency in production. Risk reduction from diseases requires continuous diagnosis of pathogens, adoption of biosecurity measures and immunoprophylaxis by vaccination by a specialised veterinary service delivery in aquatic health.

Now in the spotlight in aquaculture in Brazil, the tilapia has demonstrated its contribution in the production of proteins of high nutritional value to meets the food demand in many countries. The main species used for industrial farming is the Nile tilapia, *Oreochromis niloticus*. The fish has the correct features for its farming in net cages, mainly installed in large hydroelectric reservoirs, where conditions are favourable for growth. In cage culture, stocking densities vary from 30 to150 kg/m^3 at the end of each cycle. In these systems, the feed formulations in use are effective to provide fast fish growth and excellent performance in a short period of time until harvest, which results in an average of two cycles/year, depending on the climatic conditions of each region.

Infectious diseases are the major causes of mortality and economic losses in the global tilapia culture industry. Numerous etiologic agents may be associated with morbidity conditions in this species, and often there is the mixed infection by different groups of pathogens, which in turn, worsen the evolution of mortality outbreaks (Figure 1) and accelerate economic losses. Furthermore, some pathogens pose serious risks to humans, being characterised as zoonotic pathogens. Their transmission to humans can occur primarily by direct contact during handling of infected animals or the consumption of meat without the proper cooking. It is worth noting that the risks of transmission of zoonotic diseases exist in the production of any animal species and is not restricted to the farming of aquatic organisms.

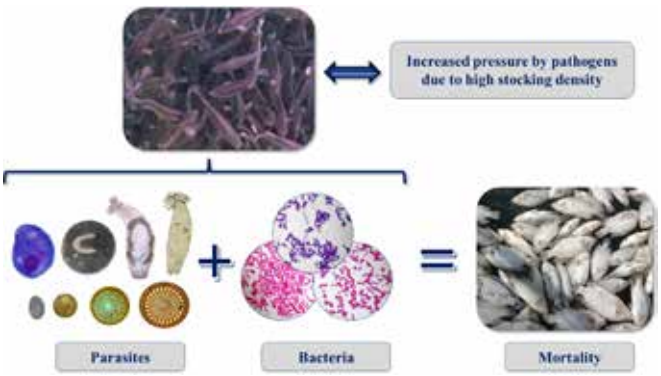


Figure 1: *Interaction between pathogens in tilapia farms that adopts high stocking densities. The parasitic infestation provide a mode of entry for secondary infections by bacteria that together with the parasites cause high mortality.*

Dynamics of pathogens in tilapia culture

Currently, parasitic and bacterial diseases are the major causes of losses in Brazilian tilapia culture. The tilapia can host several groups of parasites. Groups of gills, skin and fins ectoparasites are the most common in the field diagnosis. However, endoparasite infections are also diagnosed, although less frequently and they pose less risk to fish farming in net cages. On the other hand, endoparasite worms can be commonly found in fish farmed in earthen ponds, especially in broodstock.

Many parasites (such as *Paratrichodina africana* and monogenetic worms, figure 2) commonly diagnosed in cases of outbreaks in tilapia during the final fattening phase can also be harboured in asymptomatic fry and juveniles. Under these circumstances, the control of parasitic diseases in nursery farms is key to achieving greater sanitary control in the farming process. This is because health interventions in fish distributed in hundreds of net cages are more difficult, operationally limited, and of low efficiency and high cost. On the other hand, health interventions in nursery farms are of low-cost, operationally feasible and, depending on the adopted protocol, are highly effective in the control or suppression of parasitic diseases.

Figure 2: *Nile tilapia with severe gill lesion infected by gill parasites Dactylogyridean monogenean (a) and Paratrichodina africana (b) a pathogenic trichodina that infect only gill tissue.*

Bacterial diseases are the main final causes (*causa mortis*) of mortality in tilapia culture, often acting as secondary or opportunistic agents with mixed infection by parasites. Some bacterial diseases have a seasonal pattern with increasing cases in some periods of the year, while others may occur throughout the whole cycle and are not necessarily related to climatic factors such as columnaris disease. The francisellosis, also known as visceral granulomatosis, and the streptococcosis, also known as infectious meningoencephalitis, are examples of seasonal diseases (Figure 3), primarily related to water temperature. *Francisella noatunensis* infection causes outbreaks particularly in periods with water temperature below 24°C, while the streptococcosis occur in outbreaks during the period in which the water temperature is above 26°C.

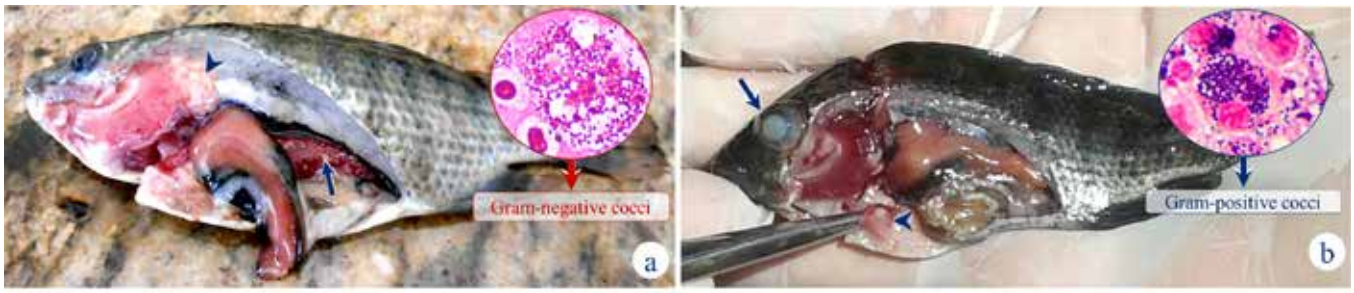


Figure 3: *Nile tilapia infected by Francisella noatunensis (a) showed whitish nodules (granulomas) in cranial kidney (arrowhead) and spleen (solid arrow), being observed gram-negative cocci into infected cell of spleen imprint stained by the Gram method. Streptococcus-infected Nile tilapia (b) showed corneal opacity and exophthalmos (solid arrow), skin darkening and pericarditis (arrowhead), being observed gram-positive cocci into infected cell of brain imprint stained by the Gram method.*

In addition to seasonality and water temperature, environmental health factors are strongly related to the incidence of diseases in tilapia. In this context, environmental health units seek to characterise all abiotic and biotic factors related to the welfare of the organisms in a given region. On the other hand, situations of high stocking densities, with high feeding rates and without efficient sanitary control are conditions that result in high risks to production. The deterioration of water quality favours the proliferation of pathogens. Therefore, for an efficient production system, with less pressure from pathogens, stocking fry and juveniles free of parasites is not enough, and this action should be complemented by a series of precautions during the production cycle in order to provide better welfare and health to farmed animals.

Health situation of tilapia culture in Brazil

With the increase in tilapia production in several Brazilian states, especially in net cages (Figure 4), there has been a concomitant increase of losses related to diseases over the farming cycle. However, few producing farms are structurally and technically prepared to meet the sanitary challenges inherent in tilapia farming. Thus, Brazilian tilapia culture has become an activity which is vulnerable to the occurrence of high pathogenic diseases with rapid dissemination. In turn, this can cause irreparable losses to the emerging industry which is also fast expanding.

Few tilapia farms adopt sanitary monitoring procedures in their routine and many other farms are lagging in performing these health care services. The lack of specialised veterinary service delivery in aquatic health is also an important limiting factor. Thus, fish farms do not adopt proper health management, since any form of intervention that aims to control and to eradicate diseases should be based on the diagnosis of the hygienic and health conditions of the farming. So, if they do not know the agents that cause diseases, they cannot direct the actions to achieve control and eradication of these diseases. However, changes are slowly emerging, based on unfavourable sanitary experiences in some farms.

To achieve a sanitary production, which is zootechnically efficient and environmentally sustainable, the professionalism of disease diagnosis or management becomes essential. Numerous farms, when purchasing animals for fattening, estimate future losses of around 10-20% in each cycle. As a measure of logical intervention, farmers stock a larger number of animals to make up for the estimated loss, instead of looking into the cause of the health problem. However, this increase in stocking density may lead to greater stress in the fish hence resulting in disease problems. Therefore, a change in management protocols in the Brazilian production sector is necessary.

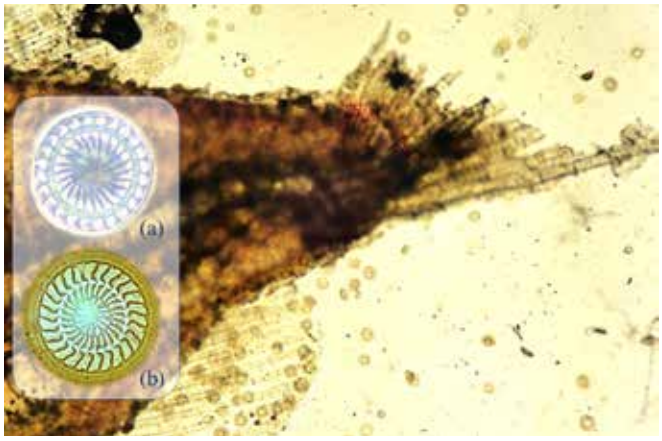
Higher level of professionalism in tilapia culture

Although huge investments are poured into the Brazilian tilapia culture industry with regards to production technology and automation, there is still a general lack of professional health management. On the other hand, changes in management protocols when facing sanitary challenges are most needed, as well as the implementation of the meticulous monitoring and diagnosis of animal diseases during the production cycle. In contrast, professional farms are not routinely surprised by outbreaks because these units apply control strategies based on a risk analysis of production. An efficient and professionalism in production has control over the pathogens that afflict the animals, and it also adopts sanitary barriers against the spread of these agents.

The development of control and disease eradication programs is the basis for achieving stability in production with greater production efficiency and lower environmental deterioration. For this, it is necessary that the Brazilian tilapia culture include a health surveillance program in the expansion plan of each business, with continuous diagnosis of

Figure 4: *Large tilapia farm (A3 Piscicultura, Ambar Amaral Group) from Santa Fé do Sul, São Paulo State, Brazil.*

pathogens, adoption of biosecurity measures and immunoprophylaxis by vaccination. Only through these tools the farms producing tilapia will be prepared for the health challenges inherent to this animal farming activity, resulting in production sustainability.



High infestation of trichodina ectoparasites on tilapia larvae.Picture shows Trichodina sp. viewed in phase-contrast microscopy (a) and Klein's silver impregnated Trichodina centrostrigeata (b), which is the main species of Trichodina that afflicts young tilapia.

