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AQUA CULTURE
Asia Pacific

Shrimp farmers grapple with diseases in Vietnam

Practising biofloc technology in Bali

Early weaned marble goby in Singapore

Yeast extracts for the pangasius catfish

Future of aqua feeds and nutrition, TARS 2011

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

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From the editor

The importance of a holistic approach

During the last financial crisis, Warren Buffet remarked "when the tide goes out, you realise who is not wearing their swimming trunks". I am paraphrasing his reference to financial institutions which have overstated their financial standing and were caught out when crisis hit. The aquaculture feed industry may not be remotely close to any crisis situation now, especially with aquaculture product prices improving but it is a good time as any to take stock of the situation and prepare ourselves for a worst case scenario.

This opportunity arose at The Aquaculture Roundtable Series (TARS) that concluded recently in Singapore with the active participation of academia, public and private sectors. The roundtable sessions focused on three sub sectors namely, shrimp feeds, freshwater fish feeds and marine fish feeds, all of which revealed common threads in the priority areas for improvement. Here are my observations and takeaway messages.

It became abundantly clear that the industry is on its own. Public sector funding is no longer available and research is left to the academia and the private sector. There is also a lack of coordinated research not only within the academia but between academia and the private sector. One would not expect coordination within the private sector so I will not address this point. However, research institutions in Asia tend to work on similar issues and this creates inefficiencies, both in terms of costs, resources and time. Perhaps a network would help bring researchers together to share their work and conclusions as well as the fame and patents that arise thereafter.

Another glaring gap was the lack of species-specific nutrient requirements leading to generalised feeds for all three subsectors. Using high protein black tiger shrimp feeds for intensive vannamei culture is a prime example. Marine fish feeds for the many species cultured in Asia have the same nutrient content while freshwater fish feeds tend to aim for two protein levels at the lowest cost possible. A major help has come in the form of the long overdue NRC nutrient requirements for fish and shrimp published in 2011. Learning from the poultry industry, there is still room for improvement in the area of nutrient digestibility and energy requirements of the species. The latter leads to bioenergetics in aquatic species and a brand new area for research. The current data is also lacking in life cycle specific nutrient requirements. The common assumption is that the early stages of the life cycle have a higher nutrient requirement compared to harvest sizes. But there is another school of thought that energy requirements should be higher at larger sizes.

One direction that all the participants agreed upon was a holistic approach to aquaculture. 'No man is an island' and the best feeds in the world cannot perform unless it is matched with a suitable culture system. There is a need to change the perception of low cost feeds measured by price per kg of feed to performance feeds measured by feed costs per kg meat yield. This is where the third variable of health management must be included because any disease occurrence will lower survival rates and increase feed costs per kg meat yield. In high density culture systems, overfeeding is the primary cause of deterioration of water quality leading to onset of diseases. Sometimes, nutritionists and feed mills have little influence over farmers today but education of farmers is critical to ensure the success of the final crop. This has led the organisers of TARS to realise that the holistic approach will help overcome this critical challenge.

With this in mind, we realise that the way forward is to engage the whole value chain of a group of species and the next TARS will focus on the shrimp industry and all the components that contribute to the marketable animal at a margin that is attractive to all stakeholders. The stakeholders and target participants will represent the subsectors of breeding and hatchery, farming, feeds and health management. TARS 2012 will be held on August 15-16, 2012 in Phuket, Thailand.

Zuridah Merican

OUR MISSION

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

Obituary

Joachim W Hertrampf 1928-2011

Dr Joachim Hertrampf passed away on 4 July, 2011 in Hamburg, Germany at the age of 84. In his last email, Joachim wrote from Hamburg on how he was missing the aquaculture industry in Asia which grew with him during his years in Asia. Since 2009, for health reasons, Joachim spent more time in Europe than in Kuala Lumpur, Malaysia where he made his second home after his retirement. Joachim, a well-respected animal nutritionist worked with several animal nutrition companies until his retirement. He loved Asia. I first knew of him from his work on phospholipids in aquatic species with Lucas Meyer whom I referred to endlessly in my research work on lipids and fatty acids in the black tiger shrimp in Singapore.

It would be years later when I would meet the man at a livestock trade show in Kuala Lumpur in the early 2000s and by that time, Joachim was well into aquaculture. He worked as a consultant to The Waterbase Feed Co, in India and produced the monthly factsheet called 'Shrimp Matters'. He also helped several animal feed additive companies move into the aqua feed sector. Joachim was a strong supporter of Aqua Culture Asia Pacific magazine and regularly contributed articles and we will particularly miss his 'letters to the editor' where he would present one or two queries, sometimes evoking the wrath of the authors. He will be sadly missed.