Mortality of tilapia farmed in net cages due to bacterial infection associated with mixed infestation by skin and gill ectoparasites

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Gearing Up Towards a Climate-Resilient Aquaculture in the Philippines

5th Aquatech: Aquaculture Expo and Convention

May 29-31, 2014, Dagupan City, Pangasinan, Philippines

Mr. Henry Fong of BMEG Aquatic Nutrition presented a topic on Feed Technology during the 4th Aquatech Convention held in Tagaytay City.

For more information, you may email the organizer at: aquatech.ph@gmail.com or call Ms. Mary Ann Venturina at +6329040227 or +639273532438

Organizer:

Events QUality & Interactive Promotions, Inc. equip

The 5th Aquatech: Aquaculture Expo & Convention Philippines is an annual event organized by ***Events Quality & Interactive Promotions (EQUIP), Inc.*** Their aim is to educate and unite the aquaculture industry to an efficient and sustainable one to be globally competitive. Partners both from the government and organizations are Southeast Asian Fisheries Development Center (SEAFDEC), WorldFish Center, National Integrated Fisheries Technology Development Center (BFAR-NIFTDC), Central Luzon State University (CLSU) and World Wide Fund for Nature (WWF-Philippines). This event is 'the only technical event in the Philippines focusing on aquaculture'.

The Philippines has been struck with great impacts of climate change last year and the country was not prepared. This convention aims to educate the aquaculture industry not only to be sustainable but also to be climate-resilient.

The 5th Aquatech: Aquaculture Expo & Convention Philippines 2014 will be held in Dagupan City, Pangasinan from May 29-31. The first two days is for the conference and exhibit and the third day is for the technical tour to be led by BFAR-NIFTDC. Other activities are a free technical seminar for the local fish farmers of the region and an aquaculture clinic.

As of press time, the organizer have announced the following resource speakers: Dr. Aisa Salayo and Dr. Rolando Pakingking, Jr. of SEAFDEC, Dr. Westly Rosario of BFAR-NIFTDC, Dr. Apolinario Yambot of CLSU and Mr. Gregg Yan of WWF-Philippines.

Milkfish production in the Philippines

By Rafael D. Guerrero III

More production with intensive systems while boneless milkfish opens export markets.

Milkfish in a chilling tank

The milkfish *(Chanos chanos)* is a euryhaline fish that is indigenous and widely-distributed in the coastal waters of the Indo-Pacific Region. It is commercially farmed as a food fish in the Philippines, Indonesia and Taiwan and produced as tuna bait in Kiribati and Singapore. According to the UN Food and Agriculture Organization, global milkfish production grew from 467,660 tonnes in 2005 to 808,559 tonnes in 2010. In 2012, the global production was more than 900,000 tonnes with 522,100 tonnes from Indonesia and 387,022 tonnes from the Philippines valued at over PhP 3 billion (USD 75 million). The milkfish is the most important farmed species in the Philippines representing about 15% of total aquaculture production.

Farming trends

In the Philippines, milkfish are farmed in brackishwater ponds for centuries with methods believed to have been introduced by Indo-Malay migrants. The Philippine Bureau of Agricultural Statistics showed that 60% of the production comes from the more than 200,000 ha of brackishwater ponds in the country, 29% from marine cages/pens, and 11% from freshwater pens/cages in 2012. The top producing regions are Region 1 (Ilocos), Region 3 (Central Luzon) and Region 6 (Western Visayas).

In nature, milkfish broodstock, locally known as 'sabalo', breed in the sea during the rainy season (May to October). The fish matures at sizes of 0.6- 0.7 m in total length and weights of 2- 5 kg at 3.5- 5.5 years of age. The planktonic fertilized eggs (1.1- 1.2 mm in diameter) hatch into larvae (3.5 mm long) 35- 36 hours from spawning and feed on plankton. The wild fry (10- 17 mm long) are collected in nearshore waters by gatherers and reared to fingerling size in brackishwater pond nurseries with pond fertilization and/or supplemental feeds.

Since the 1980s, milkfish broodstock have been naturally bred in sea cages and marine ponds and tanks in the Philippines, Taiwan and Indonesia. The fertilized eggs collected are hatched and reared in indoor nursery tanks to fry size with feeding of phytoplankton *(Chlorella)* and zooplankton (rotifer and brine shrimp). A 6-kg breeder can spawn as much as 3-4 million eggs. From the nursery tanks, the fry are grown to fingerling size (2-3 cm long) in nursery ponds with pond fertilization and/or commercial feeds for 3- 4 weeks. Milkfish breeders can be productive up to 15 years of age or more. Of the 2.5 billion fry requirement of the Philippine milkfish industry, about 95% is now produced by hatcheries.

Traditionally, milkfish has been cultured in brackishwater ponds developed from mangrove areas throughout the Philippines. The ponds with earthen dykes and wooden or concrete gates have water depths of 0.25-0.5 m and are filled and drained through tidal water flow. Nursery ponds (100–500 m^2) fertilized with organic and/or inorganic fertilizer for 'lablab' (natural benthic food) production are stocked with fry at 30-50/m^2. After 4-6 weeks, the fingerlings (1-6 g) are moved to the adjoining grow-out ponds (0.5-20 ha) by making the fish swim against the current.

At stocking densities of 500-1,000/ha for extensive culture with or without pond fertilization, the yields of market size fish (200-300 g) after 4-6 months of growing are 70-140 kg/ha per crop. The polyculture of the fish with mudcrab *(Scylla serrata)* or the black tiger shrimp *(Penaeus monodon)* is often practised to increase pond productivity and income.

Modular ponds

An improvement in the pond grow-out of the fish in the 1950s was the introduction of the so-called modular or progression method. In the system, the fish is 'herded' from a fertilized pond (e.g. 1 ha) that has been "overgrazed" after 35-45 days to another adjoining one that is double in area (e.g. 2 ha) previously prepared for natural food production; and similarly to the third pond module that is twice as large as the second one (e.g. 4 ha). Compared to the extensive method, the stocking density of the fish in the first modular pond can be 8,000/ha that is reduced to 4,000/ha in the second pond and 1,000/ha in the third pond. Annual yields of more than 2 tonnes/ha per year depending on the management and weather are possible with this method.

Intensive pond culture of milkfish began in the 1980s with the advent of commercial feeds, deep water ponds (1-1.5 m), water exchange with pumps and artificial aeration. Pond water salinity is maintained at 15-25 ppt. At stocking densities of 10,000-20,000/ha, the yields are 5-8 tonnes/ha/year with two crops a year, market sizes of 250-350 g and survival of 80%.

Harvest of milkfish in a floating cage (Panabo Bay, Mindanao)

Chilled milkfish ready for market

The cost of producing the fish in ponds ranges from PhP 20 to 40 (USD 0.5 to 1) depending on the cost of inputs and management while the return on investment per crop is 33% for extensive culture and 21% for intensive culture.

In the 1970s, the culture of milkfish in pens was introduced in Laguna de Bay, the country's largest freshwater lake, which is highly eutrophic. Pens are made of bamboo poles staked into the bottom and enclosed with polyethylene nets in shallow waters with depths of 2-3 m. Small-sized fingerlings (5-20 g) are first grown to larger sizes (40-50 g) at a density of 5-10/m^2 in nursery pens (0.1-0.2 ha) within the grow-out pens (1-50 ha) where they are released at densities 3-5/m^2 after 1-2 months. The fish is harvested after 6-8 months of culture (without artificial feeding) with yields of 4-8 tonnes/ha, market sizes of 250-300 g and survival of 60%.

Marine cage culture

The mariculture of milkfish in floating cages and pens in coastal waters came about in the 1990s. The cages with rectangular, square or circular shapes are made of bamboo or galvanized iron pipes for frames, polyethylene nets for enclosures and plastic or steel drums for floatation. The cages which vary in size from 3 x 3 x 3 m to 20 x 15 x 6 m and 10-20 m in diameter with depths of 6-8 m are held in place with moorings and anchors. Pens built in shallow tidal rivers and bays are rectangular or square in shape with sizes of 200-1,600 m^2.

Small size fingerlings (5-10 g) are first stocked in nursery cages/pens at 20-50/m^3 and grown to larger sizes (40-50 g) for 1-2 months before being stocked in grow-out cages at 10-40/m^3 and pens at 6-12/m^2. The fish is grown to market sizes of 250-500 g with feeding of commercial feeds in 4-6 months with yields of 3-20 kg/m^3 and survival of 70-80%. Fish kills due to poor water quality have occurred in areas where cages and pens are congested and the sea bottom has been polluted by fish wastes and uneaten feeds.

The cost of producing milkfish in marine cages and pens with feeding ranges from PhP 55 to 60/kg compared to PhP 33/kg for producing the fish in freshwater pens without feeding. The return on investment, however, of the marine cages/pens (32-54%) is higher than that for freshwater pens (29%).

The fish is harvested in ponds and pens by seining, and netting in cages. Chilling tanks with crushed ice are used to kill the fish before transporting in containers to market or processing plants. The bulk of the farmed milkfish is sold locally in wet and high-end markets in whole fresh chilled or frozen form at prices of PhP 90-120/kg depending on size, source and season.

Boneless milkfish

While milkfish flesh is pink, soft and mild-tasting, it has more than 170 inter-muscular bones which do not appeal to discriminating consumers. To address this, deboned or 'boneless milkfish' is now widely produced in the country. Deboning is done by splitting the fresh fish with a knife and removing the gills and gut. The bones are then pulled out manually with special forceps. The fish can also be processed into canned and convenience products as sashimi, 'milkfish bellies', fish cakes and fish balls. Frozen whole milkfish and value-added products are also exported to the Middle East, US, England, Canada and Japan.

The Alsons Aquaculture Corp. (AAC) in Sarangani, Mindanao (southern Philippines) has the largest milkfish fry production, pond grow-out and processing operations in the country. Through its subsidiary, Finfish Hatcheries, Inc., it produces 1.2 billion milkfish fry annually with 12,000 broodstock weighing 10-26 kg each. The breeders are stocked at a density of 700 (350 males and 350 females) per 0.5 ha pond with a water depth of 1 m. Two to three kg or 1.5 to 2.25 million fertilized eggs are collected from the breeding ponds each day and reared to fry size in nursery units with 50% survival. The company sells three sizes of fry at PhP 0.35-0.45 each. Free deliveries are made to local farmers with orders of at least 500,000 fry.

AAC also grows market size milkfish (0.15-1 kg) in its 400-ha pond facility and cage culture operation in Sarangani Bay. The harvested fish is sold in chilled/frozen form in wet markets and supermarkets, and processed into value-added products with the Sarangani Bay brand for the local and export markets.

A milkfish pen in Laguna de Bay

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Realising the potential of marine fish fry

A new integrated line of products to ease culture and enrich large amounts of rotifers at unprecedented quality and vitality levels.

Easy DRY selco

A rotifer tank using RoBoost which clearly shows a foam-free surface.

Marine fish farming as a whole has expanded tremendously over the past decade, while a continued optimisation of the production processes is improving overall profitability. Taking this into account, today fish fry quality is considered more than ever before as one of the most important keys to a successful marine fish hatchery.

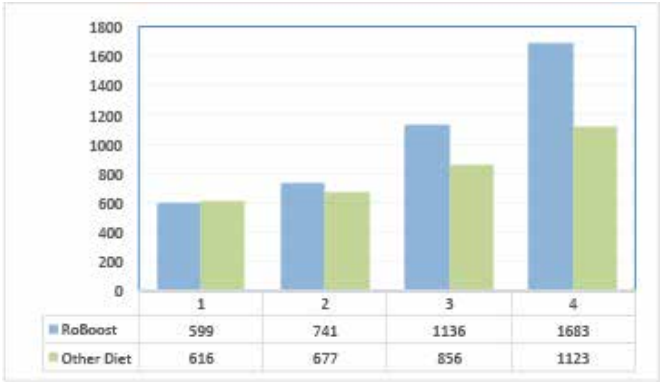
Therefore, it should not come as a surprise that hatcheries have made continuous efforts to maximise the potential of fry during the on-growing phases. More hatcheries therefore are shifting their attention towards fry quality rather than only quantity. They are also trying to make sure they perform better in terms of resistance to stress or diseases and enable higher growth performance.

Rotifers, as they have in the past, continue to be the best live feed for first feeding of most farmed species. One could even say rotifers are currently the key to the future quality of farmed marine fish. The reliable production of sufficient amounts of good quality rotifers is therefore one of the primary goals in the rearing of marine fish larvae. It is also the reason why almost all marine hatcheries continue to look for ways to boost this part of the hatchery production phase. Despite all these efforts, rotifer production is today still often subjected to problems in terms of stability, which decreases predictability and quality of production while increasing the overall costs.

Of course, not only do the hatcheries themselves invest a lot of time and effort into improving rotifer culture. Conscious and market-aware aquaculture suppliers are also devoting substantial research efforts to try and solve this bottleneck.

INVE Aquaculture, the world leader in hatchery products, has long been at the top in bringing new and research-based solutions to the aquaculture market. A clear-cut example of this is their long track record in both enrichment and culture products: the well-known selco® products were the first commercially available enrichments in the aquaculture market back in 1983. Even after this successful history, INVE Aquaculture is still looking for ways to improve the overall live food quality. In this context, the internal R&D program 'Total Quality', is launching a new integrated line of selco products to easily culture and enrich large amounts of rotifers at unprecedented quality and vitality levels.

Two new main products lead this live food line: *RoBoost* selco (rotifer booster selco) and easy *DRY selco*. *RoBoost* selco is a new revolutionary concept for rotifer culturing that has been designed to be used in combination with fresh yeast which currently is the easiest, cleanest and cheapest ingredient used for rotifer culture around the world. As it boosts the yeast, it enables clean and amazing results for all rotifers strains in almost every type of rearing environment. An added advantage is a more rapid growth when compared to other commercially available diets, which is illustrated in graph I.



Graph 1: Average rotifer growth over 3 runs (rotifer density/ml)

Tania De Wolf, Project Team Leader, INVE Aquaculture, said, "We realise that dry culture products are usually perceived as not practical to use and associated with certain difficulties, such as controlling the water quality. We wanted to change this." The use of RoBoost results in a very clean culture (no more flocs or foam on the water surface) with a consistent and superior performance. An additional advantage is

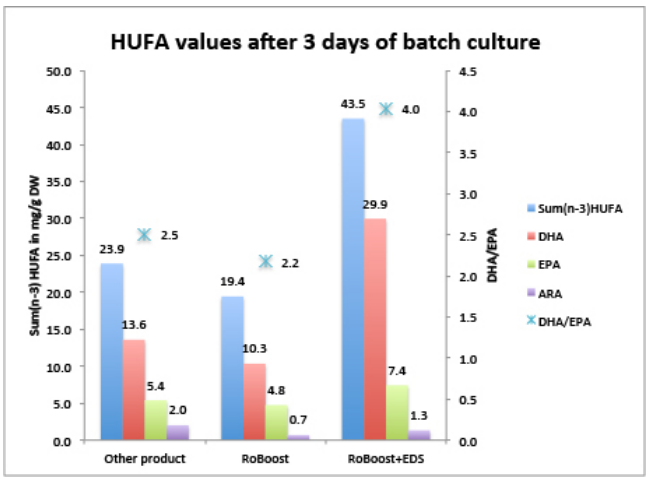
Tania De Wolf

that the rotifers are also nutritionally boosted at the end of the culture, making the normally subsequent enrichment phase obsolete for most finfish species. In turn, this saves hatcheries a tremendous amount of time and money.

"Of course, most hatcheries nowadays also look at their bottom line, and that is where *RoBoost* offers perhaps its greatest advantage as it costs up to 40% less than other rotifer diets. All things considered, it makes it a truly revolutionary product in the widest sense of the word and can be looked at as a groundbreaking achievement for the marine fish hatchery industry as a whole," added De Wolf.

The second new product, easy *DRY selco*, is a dry enrichment product for both rotifers and *Artemia*. As the name suggests, it is extremely easy to use. It consists of a formulation that boosts the live food with balanced levels of HUFAs (highly unsaturated fatty acids), proteins, vitamins and other key ingredients. What sets it apart from other live food enrichments is the inclusion of immunostimulants and a specific ingredient to keep microbiological growth low during both the enrichment phase and during feeding of the larvae. This ultimately leads to stronger fry. Easy DRY selco is also suitable for tropical and fast growing species. If used for rotifers, it can be used as a traditional enrichment (after the culture cycle) or even directly into the enrichment tank during the last phase of culture (graph 2).

During a large scale test performed at MRS - Maricoltura di Rosignano Solvay (INVE Aquaculture's commercial scale testing centre for marine fish species), Easy DRY selco was used for rotifer enrichment and was compared to classical enrichment products. The results, both



Graph 2: HUFA values after 3 days of batch culture

in terms of survival and growth, were unanimous: Easy DRY selco came out as the best product and limited the main deformities encountered during bream larval rearing, including that of the operculum.

As with all of their products, the two new selcos were tested extensively both in-house and in-the-market over the last couple of years. During and after the introduction phase, the company's staff in the market will provide support to assure the products are seamlessly integrated into the hatchery operations.

Sustainability trends in Asian aquaculture

By Luca Micciche'

Today, almost half of the seafood globally consumed is farmed. After more than five thousand years of development (records about fish farming goes to China, with data going back to 3500 BC), aquaculture is now widely practiced all over the world with variations in the size of the farms, level of operations as well as production objectives. Aquaculture currently represents one of the realistic options for meeting the growing global demand for seafood and feeding the world in the future, especially given that the harvest from ocean fisheries cannot be increased sustainably. Some fish farms combine both the hatchery and fish production activities, while others are either for hatchery or grow out operations. Most of the aquaculture activities are land based involving ponds, rice paddy, and raceways, whilst other fish culture practices are conducted in natural water bodies such as pens, cages on- bottom, stakes or rafts for fin and shell-fishes.

Almost all forms of aquaculture are practiced in Asia that represent not only the major producing but also the major exporting area, supplying its high-value products to the major importing markets; US and Europe. These among others, require strict guarantees on the quality of imported products. However, the negative environmental and social impacts associated with the rapid growth of aquaculture and the vulnerability of small-scale producers have to be addressed and are hindering exports causing difficulties to producers and exporters.

In fact, food security and food safety with regard to aquaculture products have emerged as priority issues in the last years and Asia is the epicenter of this worldwide crisis. The first problem registered in the region was primarily a lack of a sophisticated and open market for regional trade in food commodities, undermining products traceability. Price increases are due essentially to aquaculture products concerns and market requirements such as food safety standards and traceability. This is creating serious obstacles to trade, especially in excluding small-scale farmers from market chains (United States Government, 2011), a segment that sometimes represents the major producers of some goods (e.g. shrimp farms practices in Asia are mainly carried out by small-scale farmers).

Asian aquaculture sector: structure and challenges

Approximately 80% of aquaculture farms in Asia are small-scale operations, which often face inequitable access to technical and financial resources and are the most vulnerable to lose their production due to disease outbreaks (Phillips & Subasinghe, 2012). The aquaculture industry in Asia, therefore, often raises concerns about negative social and environmental impacts, which needs to be mitigated through the adoption of sound practices to ensure industry sustainability. The main factors hampering the sustainability or growth of small-scale producers can be listed as: increased trade and market-related problems; disease outbreaks; inequitable access to markets and market information; difficulties in accessing financial and technical services; higher costs associated with market-determined production, food safety, quality assurance, and sustainability certification requirements. Small-scale producers will rapidly become uncompetitive as they strive to meet the stringent sustainable production techniques and traceability requirements.

A shrimp farm member of Aceh Aquaculture Cooperative in Indonesia. WorldFish along with the IDH Farmer In Transition Program is working to improve productive practices and the shrimp value chain in Aceh, Indonesia.

Buyers and markets play a key role in incorporating and rewarding responsible aquaculture practices. As a result, the purchase of certified products is on the rise for major seafood buyers as over 80% of them have made some sort of public commitment to sustainability (Matt Elliott, 2013) based on certification schemes application. However, even with the acceptance and rise in certification, it is likely that certification will only cover a limited portion of the seafood market over the short and medium term. This leaves the vast majority of producers unaffected and there is a need for an interim level tool that allows small-scale producers to begin to climb the ladder towards more sustainable production. Although some would suggest that existing country-level GAP (good aquaculture practices) standards should fill this role, (Indonesia, Thailand and Vietnam have developed national standards applied to aquaculture to ensure the requirements for safe and hygienic products, reduce disease, reduce pollution of the ecological environment, and ensure the implementation of social responsibilities and the traceability of products), the reality is that there are large differences in how they are defined and how they address the major social and environmental sustainability issues (TFFA, 2012). This prevents buyers from using these standards, especially those with public sustainability commitments.

The 'sustainable revolution' has begun

The management of aquaculture at an area (or zonal) level is a fundamental requirement for sustainable development in the future. In addition, relative efficiencies in production by species, system and country suggest that investments, combined with the right institutional policy and market drivers, could lead to dramatic environmental performance improvement in many aquaculture sectors (Hall *et al.*, 2011).