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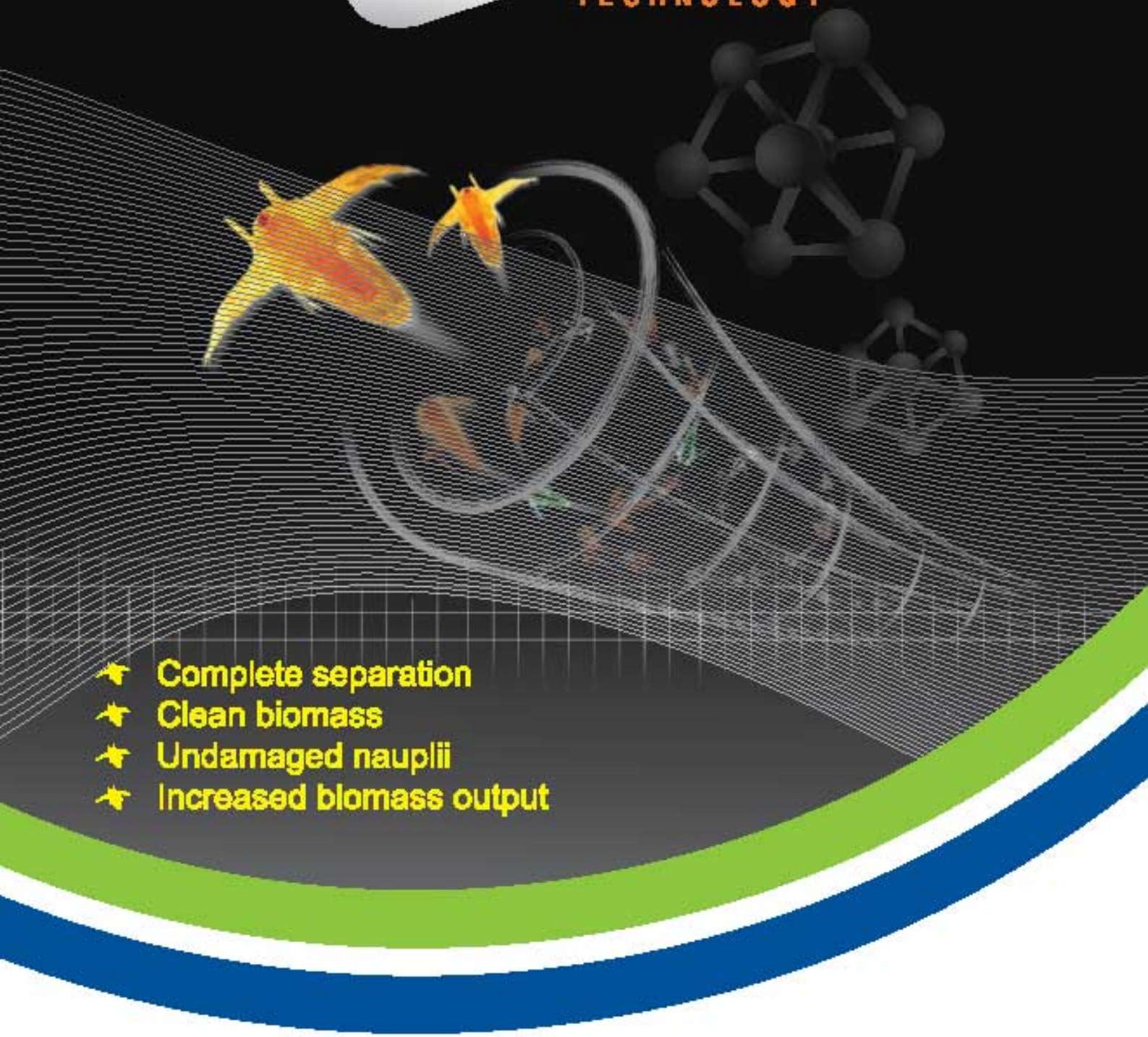

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Innovating for the future

Government and industry meet at this biennial forum on aquaculture innovations (FITA) held in Bali from July 19-21.

This was the forum for scientist to disseminate new technology and current information to industry in all areas of aquaculture. The program covered sessions on nutrition to seaweed farming and was attended by 450 farmers, industry players, academia and government. It was the venue for networking among scientists from all corners of the vast archipelago and for producers to tell the scientific fraternity their R&D demands to improve production. The theme of FITA was 'Innovations in technology to propel Indonesia as a major aquaculture producer'.

The national target is for Indonesia to be a major player in global aquaculture by 2015. In 2009, Indonesia reached the number two ranking after China, which has a 45-million tonne production. It is already leading with milkfish, giant gouramy, *Clarias* catfish and seaweed production. However, the aim is not only to produce the raw material but also to go downstream with processing. In the case of the tilapia, it wants to enlarge production to other players as currently almost 75% of production comes from one company. As Indonesia has the largest area and number of traditional ponds, it should endeavour to be the largest producer of the black tiger shrimp.

Dr Ketut Sugama (right) with plenary speakers and guests (from left) Haris Muhtadi, CJ Feeds, Endhay Kusnendar, Marc Le Groumellec and Dean A. Akiyama

Dr Ketut Sugama, director of aquaculture at the Ministry of Fisheries and Marine Affairs introduced the strategies, which included the utilisation of all potential areas for aquaculture development and the improvement of productivity. Ten species are targeted and the role of the ministry's aquaculture division is to initiate the production of brood stock and hatchery supply and that of the industry to use the appropriate production technology. In the Minapolitan concept, which involves participation from several ministries, 24 locations are chosen as trial areas and the concept is 'economy aquaculture management'.

"The fisheries production target is 18 million tonnes of production by 2015 and as capture fisheries will stabilise, aquaculture will contribute 16.9 million tonnes. In 2010, we have seen that our production was 5.4 million tonnes from aquaculture and 5.8 million tonnes from fisheries."

Sustainable shrimp

The target is also to be a sustainable producer of shrimp. Unima in Madagascar has delivered significant commitments to sustainable shrimp (black tiger) aquaculture. The details were elaborated by Dr **Marc Le Groumellec** of the Unima/Aqualma group in Madagascar. The fully integrated operations at Unima comprise a brood stock nucleus centre, hatcheries, farms, feed mill, processing plants and cooking plants in France. Environmental and social aspects, certification are important contributions to its sustainability level. The company has the advantage that no OIE listed diseases are found in wild shrimp and Unima has developed a breeding program to avoid the use of wild brood stock. Unima has a 40-year history in the market for high quality, large size black tiger shrimp cultured at low stocking density (5-10/ m^2). The product has the French Label Rouge certification allowing it to garner the high end shrimp market. But high production costs from high costs of energy, inputs and difficult logistics forced the closure of one farm recently during the economic crisis. The current production is still 4.5 tonnes/year, stable in the last 20 years.

Le Groumellec also addressed some of the issues in sustainability. "Sustainability is a long term vision and it has taken us 20 years to reach our current level. Shrimp farming in Madagascar is not the industry causing damage to mangroves, but nevertheless to regenerate the coastal flats, Unima has planted 1.3 million trees in 17 years (including nearly 1 million mangrove trees). The farm was built on salt flats only with a channel to minimise damage to mangroves. In certification, it is important to have a third eye on what you are doing and on what you claim. Admittedly, there are too many standards and it can be difficult to find the adequate criteria fitting for all the systems. There are also those voluntary standards between buyers and farmers and auditing groups.

"Later we will have to study the carbon footprint of our production. Our work showed that the highest footprint is from feeds at 30% and energy 37%. By reducing fish meal to 15% from 25% in feeds, we can achieve a 6.3% reduction. We can reduce this further by moving more to plant meals, maggot meal and animal by products. By reforestation of 1.3 million trees we can have carbon credits, so we already compensated 78 % of the carbon we produced so far. Our target is to be carbon neutral in three years."

According to **Dr Dean A. Akiyama**, Shrimp Improvement Systems, Indonesia, stakeholders have to ask themselves whether the industry is growing at an acceptable rate. Aquaculture is a business. In the initial phase the needs are quality feed, quality seed stock and good market prices and when the business is more established it moves to better research and extension, genetics and a sound government policy. Particularly in Indonesia, social constraints need to be studied in detail. Industry needs to self regulate such as in the aqua feed business which needs to meet market standard at a competitive price. Feeds need to be matched with industry standards for the farmer to use and profit. As such new entrants should be encouraged to bring in new ideas and new standards.

"Similarly in the hatchery industry, we want competitive products which meet market standards at acceptable pricing. Genetics is the way forward but when prices are too low, it will be difficult to embark on the costly genetics research. There are needs for technology but financially it can be restrictive too."

SCI is confident of a good 2011

Members of the Indonesian Shrimp Club (SCI) contribute 30% to the annual shrimp production. This may be a better year for the group, although they are cautiously continuing operations amidst IMNV and the newer slow death syndrome or MPP.

Iwan Sutanto, president of SCI said, "At FITA which alternates with Indoaqua, SCI members exchange information, get new ideas and technology and together seek ways to achieve a higher level of success in their business. We have the classroom style 'Farmer's day' where we interact. Usually the participation is always good with at least 250 farmers."

During Indonesia's heydays in shrimp farming, the highest production recorded was 179,966 tonnes of the vannamei shrimp and 133,113 tonnes (DPKI) of the black tiger shrimp in 2008. Since then, production has been on the downward trend because of disease outbreaks.

"Our strategy is to increase production and we want to help farmers revive idle ponds. We will do this with application of proven technology and using only post larvae from SPF brood stocks. This year, we are confident that SCI can contribute 130,000 tonnes and bring up national production to 400,000 tonnes. Members are happy as the problems with IMNV and MPP are being resolved with partial harvesting and use of SPF post larvae. Our technical team in Lampung, Bali, Banyuwangi and Lombok have been very active too."

Almost all farms have at one time or another faced outbreaks of the IMN virus, inherent in the coastal waters. Several farms in Indonesia have been aggressively adopting biofloc technology with zero water exchange and avoid the entry of the IMN virus (see page 12). At the behest of members, SCI organised training on biofloc technology with Dr Yoram Avnimelech. Prior to this event, well-known shrimp disease expert, Dr Donald Ligtner from Arizona University conducted a workshop on disease diagnostics. During this year's SCI farmers day session, Dr. Farshad Shishechian, president and CEO, Blue Aqua International, presented advances in culture technology and focussed on optimal physico-chemical conditions of ponds to improve production.

Indonesia's Y-generation in shrimp farming

The entrepreneurship of Indonesia's first generation of farmers investing in intensive black tiger shrimp farming in the 1980s brought up Indonesia to be a leading shrimp producer. Later, they adopted a different form of farming technology with the vannamei shrimp from 2004. They went through the ups and downs of shrimp farming in Asia, as industry saw two phases of disease outbreaks. Although still relatively young in their late 50s and 60s, this older generation have now begun to pass control of the farms they built to the second generation, mostly in their early twenties. This new group are more amiable to the new biofloc technology.

They are from all over Indonesia. The second generation, from left; Tri & Catur (Banyuwangi & Bali), Henry Wiyono (Surabaya), Robin Soegondo (Situbondo), Hartono Ali (Lampung), Ferry Effendi (Lampung), Steven Kurniadi (Bali) and Ali Kukuh, SCI (Lampung), a first generation farmer and father to Hartono.