It is obvious, starting from these assumptions that a joint effort among public and private sector stakeholders as well as certification bodies is necessary to effectively address the barriers facing small-scale aquaculture farmers. This is already happening. There are several initiatives by governments, non-government organisations, private sector as well as farmers. These are to improve aquaculture practices to gain a better product and ensure long term sustainability

Introducing milkfish aquaculture in India. With the help of WorldFish Incubator program Dr Arun Padiyar, an aquaculture expert and entrepreneur, is starting to introduce milkfish aquaculture practices in India. This species can be easily cultured along with shrimp decreasing disease outbreaks risks.

and at the same time, boost exports. Among the initiatives, voluntary standards as well as better management practices (BMPs) have been identified as powerful mechanisms to ensure all stakeholders along the value chain including the final consumers, that the products they purchase were produced responsibly, sustainably and comply with food safety standards.

Besides, several programs/actions aiming to promote linkage between stakeholders for responsible production as well as creation of awareness of market demand on quality and safety products have been initiated, thus creating a sort of 'Sustainable Aquaculture Movement'. Here are some examples:

- The EU, inside its FP7 cooperation work program, is implementing the 'Sustaining Ethical Aquaculture Trade' (SEAT) research program in Asia. This is to establish an evidence-based framework to support current and future stakeholder dialogues organised by a third party certifier and finally contribute to harmonising standards, helping consumers to make fully informed choices with regards to the sustainability and safety of their seafood.
- WorldFish through its programs 'Aqua-Spark Fish for Good' and 'Incubator: Sustainable Aquaculture Made Possible' is attracting investments helping the aquaculture sector to meet the growing demand for fish whilst ensuring equitable supplies and access for the poor.
- The Sustainable Trade Initiative (IDH) through its program 'ASC accelerator' for pangasius farming and its 'FIT fund' program for shrimp farming aims to increase the sustainability and boost the exports of this two goods, that represents the bulk of production in Asia.

Furthermore, other and several initiatives are supporting small-scale fish farmers in Asia to improve environmental and social performance and comply with food safety requirements. However times are changing, the 'Sustainable Aquaculture Movement' has generated substantial interest in certification on producers and stakeholders involved in the value chain, as buyers look for traceability and verified sustainability schemes.

These new trends are producing sensible impacts on the aquaculture sector. There are evidences that these initiatives have the potential to make up for the lack of sustainability of the industry in the main regions of production. These also highlight and possibly, in a near future, eliminate the problems encountered so far due to the existence of different certification schemes which are more often a cause of confusion among the value chain actors. Therefore small-scale farmers can become more inclusive inside this growing industry.

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Positioning for Profit

"The Asian Pacific Aquaculture Conference and Trade Show 2013, held from December 10-13 in Ho Chi Minh City, Vietnam was a huge success," said organisers, the Asian Chapter of the World Aquaculture Society (WAS) and Vietnam Association of Seafood Exporters and Producers (VASEP). Vietnam's Ministry of Agriculture and Rural Development (MARD) was the host. This is the second Asia Pacific Aquaculture conference held in Vietnam, since 2007. It was attended by 2,500 participants from more than 65 countries, comprising 1,300 conference participants, 100 companies in the trade show and 1,200 trade show visitors. There were more than 500 oral presentations in 9 sessions and 160 posters. It was preceded by a workshop on biofloc technology from 9-10 December. A successful session for farmers was organised and hosted by gold sponsor Uni-President Vietnam on December 12 (see page 4).

During the plenary session, **Dr Pham Anh Tuan**, deputy director general at the Directorate of Fisheries (D-FISH) made a presentation on 'positioning Vietnam towards sustainability'. This covered a review on aquaculture production in Vietnam and her future plans in aquaculture. He added that the challenges in aquaculture are mainly high prevalence of diseases, high costs of production, market requirements, climate change and limited financial resources.

"In 2012, some 100,000 ha of farming areas were affected by disease. In pangasius farming, the survival rate was only 60% and in tilapia, it was infections with *Streptococcus*. Lobster farms also encountered diseases. Our challenge is how to keep the balance between demand and supply and meet market requirements. Although certifications are numerous and varied, we have progressed as we have more than 20% of total production or 30 farms with Aquaculture Stewardship Council (ASC) certifications. If we consider all types of certifications, then we have 103 certified farms which is more than 40% of total production volume. Our target is to introduce VietGAP by 2015 for 100% of aquaculture production."

Dr David Hughes, Emeritus Professor of Food Marketing at Imperial College London gave a presentation on 'Fish & Seafood Demand in Growth: Sit Back and Enjoy the Ride or Buckle Up Seat Belts and Crash Hats On.' "Fish and Seafood demand is strong in both emerging and developed markets," said Hughes. "In particular, the Asia Pacific region is 'very fish positive', close to 70% of total meat consumed is fish and Australia is moving towards a 'white meat culture'. The battle will be between fish and chicken."

Dhanapong Sangsue (right) with team and Thai visitors at the Evonik booth. From left, Mai Anh Can, Evonik Vietnam LLC, Siriporn Plyhirun TRF Feedmill, Dr Preecha Ekatumasuit and Dr. Suphot Wanitkitkeurphol, TRF Feedmill, and Dr. Luengyosluechakul, ZinPro.

Utilisation of amino acids in aquaculture session

This was conducted by Evonik and the keynote speaker was Dr Albert Tacon, USA who spoke on why we need amino acid supplements in compound aquafeeds. Some presentations covered research on specific amino acids in fish; requirement of isoleucine in the olive flounder, taurine enhancement in red seabream and amino acids requirement for pangasius catfish. The presentations from the Evonik team included a review on amino acids in fish meal from South East Asia by Dhanapong Sangsue; effectiveness of crystalline amino acids in aqua feed by Dr Claudia Figueiredo-Silva and growth in Rohu fish fed the diets formulated based on ideal protein ratio (AMINOCarp) by Dr Karthik Masagounder.

The message at the session was, "Animals do not have a requirement for proteins *per se*, but they have a requirement for individual amino acids contained within dietary proteins. The nutritive value of a protein containing ingredient is the profile of the amino acids. The amino acid profile of the animal is determined by genetics and not by diet. Amino acids can be categorised as essential, non-essential and conditionally essential. In general, the closer the EAA pattern of a dietary protein approximates to the dietary EAA requirement of the farmed target species, the higher is its nutritional value and utilisation."

Dr Kua Beng Chu, Department of Fisheries, Malaysia (left) and Tan Hsian Huei at the Range Pharma Booth

However, will the demand increase? Hughes said that this is contingent on the economic growth in China. If their income drops, Chinese consumers will stop spending. In the US, consumption of fish is increasing and in schools, there are campaigns to eat less meat. With an aging population such as in Japan, demand will be for more fish but also less food will be eaten with lower metabolism. Until 2020, further fluctuation in supply and demand is expected with droughts and climate change. "In 2006 to 2013, rises in prices and volatility were evident," added Hughes.

The hurdle to more seafood consumption is due to consumer ignorance in many developed countries. Their lack of knowledge on fish: on what to buy, how to prepare, cook and eat, places a constraint

David Hughes (second right) with the Santeh team, from right, Daniel Cabrera, Patricia Rico and Ariel Reputola.

The Uni-President Vietnam team, from left, Tsai Hung Yi, Wu Sheng Wei, Liou Hai Hua , James Hung, Chan Yung Sheng and Ma Chin Tien with guest, Sim Ing Jye, Sea Horse Sdn Bhd, Malaysia.

on the demand. The fish sellers in supermarkets know little about fish. Threats are in the perceived industrialisation of fish and seafood, supply chain integrity and commoditisation of the industry.

At the trade show, the range of products was from polychaetes for shrimp broodstock maturation to feeding and aquaculture systems. Disease is a priority challenge in shrimp farming, in particular, early mortality syndrome or EMS. Several aquaculture solutions and health companies had new products to mitigate EMS such as the diagnostic kit by Taiwan's GeneReach Biotechnology (www.genereach.com see page 10). Range Farma, Malaysia has Shrimp Pro which contains yeast protein extracts and amino acids, lecithin, mannan oligosaccharides, valine and vitamin E and helps to prevent EMS as it improves the condition of the hepatopancreas and the general health of shrimp. Range Pharma is one of the leading and pioneer veterinary pharmaceutical companies in Malaysia. (www.rangepharma.com.my).

Framelco B.V., Netherlands specialises in functional feeds. At their booth, Devi Hermsen, R&D manager Aquaculture, explained that they have a new development, FRA®Shrimp Protect Liquid which reduces the impact of EMS by blocking bacterial infections. It prevents high infection rates and lowers the mortality rate caused by EMS. This is based on a patented technology for the esterification of fatty acids. The product contains several 1- monoglycerides, selected organic acids and micro-ingredients. The 1-monoglycerides possess antibacterial, antiviral and animal performance improving properties. Although possessing bactericidal properties, the product cannot be classified as antibiotics since the molecules do not literally kill the bacteria. Instead, the 1-monoglycerides disturb the cell's homeostasis by altering membrane structures. Hereby the bacteria cannot longer take up energy and water. As a result, the bacteria starve to death. An *in vivo* challenge trial at the University of Arizona, USA, showed a reduction of 80% mortality after 7 days of using the product in the feed, feeding once a day. An MIC trial in Thailand showed the inhibitory effect on *V. parahaemolyticus* at a concentration of 0.8%.

At the ABCA booth, the new products were AB MOS, a solution for gut health and for enhancement of resistance to disease and parasites. It contains high levels of MOS (mannan oligosaccharides) and beta-glucans which help in mucin production and improves survival rates through immune system modulation. AB Yestex with premium yeast extract from a selected strain *Saccharomyces cerevisiae* and nucleotides support larval development as well as maintain a healthy immune status. ABCA is a division of AB Agri Ltd, the Agriculture group of Associated British Foods. plc (www.abagri.asia)

The team from Uni-President Vietnam marketed its new product range. This is the monodon booster feed 100 series which showed good growth performance and reduce risks from diseases. The product has immunostumulants to promote shrimp health and resistance (www.uni-president.com.vn). Ocialis Vietnam has a new range of feeds for the marine fish called Nutrilis. The feed has a crude protein range from 52% to 42% and crude fat levels from 10 to 25%. The feed was created from R&D support of the global Ocialis team specifically for barramundi, snapper and pompano. It has beta-glucans added into the feed to improve the natural resistance of fish (www.invivo-nsa.com.vn).