"Most of us are using biofloc technology to control conditions in our ponds. We need this to maintain productivity of our ponds and we are constantly being challenged with the presence of the IMN virus in our coastal waters. We also live with the fear of diseases infecting our ponds especially at times like this in Bali when temperatures fluctuate too much. The goal is to reduce the frequency of water intake," said Steven Kurniadi whose father started the shrimp ponds in Gianyar and in North Bali in 1997. Steven started to learn about shrimp farming in 2006 when he was 25 and had just completed his bachelor's degree in mechanical engineering.

"Our parents and their generation are more traditional and closed with the knowledge that they have. There is little sharing of information. However, times have changed and between all of us, we are in frequent contact and are open to ideas from all over the world. We need to do this and slowly learn to manage diseases. Unlike our parents, we do not wish to take chances with any disease. We are clear in our ways that if we work together and learn to prevent them, we will have a sustainable business. Basically we want to be certain on the harvest, be able to plan well ahead in marketing and in projections for the future etc."

"This second generation is our important asset. They are better equipped with basic science and applications of aquaculture principles and more importantly, are quick to learn and are open to new ideas," said Iwan.

Academics and industry at FITA; from right, Mivida, Universiti Hang Tuah, Surabaya, Suko Ismi, Zafran and Tatam Sutarmat, Gondol Research Institute for Mariculture, Bali

News in Brief

Higher fish consumption in India

The Seafood Exporters Association of India (SEAI) said that consumption of fish in India is increasing significantly due to life style changes and rising meat prices in the past few years. This domestic demand is putting pressure on the price of fish and is affecting the export sector. Anwar Hashim, SEAI, said that domestic availability of fish is not rising with growing demand. National Fisheries Development Board projections show that fish demand is estimated at 60% for domestic consumption, 7% for exports and 33% for other purposes. The projected demand for fish by 2012 is 9.74 million tonnes and supply will be 9.60 million tonnes, comprising 5.34 million tonnes from inland aquaculture followed by 3.10 million tonnes from marine fisheries. As marine capture fisheries is stagnating, future supplies will be from deep-sea fisheries, aquaculture from freshwater and brackishwater resources, reservoirs and mariculture.

Lower AD for Thai shrimp

The US has lowered the antidumping duty (AD) for shrimp imports from Thailand. This followed a World Trade Organisation ruling that the US breached WTO regulations when calculating duties against unfair prices. The AD has been reduced from 1.11-4.39% in 2010 to 0.41-0.73%. Duties were imposed in 2004 and began with 5.8 to 6.82% and have been reviewed 5 times. The new rate is less than that for India, a major export rival of Thailand in the US market. India has duties of 1.36-2.31% for its shrimp exports to the US. The US is also revising the duties for China and Vietnam. A Thai official said that these countries could face higher duties and Thailand will gain with a higher export share. The US is the main export destination for Thai shrimp, accounting for 43% of the total export value. Thai shrimp exports to the US have increased by 13.5% to USD314.18 million (THB 9.35 billion) in the first half of the year.

Responsible fish farming

In Malaysia, grouper farmers from the states of Johore, Selangor and Penang have formed the Marine Fish-Farmers Association of Malaysia (MFFAM). This development is significant as the three states account for approximately 80% of Malaysian farmed fish production. Preparatory meetings were supported by WWF-Malaysia, the WWF Coral Triangle programme and the Malaysian Department of Fisheries. "It is hoped that through the MFFAM, members can be influenced to adopt best practices in order to meet market demand sustainably," says Gangaram Pursumal, manager of the Peninsular Malaysia Seas Programme at WWF-Malaysia.

Membership of this association will be open to all marine fin-fish aquaculture related associations, companies or organizations. The association will have a governing council comprising 12 members, with WWF-Malaysia likely to be playing a key role. The objective is to promote and advance knowledge on all aspects of sustainable aquaculture. The WWF Coral Triangle programme has acknowledged that grouper farmed in cages is among the worst environmental performers globally due to issues such as feed inefficiency, cage farming effluents and habitat impacts, potential for disease transfer, etc. "The WWF Coral Triangle programme is committed to promoting better grouper farming practices, especially responsible full-cycle mariculture," said Dr Geoffrey Muldoon, LRFFT (Live Reef Food Fish Trade) strategy leader for the WWF Coral Triangle programme.

Focus on the black tiger shrimp

The Food and Agriculture Organisation (FAO) of the United Nations has urged Thai shrimp farmers to design measures that will shield production from the effects of climate change and strengthen their competitiveness as more newcomers enter the export market. Simon Funge-Smith, FAO's senior fishery officer in the regional office for Asia and the Pacific, suggested an increase in the production of black tiger shrimp. At a seminar on 'Driving Thai Shrimp Industry amid Economic, Social and Environmental Challenges', panelists said that the Thai shrimp industry still has great growth opportunities due to its high-quality production. However, the main risks are climate change, widespread shrimp disease, the fragile global economy and higher labour and production costs.

"Thai farmers should also produce more black tiger shrimp to serve the market, as there is still demand for this type of produce. In addition, it will differentiate Thai produce, instead of going ahead primarily with the vannamei shrimp against many export rivals," said Funge-Smith. Currently, vannamei shrimp account for 95% of exports. The shift back to the black tiger shrimp will require efforts to overcome diseases and hygiene problems. Dr Panisuan Jamnarnvej, president of the Thai Frozen Foods Association, said shrimp exports may grow by just 8% to about 390,000 tonnes this year because of lower supply, while the value may increase by about 7%.

Vision 2020 in marine fish farming

Vietnam's Ministry of Agriculture and Rural Development (MARD) has approved the marine fish farming development plan until 2015 and vision 2020, according to a report in Vietfish International. Marine fish will be farmed in traditional cages in river estuaries, industrial-scale cages in offshore waters of Quang Ninh, Phu Yen, Khanh Hoa, Vung Tau, Kien Giang provinces and in brackish water ponds. Target production will be 160,000 tonnes by 2015, valued at USD 1.04 billion and and 200,000-260,000 tonnes, valued at USD 1.8 billion in 2020. The priority species will be high value marine fish, such as cobia, sea bream, red snapper and silver snapper. Production can be in combination with molluscs and seaweed.

Moving processing business due to supply shortage

A number of shrimp processing companies might consider relocating their factories to Thailand or China if the current shrimp supply shortage continues, said an industry group in the Jakarta Post in July. Indonesian Fisheries Product Processing and Marketing Association chairman Thomas Darmawan said that local shrimp processing firms need adequate shrimp supply in order to fulfil contracts with overseas buyers. The Indonesian government has a ban on imports of shrimp to prevent the transfer of diseases and to protect the local culture industry. Darmawan said that recently, China launched an integrated shrimp center, South China International Trade Center, in Zhanjiang, Guangdong province and Indonesian firms have been invited to invest.

Currently, local shrimp processing companies only produce about 150,000 tonnes of processed shrimp products a year, far lower than their production capacity of 565,000 tonnes, due to the lack of raw materials. According to Darmawan, between 2008 and 2010, 16 firms reported declines in production and three have ceased operations in 2010. This year, another two large firms in Malang, East Java and Makasar, South Sulawesi have stopped operations due to the supply shortage.

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Vietnam farmers grapple with diseases

A bearish first half as farms suffer from high mortality with both the black tiger and vannamei shrimp in the Mekong Delta. By Zuridah Merican

Ben Tre: Living with diseases

When authorities in Vietnam opened up the culture to vannamei shrimp, it was initially restricted to the central and northern provinces. Although the strategy was to keep black tiger as the dominant shrimp in the Mekong Delta, with time, more areas in the delta gradually turned to farm the vannamei shrimp. A common sight is both species farmed side by side giving farmers two crops of shrimp per year.

In Ben Tre province, the culture season starts from March up to October and it begins with black tiger shrimp followed by vannamei shrimp. The province has 36,700 ha of farms where the black tiger and vannamei shrimp are cultured intensively and production ratio has been 70:30 (BT:vannamei shrimp) in 2010. Farmer and feed dealer, Hoang Vu adheres to this arrangement. His 10 ha farm in Binh Dai has 13 ponds, averaging 4,300m^2. The stocking density of the black tiger shrimp is 30 post larvae/m^2 to produce an average of 10 tonnes/ha/crop of 35-40pcs/kg shrimp over a 130 day cycle. The vannamei shrimp is farmed at 80-90 PL/m^2 with harvests of 15 tonnes/ha/crop in a 75-day cycle for 65-85 pcs/kg. The common practice from November to March is to prepare ponds for the following year's crop. Binh Dai has 3,743.49 ha of shrimp farms.

"Ben Tre is unique as authorities regulate us. We are allowed to stock ponds only in April, after the rainy season in March. December to February is the dry season. This is a preventive measure against the white spot syndrome virus which we know is more virulent under sub optimal culture conditions. It was imposed some 6 years ago. Violators will be fined fromVND 1.5 to VND 5 million but will be permitted to continue farming once started. The regulation extends to local hatcheries which are not allowed to produce post larvae and neither can post larvae be imported from other regions. If farms have ponds and wish to continue farming from September to February, they will need to seek permission from the authorities. There are conditions whereby the farm is required to report any cases of diseases. Enforcement and monitoring is good by provincial authorities," said Vu.

Hoang Vu with his invention to increase aeration.

Pumping station for diffused aeration system

More serious outbreaks in 2011

Recent news reports tell about the massive damage to farms from severe infections, both for the black tiger and vannamei shrimp, in the country. For the past two seasons, since late last year and up to June 2011, farmers throughout the Mekong Delta have reported mass mortality of black tiger shrimp at 15-25 days after stocking. In some cases, the shells had white spots. Vu said that farmers know that the disease is inherent in post larvae as they come from infected and wild broodstock, despite the fact that each batch was tested to be free from known diseases. Farmers also send the post larvae to local laboratories for further checks.

"We only sample 20 to 30 out of 200,000 black tiger post larvae. Based on my experience, I know that the chances of WSSV are lower at only 20-30% during the March to September cycle. Since 2000, I have seen that the chances of WSSV occurring rise to 70-80% during the September to February cycle. We also know that at a lower salinity (<12ppt), shrimp grow well and problems with diseases are less. Disease problems are higher at >20ppt. In some farms, farmers stock when the rains come and salinity goes down.

"The situation is getting worse this year. In 2010, the incidence of mortality was only 10% but it was 40% in March and April this year. Now (June) it is getting better."

There was another problem with the vannamei shrimp. Previously farmers have recorded incidences of white faeces diseases but since late 2010 to late June, the issue was some kind of a slow death syndrome. The blame has also been placed on post larvae stocks which has been in high demand.