A first time exhibitor is Harvest Co Ltd, shrimp and fish feed (catfish, tilapia, seabassetc) producer from Vietnam. It also farms and exports pangasius products (www.harvestaquafeed.com). It was also a first for Rich SA, Greece at an Asian exhibition. Rich produces feeds specifically for the marine fish and shrimp hatcheries. Antonios Komis introduced the new product, Essential a freeze dried powder for green water in marine fish and shrimp larva feeding (www.rich.gr). Also in the hatchery industry is Service Aqua LLC, USA which supplies pathogen free broodstock feeds such as European farmed marine polychaetes, US frozen brine shrimp and frozen Californian squid (www.serviceaqua.com).

The team from Lucky Star Aquaculture Feed, Taiwan was promoting its Lucky Star Hirame feed for nursery rearing. It also has dry larval and brood stock diets for the marine shrimp (www.luckystarfeed.net). Philippine feed manufacturer Santeh Feed Corporation was active at the trade show and conference. Daniel Cabrera presented on Santeh's 25 years of experience in the Philippines aquaculture at the Economics and Management session. Santeh has a line of fry booster feed and floating micro-pellets for hatchery and nursery rearing. It is also well known for its range of marine fish feeds designed for cage and pond culture of the grouper, seabass, snapper and pompano as well as mud crab feeds (www.tateh.com).

Australian Nutrakol has Nutrafeed® - a semi moist maturation diet for shrimp and other crustaceans that can replace completely fresh/frozen feed. The diet contains feed attractants,making it as appealing as fresh feeds. Although semi-moist, the diet is very stable in water (up to 24 hours) and will not break down when shrimp or lobster is holding or chewing the feed. The diet also has a long shelf life. The feed was tested with vannamei and monodon shrimp, bugs *Thenus orientalis* and tropical lobster *Panulirus ornatus*. The diet contains herbal extracts (NutraBrood Enhance®) that enhance and boost the shrimp hormonal cycle resulting in improved spawning (quality and quantity), larval quality as well as provide immune and digestive system support (www.nutrakol.com).

Tyson Animal Nutrition Group, USA was a WAS premier sponsor at APA 2013 and the president's reception (www.tysonanimalnutrition.com). Tyson is one of the world's largest processors and marketers of meat and poultry. For the feed industry, it has 100% chicken-based meal such as chicken by-product meal, feather meal and chicken fat. Chicken by-product meal is made from chicken parts and the

Sagiv and Judith Kolkovski at the Nutra-Kol booth

minimum crude protein (CP) content is 66%. Feather meal has 80% minimum CP. Meals come with options for antioxidants. At its booth, Jeannie Ozlanski, Associate Product Manager said, "Asia is a budding market for the company and we are excited by the potential for exports into China, Vietnam and Indonesia. We are beginning to see more demand from the fish and shrimp feed market especially now that the EU has removed the ban on the use of poultry by-product meals in aqua feeds. Tyson is marketing into the aqua feed markets in Asia through promotional marketing at APA 2013 and in publications." She added that industry pricing of poultry by-product meals are formulated based on the soybean meal market prices.

Behn Meyer Aquaculture is an established player in SE Asia with innovative products for the entire aquaculture value chain; from hatchery, feed production to nursery and grow out farms. It has an R&D centre in Vietnam to work on customised solutions, which was recently extended to include a marine system for shrimp research and digestibility tanks for more comprehensive nutritional work. At the trade show it launched PhytoVit Aqua and OptiGuard, both all natural supplements to help farmers manage stress and disease in aquafarms.

At the Tyson booth, Chuck Malone, Tan Boon Wan, Jeannie Ozlanski and Andy Dilatush

PhytoVit Aqua is a new botanical additive containing bioactive compounds rich in polyphenols, anthocyanins and flavonoids with anti-oxidant and immune enhancer properties. At a presentation during the session on finfish nutrition, Dr Wee Kok Leong, Regional Technical Manager - Aquaculture, discussed the value of botanicals as feed additives in enhancing growth performance, conversion efficiencies and disease prevention/treatment. The product was Phytovit Aqua which when added at 1kg/tonne in feeds for the tilapia, pangasius catfish and shrimp led to significant improvements in growth and feed conversion efficiencies. It has also conducted trials at the R&D centre on the effect of PhytoVit Aqua on immune response and disease prevention in fish and shrimp. Also under Behn Meyer Aquaculture is a natural trace mineral called Azomite. In a presentation, Dr Douglas Fodge showed that inclusion in diets for shrimp and tilapia improved weight gain, feed conversion, and digestive enzyme production and in addition, important changes in immune parameters. In the hatchery supply chain Behn Meyer Aquaculture works exclusively with Epicore BioNetworks Inc., a renown producer of probiotics and liquid feeds. Epicore's Fernando Garcia presented a paper on 'third phase - the potential of raceways systems in SE Asia as a tool to overcome EMS/AHPNS' during the session on crustacean husbandry and management.

It was a first at an Asian aquaculture trade show for Cablevey Feeding Systems, USA (www.cableveyag.com). The company has adapted its unique overhead feeding system for aquaculture. A model of the system at the show showed the simplicity of the design.The feed moves from the bulk bin through a galvanized steel tube by means of parallel plastic discs to deliver whole pellets to the fish. Feed is discharged from the tubing at desired locations through custom cut openings. AQ1 Systems, Australia has developed a novel shrimp control system, the SF200 (Sound Feeding), based on measuring the acoustic signal created during feeding. This allows the control of feed intake precisely and instantaneously. The system does not allow feed to build up on the pond bottom due to the approach of ensuing each feed delivery is consumed prior to the delivery of more feed.Trials with vannamei and blue shrimp show improvements in SGR (10-20%) FCR (5-15%) and an increase in harvest biomass (www.aq1systems.com).

The Behn Meyer team. Back row, from left; Nguyen Quoc Viet and Mai Anh Tuan, Vietnam, Yusuf Marianto Masidik, Indonesia, Wee Kok Leong, Malaysia. Front row, from left, Dao Ngoc Thuy and Nguyen Thi Minh Huong, Vietnam, and Evie Erlina Shanti, Indonesia

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Aqua additives for a sustainable blue revolution

Global experts proposed solutions in health and digestive physiology for some immediate problems in fish and shrimp farming

The Nutriad team and speakers at the seminar. Front row, from right; Allen (Ming-Hsun) Wu, Regional manager - Aquaculture, Asia Pacific, Taiwan; Dong Bui Van and Quang Le Minh, sales managers Vietnam. Back row, from left; Alexander van Halteren, Business Development manager, AP & EMEA, BU Aquaculture, Nutriad Belgium; Fernando Kubitza; Tim Goossens, Erik Visser, Peter Coutteau and Hanno Slawski.

In December 2013, Nutriad's Asia Pacific team organised a seminar in Ho Chi Minh City, Vietnam where global experts discussed some solutions in health and digestive physiology appropriate for the Asian fish and shrimp farming industry. It was held on 10 December, 2013, a day before Asian Pacific Aquaculture 2013, conference and trade show. Hosted by CEO Erik Visser, the seminar was also a meeting of new and existing industry partners and clients. Belgium-based Nutriad provides smart additives solutions for sustainable and cost-efficient aquafeed.

"Nutriad is a global animal feed additive company but we work very close together with our customers as we want to understand their daily challenges. As I see it, aquaculture is at the level of the livestock industry, 30 years ago. It is hungry for new solutions and technology to fuel growth. Our product development is centralized in Dendermonde in Belgium but we have aqua experts in all relevant aqua markets working hand-in-hand with our customers to develop innovative solutions. We are proud to have 'central engineers but local delivery'," said Erik Visser, CEO.

"Within the global animal feed industry, the aqua feed industry is a niche market, which is not standardised yet extremely dynamic. Although showing fast growth, most of the aquafeed industry is fragmented over many different species, countries and culture methods. This makes it a challenging business to develop at a global scale. During the last GOAL meeting, the top two challenges identified by the industry were diseases followed by productions costs which are mainly related to feed costs. Our role is to resolve bottlenecks using our aqua expertise and our capabilities to innovate in aquaculture", said Aquaculture business unit manager, Dr Peter Coutteau. "The purpose of this seminar is to exchange knowledge from different species and continents with our asian customers. We invited speakers from Europe and Latin America covering the current main interests in Vietnam and Asia i.e. diversification of fish production into tilapia and other new species, and managing EMS."

Coutteau described some results from trials conducted with Nutriad's two main programs of specialty additives, digestive enhancement and health. "The rules in costs of feeds are always changing with that of raw materials costs. The recent increases of the cost of protein ingredients and fats improves the relative benefits from improving the digestive and metabolic efficiencies. The product line Aquagest offers species specific enhancers of metabolic/digestive efficiency. The product line Health contains different specialized products to prevent the impact of disease and parasites on production of fish and shrimp. With ISA and sealice in salmon, EMS in shrimp, gill and gut parasites in marine fish, the disease pressure is high and increasing in many aquaculture operations. Specialized, natural feed additives have a great potential as a key tool in prevention strategies," added Coutteau.

Assoc Prof Kathy Han-Ching Wang (middle) with colleagues from National Cheng Kung University

Feed additives in fish feeds: stabilizing or upgrading fish performance?

Dr Hanno Slawski, R&D Manager, Aller Aqua, Denmark described the research in the use of feed additives in a simple and smart way. There are two ways to add feed additives; supplementing the feed additive to the existing recipe to increase performance but also increasing recipe cost or reformulation of the recipe and incorporating the feed additive without affecting or in some cases reducing the recipe cost. Both strategies may show an increase in fish performance and offer more flexibility on ingredient choice.

An example is the development of a winter diet for rainbow trout in Europe. Trout only grows well from May to November. During the winter months, there is no growth and as such, any feed to propel growth will be an advantage. A new feed was optimised with increased availability of energy through the use of an additive complementing the fish's capabilities to digest fat. Farmers reported improved performance in terms of growth and FCR with this feed but also observed that much less fat is released from the faeces and collected in the surface cleaners. The latter illustrated visually that fish fed the winter diet clearly improved fat digestion and utilization during winter", said Slawski.

A talk on disease challenges and productions risks for tilapia and new fish species in Brazil was presented by Dr Fernando Kubitza, an independent consultant, Acqua Imagem, Brazil. "In Brazil, tilapia production is 250,000 tonnes annually but this can be better as the available farming area is 4 million ha. There are three types of farming systems (green water ponds with no aeration, green water with aeration and water exchange and net cages). The majority is in net cages with a standing crop of 40-250 kg/m^3. The latest trend is a lower standing crop with exposure to fast currents in net cages. The risk of nutritional disorders is high in cage culture where the pathogen load is high. Disease outbreaks are not related to density but to feed and culture management."

Kubitza added that in net cages, the loss to disease is moderate to high. Losses due to disease from mortality, growth reduction, poor feed conversion and the need to use medications can be as high as USD 2/kg. The nutritional disorders are from mycotoxins and anti-nutritional factors causing inflammation of the gut. There is also the impact from low oxygen which negatively impact growth and feed conversion ratios.