"Two years ago, we experienced another disease when shrimp had enlarged hepatopancreas with a yellow/orange colour. The tail meat was soft," said Vu.

In discussing the spread of the infections, Vu was at a lost on the circumstances. He said that even though pond and water conditions are the same, the vannamei shrimp is less easily infected.

Not a deterrent

Although frequently faced with uncertainties with diseases and weather conditions, Vu reckons that he will stay with shrimp farming. It is profitable, more so recently, with high prices since mid 2010. Ex-

farm, 80 pcs/kg of vannamei was sold at VND 110,000/kg (USD 5.5/kg) while cost of production was VND 58,000/kg (USD 2.9/kg). The only threat to rising costs is the feed prices which have been increasing with increasing costs of raw materials but the feed conversion ratio of 1.2:1 of the feeds that he uses (Uni President Vietnam's HiAqua) helped. Prices of post larvae have been increasing as farmers continue to restock ponds after repeated failures. The price of good quality vannamei post larvae was VND80/PL in late June.

If not for these diseases, profit margins could be better for the black tiger shrimp which cost VND 83,000/kg to produce 40 pcs/kg and can be sold at VND 170,000/kg (USD 8.5/kg). The main costs are for feed. Black tiger shrimp require the premium feed LAone which gives a FCR of 1.4 to 1.5. For both shrimp, the average survival is 60-70%. In contrast with those for the vannamei, black tiger post larvae prices have declined to VND 60/PL because of the lower demand. Vu is aware of the availability of disease-free selectively bred post larvae but the high cost is a deterrent.

Innovation in aeration for higher stocking density

According to Vu, there are some farmers in Ben Tre who have attempted successfully to stock 250/m^2 with a harvest of 6,575 tonnes/2,200m^2 ponds (29.8 tonnes/ha). The harvesting had to be partial starting with 1.5 tonnes of 100 pcs/kg shrimp, followed by another 1.5 tonnes each of 90pcs/kg and 80 pcs/kg. The final harvest was 63 pcs/kg after 110 days of culture. He is also keen to increase the stocking in some of his ponds such as stocking at 200PL/m^2 in a 4,000m^2 pond with a salinity of 15ppt. However, he will need to increase aeration to the pond. His innovation is a diffused aeration system to be used in addition with two long arm paddle wheels. This is a long air stone placed on the bottom of the pond and which creates fine bubbles.

When asked whether he is a leader with vannamei shrimp farming in the area, Vu humbly said that all the farmers are equally capable of handling vannamei shrimp farming successfully.

Fine bubbles from the diffused aeration system

Long arm paddlewheels are the main aeration devices

Soc Trang: Starting culture with larger vannamei post larvae

Nguyen Van Tuy operates two large farms in Huyen Long Phu, Soc Trang province. Currently, in these ponds, he alternates between black tiger and vannamei shrimp. Stocking and harvesting are staggered. Usually, pond preparation starts in December and by February, the ponds are cleaned and ready for the year's two crops of shrimp. The water intake is direct from the estuary.

Until recently, the culture protocol with no treatment of incoming water has worked well. Treatment may be carried out in the ponds with a crustacide, without water exchange. In February, black tiger shrimp are stocked for the 135-day cycle followed by pond cleaning in June. The ponds are then stocked with vannamei shrimp in July or August for the 105-day cycle. The last harvest is in October to November.

The farms comprise 103 ponds, covering 100 ha. Pond sizes are 4,500 to 5,000 m^2. In Camau, Tuy has another farm with 138 larger ponds of 6,000 m^2 in a 145 ha area. One manager manages these ponds in Soc Trang and another is responsible for the farm in Camau. Tuy started the farm ten years ago culturing only black tiger shrimp. Vannamei shrimp was only introduced in 2008.

Vannamei post larvae are stocked at 80-100 PL/m^2 and black tiger shrimp at 50 PL/m^2. The stocking density for the black tiger shrimp has remained unchanged since 2003. Survival rate is high at 80% for both species. The water salinity ranges from 15 to 25 ppt. Harvests have been good at 10 tonnes/ha of 33 pcs/kg black tiger shrimp and 12 tonnes/ha for the vannamei of 70-80 pcs/kg. To secure higher ex-farm prices, black tiger shrimp are grown to 30-40 pcs/kg and sold at VND 200,000-230,000/kg (USD 10-11.5/kg) in comparison to only VND 72,000/kg (USD 3.6/kg) for 100 pcs/kg. In contrast, 100 pcs/kg vannamei shrimp is sold at VND 100,000/kg (USD 5.0/kg).

Inside the nursery

Grappling with diseases

According to Tuy, disease outbreaks escalated quickly in early 2011. Out of 10 ponds, 3-5 vannamei ponds would be infected and in the case of black tiger ponds, the infection rate was almost 9 out of 10 ponds. Water treatment protocols were changed to iodine as bactericide; chlorine being too expensive and there are too many fake products in the market. Saponin is used to kill all other animals. Tuy also produces his own probiotics. To prevent soil erosion, the sides of the ponds are lined with HDPE liners of 0.5 mm to 0.7 mm thickness. This also improves water clarity.

Diseased vannamei shrimp displayed yellowish hepatopancreas and soft flesh, said Tuy. Some dead shrimp floated whilst others would be in the feed tray. This indicated that several more dead shrimp would be on the pond bottom.

"In February, when we stocked shrimp, after 15 days there was mass mortality of the black tiger shrimp stock. Ponds were cleaned and we restocked but when the problems persisted, we cleaned up, left the ponds fallow and waited for the vannamei season. This is the second year that we have had these problems and sometimes we are too scared to continue.

"With the vannamei shrimp, there was also the slow death syndrome but we will be able to harvest large shrimp 30-40 pcs/kg after the 105-day cycle."

Nguyen Van Tuy (second left) with the sales team from Uni President Vietnam.

75-day shrimp from the ponds

Nursery system to help

The Ministry of Agriculture and Rural Development has gathered local and international experts to help determine the causative agents of the outbreaks in Vietnam. Up to the end of June, there was no information. Tuy believes that the diseases could be caused by crustaceans in the water. A crustacide, of Thai origin was then used. Similarly as in the farm in Ben Tre, post larvae were tested for diseases such as WSSV.

Devoid of any explanations and solutions to combat the disease situation, Tuy has set up a simple nursery with small, lined ponds of 4 m^2 in a covered shed. Vannamei PL 5-6 are grown to PL 25 ready for stocking the ponds. In this way, he said that he will be able to control the culture conditions during the early vulnerable period as well as monitor shrimp health. All of the post larvae used by the farm is from a hatchery in Binh Thuan in the central region, affiliated to the farm. Prices are VND 70 for PL 5-6 (USD 3.5/1000 PL).

"Whatever the circumstances, I will still need to continue with this business as I have invested a lot in these farms. In the meantime, I will have to put on hold any expansion plans", lamented Tuy.

Learning curve in biofloc for vannamei shrimp

Adapting biofloc systems to the ponds in the farms amid changing weather conditions in Bali.

Getting ponds ready for the next crop

The uptake of biofloc technology is high in Indonesia, mainly a consequence of the massive infections from IMNV-infectious myonecrosis virus or 'mio' as it is referred to among Indonesian farmers. Biofloc is managing microbial community in the ponds with zero water exchange and this requires high aeration. Understanding the different processes in the ponds will always be a learning curve for Lois Lie Darminto in Singarajah, North Bali. However, she is glad that there is the constant exchange of information among the Y-generation of farmers.

Common belief in Indonesia holds that control over pond conditions is the way to overcome diseases and to succeed in the shrimp farming business. Lois took over the farm, four years ago when she was only 19 years old and despite all adversities, is determined to continue the legacy left by her late father, Herly Lie Darminto, one of the early pioneers in shrimp farming in Indonesia.

PT Utama Terus Jaya Makmur was started in 1988 with 27 ponds, all cement lined walls for the farming of the black tiger shrimp. Currently, three of these ponds are being used as reservoirs and the rest for grow-out. There is a massive pumping system to draw seawater and pump into the ponds. In the reservoirs, seawater (30ppt) is chlorinated with (10-15ppm) of trichlorine and later is filtered through 250 micron filters. There are 25 workers and 4 technicians at the farm, one for the reservoir and the rest for the culture ponds. Ponds sizes range from 3,500 to 4,250m^2.

Lois and guests during the visit; from right, Poh Yong Thong, Bambang Setyo and Budi Rasdiyono, Gold Coin Indonesia

"My father had the vision to increase production. He continued to invest in the farm. In 1998, he deepened the ponds ready for vannamei shrimp farming. I started in 2006 and for four years, we stocked 120 PL10/m^2 with good results. Now if I am successful with this stocking density, I will try to increase stocking to 150 PL10/m^2 or more. Post larvae come from NDarulaut in Banyuwangi, our partner's hatchery. Those days, the highest yield was 30 tonnes/ha and the lowest was 15 tonnes/ha."

However, during the past two cycles in 2011, the disease brought down production at the farm. Whilst seeking for solutions, Lois has dried all the ponds for 1.5 months and is cementing pond bottoms.

"I started using biofloc technology in 2008 but will still to need to update information with other farmers using this system, as I do lack experience in its application. Every new cycle, different water conditions, climate changes, feed, diseases etc, will be a learning curve. I managed to have a stable floc in two ponds out of 14 during the last cycle. This means that I still need to study more on how to create the floc earlier in the ponds before stocking. It was a challenge as the weather was not stable and nutrient populations fluctuated too. I also believe that the aerators may not be in the best position. In this new cycle, my goal is to correct the paddle wheel positions so that they can give a good circulation of the suspended floc. There are still some major works to do to analyse the correlation of the plankton, biofloc, water parameters, shrimp, and nutrients in order to balance the ecosystem," said Lois.

"I realise this is easier said than done. During our last experience with 'mio', the average production was size 80/kg, survival was 85%

Water channels

The pump station for intake water

and feed conversion ratio (FCR) was 1.3:1. In 3 ponds, survival was 50% and in the remaining 11 ponds, it was 70% to 80%. We counted the dead shrimp and tried to link this to feeding so we can give the correct amount of feed for the remaining stock to maintain a good FCR. Feeds are from three companies, Matahari Sakti, Suri Tani Pemuka and Grobest. Our best harvest during 2007-2010 averaged 25,000 tonnes of 45 pcs/kg shrimp and the average FCR was 1.4."

Despite the threat of disease, Lois is confident that with a good aquaculture practice, solid teamwork and constant learning in biofloc system, they will improve. The farm practices one time harvest as Lois believes that partial harvesting stresses the shrimp. "However, I need to learn from other experienced farmers on how to carry out partial harvesting if one day I need to do so".