QS inhibition and EMS

Since 2010, the research team on Gut Health at the Nutriad Technology Center in Belgium has been working on the application of quorum sensing (QS) inhibition to enhance gut health and microbial control in the digestive tract of poultry and aquaculture species. The relevance of quorum sensing inhibition for shrimp health was introduced by Nutriad in August 2012 at the 2nd TARS meeting in Phuket, Thailand. Since October 2013, it is widely accepted that the early mortality syndrome in shrimp is caused by a number of specific strains of *Vibrio parahaemolyticus* producing a potent toxin which is regulated by quorum sensing. "Controlling the development of pathogenic Vibrio in the shrimp's stomach can be done by bacteriostatic action, ie preventing their explosive growth, and/or by quorum sensing inhibition, ie preventing the bacteria to coordinate the release of the toxin that damages the shrimp's digestive system. Using *in vitro* bio-assays as well as *in vivo* challenge tests we have been able to select a number of natural components on their synergistic actions at the level of both mode of actions, resulting in products such as Sanacore GM which are potent in bacteriostatic action as well as QS inhibition against different Vibrio species," said Dr Tim Goossens, senior scientist Gut Health.

"With Sanacore GM, first results from the field in Thailand and Vietnam show lower Vibrio counts in shrimp gut and drastic improvements on survival and harvest yields beyond day 45 of culture. It will be impossible to eliminate totally the pathogenic Vibrio in shrimp ponds but through the combination of farm management to control the microbial environment in the pond and dosing the right combination of natural anti-microbials through the feed to control the gut microflora, we can avoid EMS and allow shrimp to reach harvest size," added Coutteau.

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

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

Getting more from less

As feed resources are finite and costs of protein sources increasing, can protease be the solution to get more out of protein sources and reduce feed costs? During APA 2013 in Ho Chi Minh City, Jefo and their partner in Vietnam, Nutrispices organised a seminar on its enzyme product for the fish and shrimp feed industry in Asia.

"Today, industry has to look at the finite pool of resources available for feed production and we also have fewer new raw materials in the market. Some of these are also poorly characterised. How can we maximise its use and those of co-products? Can enzymes be a solution? If so, what about heat stability as the extrusion and pelleting processes in aquafeed requires high temperatures? " asks Dr MA Kabir Chowdhury, Product Manager-Aquaculture, Jefo Nutrition Inc in his introduction on the company.

Jefo is a feed additive company based in Quebec, Canada and well recognised in development of species-specific enzymes, acidifiers, and essential oils for the animal feed industry since 1982. Although it began research in 2004 with trout diets, marketing of protease in aqua feeds began 2-3 years ago.

The use of enzymes is common with phytase being a well-known example in aquafeeds. "Proteases are enzymes for proteins and the types of serine proteases are chymotrypsin-like and subtilisin-like. The former works similar to trypsin, chymotrypsin and elastase on different amino acids such as trypsin on lysine and arginine bonds in a protein molecule. We tested our protease for survival rates, protein efficiency ratio and feed conversion ratio in fish and the vannamei shrimp. To get the best with the high dosage, we tested three dosages and 175mg/kg was the best in all three parameters. The universal inclusion rate is 175g/tonne of feed for our AG175 protease for aqua feeds."

Heat stability

Aquafeed manufacturers are most concerned with heat stability of enzymes. Chowdhury said that trials have confirmed that Jefo's protease is exceptionally thermo resistant. "In one example, where both pelleted (60°C) and extruded feed (120°C) were tested, there was a significant increase in protein digestibility (15%) in the case of pelleted feeds. The increase in extruded feeds was lower (10%), which was expected as extrusion itself improves digestibility of the feed."

Optimising feed matrix

The use of the protease should be associated with changes in formulation and use of less digestible protein ingredients. Economical benefits can be maximized when digestible proteins and amino acid contents in the feed are reduced by 0.5 to 2.5% compared with the regular feed.

"There are two ways to use enzymes in feeds. It can maximise feed performance for the diets with low or marginal crude protein and amino acids compared to the requirements of the animal and when known low digestible protein sources are used. On the other hand, we can lower the crude protein or digestible protein and add the enzyme into the matrix and reduce the use of expensive proteins such as fish meal and SBM," said Herve Lucien-Brun, aquaculture consultant.

"Incorporating the protease in a formula with 26% crude protein will give a 1.6% cost reduction and if reformulation for a 35% crude protein diet is done, we can have cost reduction of 2.8%. The savings will depend on species type, level of crude protein, raw materials available in the matrix and maximum usage set as constraint. The higher the SBM and fish meal prices, the larger will be the savings.

David Serene, director Nutrispices (right) and Herve Lucien-Brun

The economic benefits are target reductions in feed cost by USD 7-20/tonne and maximise usage of cheaper ingredients. The zootechnical benefits will be for end users such as better growth performance and feed conversion ratios."

Philippe Serene, consultant, Nutrispices, said, "In Vietnam, we have worked out a formulation for the pangasius catfish which will reduce the use of SBM and fish meal but increase inclusion rates of meat bone meal, rice bran and wheat flour. We can reduce costs by VND160/kg (USD7.59 /tonne). In tilapia feeds, we can reduce costs by VND400/kg (USD 18.9/tonne).

As the future of optimisation is to build a matrix specific to each source of protein, the offer to feed clients was to calculate cost savings by entering the AG175 matrix into the formulation software, free samples and organise a field trial to validate efficacy.

World Nutrition Forum explores sustain:ability in Munich

After a successful Asia edition, sponsored by BIOMIN, the World Nutrition Forum returns to Europe in 2014. The biennial Forum brings together thinkers, decision makers and opinion leaders in the animal nutrition and related fields for several days of high level debate and discussions in an event that has become synonymous with the sharing of ideas rather than products.

A decade since its debut in Salzburg in 2004, the Forum will be hosted outside Austria this year, this time in Munich which presents the perfect venue where the concept of sustainability can be revisited under an exciting and carefully planned theme- "sustain:ability".

In line with this, Jørgen Randers of the Norwegian Business School and co-author of "The Limits to Growth", will present a view of the world to come in the next 40 years. Keynote speakers for the opening day (16 October) also include Marty D. Matlock of the University of Arkansas's Department of Biological and Agricultural Engineering, who will present key trends in the future of animal nutrition, and Didier Jans, secretary general of FEFANA, who will speak on the topic of worldwide regulation and harmonisation.

Based on the concept of previous Forums, breakout sessions will be organised for the four target species—poultry, swine, ruminants and aquaculture on 17 October, a top-class mycotoxin expert panel will address key research findings and the application of new technologies that will mark the industry in the upcoming years. More information: www.worldnutritionforum.info

New aquaculture centre in Singapore

The first of its kind at a local polytechnic will lead research and learning for the growing aquaculture industry

Signing of MOU with James Cook University, Australia

In January, Singapore's Republic Polytechnic (RP) had an open house where it announced the opening of the new Aquaculture Centre and a new Diploma in Marine Science and Aquaculture (DMAC) conducted by the School of Applied Science. The centre called *The Aquaria* will be for teaching and support research in marine science and aquaculture technologies. This is to support Singapore's goal to boost local food fish production in a sustainable manner.

"Singapore's aquaculture industry is growing fast, in line with the government's target to increase local production of food fish from about 7% to 15% of local consumption. It is important to ensure that our students are kept abreast of modern aquaculture technologies, so that they can act as conduits, translating advanced techniques and technologies into the industry, thus accelerating the growth of our local aquaculture industry," said Yeo Li Pheow, RP's Principal/CEO.

DMAC is the first full-time Pre-employment Training (PET) program. It will take in its first batch of 50 students in 2014 to focus on marine biology and conservation, aquaculture technology and marine coastal ecology. Students will also learn about seafood species, sustainable production systems, and the management of marine and aquatic health. Both the DMAC and the Aquaculture Centre will equip students with the requisite skills and knowledge in using advanced technologies to support the setup of aquaculture facilities. Graduates will be able to pursue careers such as aquarists, aquaculture laboratory technicians, farm managers and marine conservation executives in oceanariums and marine reserves.

RP had asked feedback from industry on manpower requirements and Ashley Chua, assistant director, Administration for the School of Applied Sciences, said, "Many fish farms in Singapore indicated that they do not have enough trained manpower for their needs. Our role is to expose students to the new environment in fish farms where the target is higher productivity levels. The only way to do this is to improve the technology, apply more scientific methods to their fish growth processes. The new centre will hopefully provide a new perspective to what fish farming can do."

The state-of-the-art 180m^2 indoor and outdoor laboratory features five outdoor circular fiberglass tanks and a sophisticated indoor facility. The indoor facility with 48 experimental tanks with UV light and temperature control capabilities is for research on both fresh and marine fish and crustacean species. The indoor facility also features two-metre long coral tanks for research in coral conservation. The centre will conduct research in areas such as fish feed formulation using sustainable resources such as soy waste and identify how various combinations of water conditions and parameters can be used for cost-effective health management of fish in aquaculture facilities.

Three Memorandums of Understanding (MOU) were signed. The MOU with Temasek Life Sciences Laboratory (TLL) will be in areas such as feed formulation and microalgae cultivation whilst that with Resorts World Sentosa (RWS Marine Life Park) will explore volunteer program, scholarships for DMAC students as well as collaborative projects on marine conservation. RP will also collaborate with the Tropical Marine Science Institute (TMSI) of the National University of Singapore (NUS) in areas such as anti-fouling, aquaculture techniques, and co-application of competitive grants for aquaculture research. A joint-laboratory agreement was also signed with James Cook University, Australia which will see part of the aquaculture facility retrofitted with equipment for marine conservation and exploration cum surveillance work (More information: www.rp.edu.sg)

Skretting ARC celebrates 25 years of research

Lerang Fish Trials Station.

In January 2014, Skretting Aquaculture Research Centre (ARC) in Stavanger, Norway, celebrated 25 years of service to Skretting and to aquaculture. Important innovations and many smaller ones have brought significant benefits in feeds and in production technology.

Research originally began in Stavanger in a small way in 1979, to support the fish feed activities of the Norwegian company Skretting, later to become part of Nutreco. Twenty-five years ago the research centre became a separate operating company with an increase in responsibility to support all fish feed production in the group, which was now producing fish feed in several countries. During the next decade, the main focus was on establishing world-class R&D in salmon nutrition. Wolfgang Koppe, the head of the ARC Nutrition department comments, "Creativity and hard work have been success factors since ARC was founded. We managed to shape the development of aquaculture feed, and we intend to continue to be the leader in this industry!"

An international team

Over the years, ARC has built an international team of scientists specialising in fish nutrition, health and feed production as well as experts in conducting trials and analyses. "The key to the ARC's success and world-class standing is its people. This unique collection of talented individuals works as a team to deliver innovation after innovation to support progress in aquaculture," says ARC managing director Alex Obach.

Today the centre employs 100 people of close to 25 nationalities. R&D activities are grouped in three departments: Nutrition, led by Wolfgang Koppe; Fish Health, led by Charles McGurk; and Feed Production led by Jan Jonkers. The fish trial units in Norway are led by Nanne Jørum. ARC has its own controller, Tessa Tuestad, who has been present throughout the 25 years. "Today, research is more easily translated to products and improvements across the globe than 25 years ago, through an enhanced integration of business and research," says Tuestad. Together with Alex Obach, these people form the management team.

The latest steps for this growing organisation are a new research unit in China, managed by Eva Zhou (see box), and research in shrimp feeds. Currently Skretting ARC supports feed activities for more than 60 species on five continents and the research team has close cooperation with 40 research institutes and universities, in Norway, Germany, Netherlands, USA, Scotland, Spain and Italy. There is a joint research centre at Kagoshima University in Japan.

Alex Obach

The facilities

Skretting ARC in Stavanger has offices, a specialist laboratory and the Feed Technology Plant (FTP). Nearby it has the Lerang Fish Trials Station. The internationally accredited laboratory analyses feeds, feed ingredients and fish and is the centre of the company's NIR analytical network. Today all Skretting feed plants are equipped with NIR instruments linked with ARC to ensure consistent standards.

Opened in 1997, the FTP uses small-scale feed production equipment to explore production technology, new feed formulations and potential raw materials. It is a facility for competence sharing and training, and it produces small batches of experimental feeds for trials. The latest addition is equipment to make shrimp feed. "It is exciting to be part of a growing business, to have close interaction with the operations and to see our results used to further improve the performance of our production plants," says Jan Jonkers who is responsible for the FTP.

Lerang, opened in 1990, has facilities for growth and digestibility trials with freshwater and seawater feeds. Originally seawater trials were in conventional pens in the adjacent fjord. Today they are in large tanks, inside a building on land. The tanks feature programmed lighting and controlled water flow rate, temperature and oxygen levels. Filters collect uneaten feed. In 2011, a sea lice laboratory was added. Nanne Jørum, manager of the trial units, said, "Over 25 years Skretting ARC has developed excellent trial facilities that provide valuable contributions to research projects and product development. The way we work in close cooperation with researchers in ARC is unique."

Significant advances in health feeds

Twenty-five years of Skretting ARC research led to the launch in 2013 of the new generation of Protec. The original anti-stress diet, Response, was introduced in 1992. This diet was further improved to Response Proactive, launched a few years later. Continuing research with active ingredients resulted in 2007 in Protec diets. Protec became an industry leader, with synergistic active ingredients that enhance the ability of fish to cope with stressful situations and support their immune systems. The new Protec builds on these benefits. It has active ingredients with anti-viral properties in addition to those that boost the immune system, further improving the productivity and

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sustainability of aquaculture. "It's rewarding to see ARC's research outputs being implemented across the globe, sustainably improving productivity while enhancing fish welfare," says Charles McGurk, Fish Health Manager.

Some fish feed milestones

ARC first used beta-glucans in fish feed in 1992, to boost immune systems which led to a new category of health-supporting functional feeds. In 1993, SPAR production technology significantly increased the maximum possible oils content in fish feeds. Then in 1996, ARC applied AminoBalance, new knowledge essential amino acids for building fish protein. In 1998, it was LipoBalance as alternatives to reduce fish oil. The continuous research from 2000 to 2013 led to defining the nutritional value of raw materials (more than 500 raw materials tested), reduce dependence on fishmeal and fish oil. The identification of key micronutrients in fishmeal in 2010 led to the MicroBalance® concept In 2003, it developed dry feeds for marine fish larvae, thus reducing dependence on live feed.

In 2006, the Optiline feeds based on digestible energy and digestible protein delivered the lowest cost per kilo of growth. It was followed by Supreme transfer diet in 2008–2009 which become a market leader in Norway. In 2011, the high temperature (HT) versions of Optiline salmon feeds were popular in Australia. In 2012, Optiline Premium diets delivered better feed conversion efficiency and increased fillet yield with higher omega-3 content.

Looking ahead, future research objectives include further development of the MicroBalance concept for different species, environmental diets (e.g. low oxygen), and LipoBalance 2G. In health, it will be in Protec for shrimp, mitigation diets for Amoebic Gill Disease and sea lice. In feed production, it will be in high-quality shrimp feed concepts, anti-fat leakage solutions and diets for new species such as tuna. ARC is also expanding its work with new methodologies; in near infrared reflectance, quantitative histology and plasma biochemistry.

New research facility for shrimp and Asian fish species in China

Skretting Aquaculture Research Centre (ARC) officially opened its new Hezhoubei Research Station in the Guangdong Province, China on 21 January 2014. This new station becomes Skretting's main research facility for shrimp and Asian fish species. The station has been established to support the growing need for sustainable feeds in Asia and is ideally positioned to contribute towards the global growth of best-practice aquaculture production.

Driven by growing demand from Asia and Latin America, the global shrimp feed market is expanding at a rate of approximately 5% each year (from an estimated 3.9 million tonnes in 2012). ARC China will use Skretting's worldwide R&D knowledge to help shrimp farmers increase their production in a more sustainable manner.

Speaking at the official launch ceremony, Dr Alex Obach, Managing Director of Skretting ARC said: "The opening of the Hezhoubei Research Station is a very important milestone for ARC. This investment demonstrates our considerable commitment to helping build a more sustainable shrimp farming industry through world-class research and innovation."

Obach also paid tribute to Dr Eva Zhou, Manager of Skretting ARC China, and her team for overseeing the construction of the research station, both in terms of extensive upgrades to existing research facilities and the building of new research laboratories.

"Eva's diligence and attention to detail has resulted in a state-of-the-art research station, which will enable Skretting to develop more high-performance aquafeeds that are proven to deliver faster growth and improved feed efficiency to our customers throughout Asia and beyond."

Occupying a land area of 20,000m^2, the Hezhoubei Research Station comprises indoor facilities for conducting trials on shrimp and fish growth and nutrient digestibility. There are also outdoor tanks and ponds for fish trials. In total, more than 250 experimental units (tanks and cages) are available to run research trials with both shrimp and fish in different environmental conditions. The species currently targeted at ARC China include vannamei shrimp, Asian seabass, snakehead, yellow catfish and tilapia. The station will conduct trials throughout the year and currently has a workforce of 18 employees.

Skretting ARC officially opens its Hezhoubei Research Station in the Guangdong province, China. This new station becomes Skretting's main research facility for shrimp and Asian fish species.

Going the extra mile with health tests on feed

OddGeir Oddsen

As soon as UK based ProChaete saw reports of a Thai academic's suspicion that feeding marine worms (polychaetes) could be making shrimp broodstock carriers of EMS, the company immediately commissioned additional laboratory tests on its feed.

"We now have the additional test results from the University of Arizona Aquaculture Pathology Laboratory," says CEO OddGeir Oddsen, "I am delighted to report that AHPND/EMS was not detected in any of the samples tested. Researchers from this university had already ascertained that the AHPNS pathogen is a unique strain of a common marine bacterium, *Vibrio parahaemolyticus*. Clearly, there is still a wide debate around the origins of EMS in shrimp, but we felt that anything we can do to help and reassure our customers is worth doing, so we instructed these additional tests as soon as we read the report on Professor Tim Flegel's work."

In December, Shrimp News International carried a report on research by Professor Tim Flegel of Thailand's National Center for Genetic Engineering and Biotechnology (BIOTEC) which indicated that outbreaks of EMS (early mortality syndrome), could stem from broodstock that have eaten polychaetes carrying a unique strain of V. parahaemolyticus bacteria in their gut and thus becoming carriers of the disease.

"We have been aware throughout our development process that combating disease is a prime concern for shrimp farmers," adds Oddsen. "Biosecurity and strict quality control are therefore top of our agenda. There is nothing new in feeding marine worms to farmed shrimp, either fresh or frozen. However, an important benefit for shrimp farmers is that ProChaete is growing marine worms in biosecure units in Europe, where there is no shrimp farming, and therefore shrimp diseases do not exist. In addition to this, as part of the process, our extruded feeds are heated to over 90°C for a specified period, which effectively kills bacteria."

Ponds

The marine worms farmed by ProChaete have also been tested to show freedom from the seven shrimp viruses on the OIE list. The company can offer SPF (Specific Pathogen Free) product for all stages of shrimp production from broodstock and first-feeding larvae through to grow-out feeds, in a variety of formats and pack sizes.

It is a member of the Seafresh Industry Group and was set up last year to fill a gap in the feed market. The company farms polychaetes (marine worms) in Wales and processes them in its custom-built feed plant,also in Wales. The company also aims to serve the market for finfish feed to help fulfil the need for 'greener' solutions.

Research has shown that polychaetes offer many advantages to growers. They provide a highly valuable protein source, as good as if not better than fish meal. They have a good fatty acid profile, and contain factors which are important for the maturation process in many farmed species, addressing the fact that farmed seafood does not get access to the bromophenols found in the diets of wild species. Tasting panels also preferred fish fed with ProChaete feed.

More information: www.prochaete.com

New hammer mill

Dinnissen Process Technology offers a wide range of crushers, hammer mills, roller mills, and knife mills for grinding, crushing and micronizing a wide variety of ingredients. Hammer mills are especially suited for grinding soft to medium-hard products down to particle sizes of between 3 mm and 150 µ. In Dinnissen's hammer mills, freely suspended hammers rotate at high speed inside the grinding chamber. The centrifugal force produced by the rotating hammers crushes the product into smaller particles against special grinding panels on the inside of the grinding chamber, after which the processed product passes through special screening panels before exiting the hammer mill. The screen surface and perforations determine the capacity, quality and effectiveness of the screening process.

Dinnissen has made significant investments in developing innovative solutions in this area. The newest hammer mill is equipped with increased screen surface, extra-large grinding panels, and an automatic screen exchanger in combination with a wide range of screens.

The increase in the surface area of the grinding panels as well as screen panels inside the hammer mill will increase grinding as well as screening capacity. The screen storage facility is fitted with an extra-wide chamber for easy maintenance and replacement of damaged screens. This in turn reduces downtime during maintenance stops and increases the overall efficiency of the new hammer mill.

The mechatronic screen exchanger system increase speed, ease-of-use and reliability to clients who regularly switch between different ingredients and product specifications. The automatic screen exchanger has enough space for 4 to 6 sets of different screen panels. The automatic screen exchanger can also be fitted with a screen detection system, making it possible to identify and report the right selection to the control room.

This innovation will be present during VIV, Interpack, Schüttgut and Victam in the coming months. More information: visit Dinnissen during VIV, Victam, Interpack and Schüttgut or go to www.dinnissen.nl

Acquisition of UV disinfection and water filtering solutions company

In February, Pentair Aquatic Eco-Systems, Inc. announced it has purchased the assets of Pottstown, Pennsylvania based Emperor Aquatics, Inc. (EAI), a leading supplier of UV disinfection and water filtering solutions in December 2013. With the addition of EAI, Pentair is well positioned to address the growing concerns over biosecurity in aquaculture and the increased use of UV disinfection in the pool industry.

"This acquisition provides entry into the growing UV market and is the perfect complement to our existing commercial sanitization products," said Karl Frykman, President of Pentair Aquatic Systems.

By establishing a UV center of excellence, Pentair Aquatic Eco-Systems looks to continue development of tailored engineered solutions across all industries. Robert D. Miller, Chief Financial Officer of Pentair's Aquatic Systems business, leads the day-to-day operations of Pentair Aquatic Eco-Systems, including EAI.

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

Aquaponics technology and design workshop

April 1–5, Apopka, Florida, USA

Pentair Aquatic Eco-Systems is hosting an Aquaponics Technology & Design Workshop April 1-5, 2014 at their Apopka location. This is a 4.5 day workshop which will be conducted by three experts. **Dr. James Rakocy**, a research professor of aquaculture.and formerly the director of the University of the Virgin Islands (UVI) Agricultural Experiment Station. He is also known as the 'Father of Aquaponics'. **Dr Wilson Lennard**, a graduate from RMIT University in Australia with 10 years of practical commercial aquaponics experience and knowledge. **Dr Fred Petitt** is the Agricultural & Water Sciences Director for Walt Disney Parks & Resorts. He joined Epcot® during its construction phase and worked to turn The Land pavilion from vision into reality.

The list of topics include system design and management which will encompass aeration, blower selection and sizing, plumbing, pump selection, total dynamic head (tdh), components, construction techniques, operation and electric cost. In fish production it will cover stocking rates, feeding, growth and survival, harvesting and processing, water quality, brood stock management, breeding and fry sex reversal. In plant production, the sub topics are seedling production, importance of pest identification, disease and insect control and nutrient dynamics. There will be hands on instructions on pvc work, pump setup and plumbing, plant grow tray construction, fish handling and water quality testing as well as a Green Sky Growers Rooftop Greenhouse Tour and "Behind The Seeds Tour" at The Land At Epcot® More information: Email: PAES.General@Pentair.com Web: PentairAES.com

8-10 April 2014, Bangkok, Thailand

The feed and grain industry from throughout Asia and beyond will gather in Bangkok in April to attend what has now become the region's largest and dominant animal feed and grain event. This multi-attraction showpiece event will take place at the BITEC exhibition centre in Bangkok from 8 to 10 April 2014.

FIAAP/VICTAM/GRAPAS Asia 2014 will be three international exhibitions serving South and Southeast Asia. **FIAAP** profiles the ingredients and additives that are used within the formulation of safe and cost effective animal feeds. **VICTAM** is the premier event for technology that is required in the processing and manufacture for these animal feeds. It is also the industry showpiece event for biomass pelleting technology. The main coverage for **GRAPAS** is specialist systems and technology used within rice and flour mills

The organiser said that the co-located event will have over 200 international companies supplying additives and ingredients, processing and milling technology, ancillary equipment etc. Many will be presenting the very latest innovations for these industries at the event. A series of conferences and technical seminars will also be held over the same period at BITEC.

ASEAN Feed and Rice Symposium

For the first time senior executives from the Asian Development Bank (ADB), the ASEAN Secretariat and the Food & Agriculture Organisation of the United Nations (FAO) will share the platform to present keynote speeches on subjects that could have consequences for the industries we all serve. These include the economic and trading consequences of a single market and feed and food security. Keynote speakers are:

- Mr Tran Dong Phuong, director for Finance, Industry and Infrastructure, ASEAN Economic Department.
- Dr Sununtar Setboonsarng, Principal Natural Resources and Agriculture economist, Environment, Natural Resources and Agriculture Division, Southeast Asia Department, ADB.
- Mr Hirioyuki Konuma, assistant director General & Regional Representative FAO, Regional Office for Asia and Pacific.

The moderator and chairman will be: Mr Pornsil Patchrintanakul, President of the Thai Feed Mill Association, Senior Advisor Charoen Pokphand Group of Thailand.

The ASEAN Feed and Rice Symposium will be held on 9 April. Participation is free but seating is limited. Register as a delegate at www.victam.com. Visitors can also register for the FIAAP, VICTAM & GRAPAS Asia 2014 exhibitions and conferences. Entry to the exhibitions is free for all registered trade visitors. Also available at the respective websites; www.fiaap.com www.victam.com or www.grapas.eu are exhibitors and details. An online show catalogue is available at www.victam.com/?i=276

Feed conferences

7th Aquafeed Horizons Asia and 5th FIAAP Conference will take place on April 8-9. These are for feed industry professionals from throughout Asia Pacific and beyond. Previous conferences have attracted a high level of participation. The 2014 meetings have already seen registrations from the region as well as Europe, the USA and Australia. With special rates for students, Thai delegates and groups and for the first time, simultaneous interpretation into Thai for both conferences, the organisers expect the meetings to fill up fast. "People should not delay in securing their places", said organiser, Suzi Dominy.

The Aquafeed Horizons Asia Conference presents advances in formulation and processing technology, while the FIAAP Conference focuses on feed additives and ingredients. Both meetings feature presentations by international teams of industry experts. The full programs, presentation summaries, speaker biographies and registration can be found on the conferences' website: www.feedconferences.com.

Aquafeed Horizons Asia- Advances in Processing & Formulation

April 8, 2014, Bangkok, Thailand, Room 224/225 BITEC . The program is given below

Ingredients & Formulation

Novacq – commercialising the paradigm shift in shrimp nutrition- Dr. Matthew Briggs, technical project manager – Novacq™ Commercialisation, Ridley AgriProducts Pty. Ltd., Australia

Organic acids as a functional feed additive in the commercial feeds of tilapia and marine shrimp - Professor Wing-Keong Ng, Fish Nutrition Laboratory, School of Biological Sciences, Universiti Sains Malaysia.

Least cost diets are for suckers – economic formulations for 2020- Dr. Richard Smullen, technical manager, Ridley AgriProducts Pty. Ltd., Australia

Protease in aquaculture feed - better quality, better profit or both? -Dr. M A Kabir Chowdhury, product manager Aquaculture, Jefo Nutrition Inc., Canada

Functional feed additives to reduce the impact from bacterial diseases on shrimp production-Dr. Peter Coutteau, Business Unit manager – Aquaculture, Nutriad International NV, Belgium

Processing Technology

High capacity and cost efficient aquafeed production – Finn Normann Jensen, director of Global Business Development & Marketing, Andritz Feed & Biofuel A/S, Denmark

Improving aqua feed buoyancy and pellet uniformity with density controllers and revolver die – Dr. Cristian Atienza, Aqua Feed Technology manager, Buhler, Switzerland

Single use or multiple purpose extruder designs – Joseph P. Kearns, Aquaculture Process Engineering manager, Wenger Manufacturing, Inc., USA

Process and technology considerations for efficient drying of aquafeed of varying sizes – Justin Hamm, Global Applications Engineering Specialist, Aquafeed and Petfood Drying, Bühler Aeroglide, USA

More information: infor@feedconferences.com (Suzy Dominy)

World Aquaculture 2014

June 7-11, Adelaide, South Australia

Rewarding young leaders

Emerging leaders in the aquaculture industry will be recognised at this year's World Aquaculture Adelaide conference in June. Bursaries of up to AUD2000 each will be awarded to ten outstanding young Australian aquaculture industry people by the Fisheries Research and Development Corporation (FRDC), giving them the opportunity to attend the international conference on their home soil.

The conference will showcase over 500 of the world's leading aquaculture thinkers and innovators. It will feature seven consecutive streams of presentations providing delegates an unprecedented learning opportunity. National Aquaculture Council Chairman, Pheroze Jungawalla, is seeking assistance from the Australian aquaculture industry to nominate young people (under 35 years old) who are identified as emerging leaders in the industry. "We are particularly keen to find young people who will become our next generation of industry leaders and innovators," he said.

Nominations, should be directed to Sarah-Jane Day (sarah-jane.day@aquaculture.org.au) briefly stating the nominee's full name and contact details and the reasons for the nomination. Nominations close on 24th March 2014.

Additionally 'The Blue Thumb' Australian Aquaculture Awards which commenced at Australasian Aquaculture 2012 in Melbourne will be part of the awards program for WAA14. Four award categories cover Aquaculture Science Research/er; Aquaculture Production; Aquaculture Service Provider and New Product/Technical Innovation. All information on the awards including the official nomination form is available on the website. The awards will be presented at the President's Reception (Wear Your Colours) at the newly completed Adelaide Oval on the evening of 10 June 2014.

More information: Web: www.aquaculture.org.au

2014

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

April 8
Aquafeed Horizons Asia 2014
Bangkok, Thailand
Email:info@feedconferences.com
Web:www.feedconferences.com

April 8-10
FIAAP Asia 2014/Victam Asia 2014
Bangkok, Thailand
Web : www.fiaap.com/www.victam.com

May 6-8
Seafood Expo Global
Brussels, Belgium
Web: www.euroseafood.com/

May 13-15
The Asian Aquaculture Insurance and Risk Management Conference
Kowloon, Hong Kong
Web: www.aairmc.com

May 16-17
Aquaculture Chennai 2014
Chennai, India
Email: acci.meet14@gmail.com/ frectnfu@gmail.com
Web: www.tnfu.org.in

May 21-25
World of Seafood
Bangkok, Thailand
Web: www.worldofseafood.com

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

May 25-30
16th International Symposium on Fish Nutrition and Feeding (ISFNF XVI),
Cairns, Australia
Email: info@isfnf2014.org
Web : www.isfnf2014.org

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

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

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

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

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

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

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

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

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

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

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

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

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

World Aquaculture Adelaide 2014

Conference & Trade Show

7 – 11 June

Adelaide Convention Centre
South Australia

GENERAL ENQUIRIES
sarah-jane.day@aquaculture.org.au

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worldaqua@aol.com

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