"We now have filled up 11 ponds. The days of culture will be 100-110 days to reach sizes of 50 pcs/kg. In general the cost of production (COP) is about IDR 35,000/kg in Bali but is lower at IDR 30,000/kg for farms in Jawa Island. Feed is the largest component to costs at 45% when the FCR is 1.5. Post larvae costs are 3 % of COP. In June, the ex-farm price for 50pcs/kg was IDR 60,000/kg, which was much higher than prices in Malaysia and Thailand. Feed prices increased to IDR 10,000/kg, an 8 % increase."

With biofloc, Lois expects to minimise water exchange. However, the downside is that during each cycle, there are weather changes. Once she has learnt to overcome 'mio', she will extend this technology to the rest of the ponds and fully stock the rest of her ponds. In the current state, there are no plans to expand the farm.

"In the four years, I have learnt a lot from experts in the business. I am also very grateful for the advice from Dr Nyan Taw and Dr Yoram Avnimelech. They have really inspired me with their hard work and research.

"This will now be my contribution to the business and I would like to thank everyone who has kindly shared their experiences with me. I appreciate this opportunity given to me and I know that my father would have wanted me to keep learning and improve in the face of these challenges in shrimp aquaculture."

The Aquaculture Roundtable Series
17-18 August 2011

Where do we want to be tomorrow for Asian aqua feeds

This new roundtable concept to share information was a success with participants from various segments of the aqua feed and aquaculture industry network.

The inaugural Aquaculture Roundtable Series (TARS) 2011 was held in Singapore from 17-18 August. Designed as a series of roundtable sessions to focus on specific areas of the industry, the first TARS focused on the topic of Aquaculture Feeds & Nutrition.

Participants included academia, the public and private sector. Among the private sector were nutritionists, feed formulators, aqua feed producers, integrators, feed equipment manufacturers, feed ingredients and feed additive suppliers from 20 countries around the world, including Asia, USA, South America and Europe. Academia came from Malaysia, Singapore, Thailand, USA and Canada.

Aquaculture in Asia has the enormous responsibility of creating an alternative source of seafood to the dwindling capture fisheries. However, there is a lack of direction, coordination and technology development to propel the industry into the next level. The industry needed a platform for the public, private sector, academia and NGOs to deliberate and identify a clear strategy to take the industry forward. TARS is a stakeholder driven effort to facilitate the sharing of information and improve efficiency. The result should be a self-initiative to direct development in a guided manner, yet allowing for opportunities to 'think outside the box'. This concept was jointly developed by Aqua Research Plc, publisher of Aqua Culture Asia Pacific and Corporate Media Plc, both based in Singapore.

The *modus operandi* for TARS is simple. The objective of the first day is to determine 'where we are today'. Participants benefitted from updated overviews from leaders in their respective fields. This formed the starting point for the break-out sessions. The Plenary Sessions on Day 1 saw 13 experts from Asia, Europe, USA and Canada address current challenges and emerging trends. Led by team leaders, participants split into three main industry groups (shrimp, marine fish and freshwater feeds) to discuss key challenges and formulate a strategy to drive the industry forward during the breakout sessions on Day 2. The results from every group were then consolidated and deliberated in a panel discussion open to all participants to encourage cross fertilisation.

Going back to basics

Challenge for the nutritionist

In 'What do marine fish need and what do feed ingredients bring: thinking beyond fish meal and fish oil replacement, **Dr Dominique Bureau**, UG/OMNR Fish Nutrition Research Laboratory, University of Guelph, Canada, said, "Despite years of research and millions of dollars invested, fish meal and fish oil remain almost essential components of successful commercial marine fish and shrimp feeds."

"Fish meal is both a complex and a generic group of ingredients. We need to understand what this type of ingredients is bringing to the fish" said Bureau. "What does fish meal have which plant meals do not have?" is an important question.

From left, Dan Fegan, Cargill, Thailand who led the shrimp feed panel discussion, Guo Fu Ci, Alltech Malaysia and Karim Kumaly, DSM, Singapore.

Bureau believes that so far research has generally been simplistic with the main focus being the "fish meal replacement value of protein ingredients". More rational and systematic approaches to fish nutrition research and feed formulation are required. "Balancing our understanding of what feed ingredients are bringing, what animals require and how we can meet these requirements" is what is most critical. Simple improvements in the experimental design of research studies could lead to major gains in our understanding of requirements of the animals and the nutritive value of feed ingredients. More should be invested in the definition of the nutrient requirement of different species and at different life stages reared in different production systems. The characterisation of the content and bioavailability of individual nutrients and the variability among batches of ingredients

Back to basics, with from left, Dr Dominique Bureau, Jacques Gabaudan and Wee Kok Leong

are also very important. Research needs to be in tune with the needs of the feed manufacturer. In turn, feed manufacturers should aim to make better use of the valuable information generated by the hundreds of nutritional studies published each year. In this context, Bureau presented some examples on how nutritional models could be very useful tools for feed manufacturers.

The right feeds for shrimp at the grow-out phase

Towards the end of the shrimp culture cycle, the biomass is higher in intensive culture systems and the water quality poorer, as indicated by high levels of ammonia, nitrite, or hydrogen sulphide and low levels of dissolved oxygen amongst other parameters. Such conditions may lead to stressful conditions in the pond and subsequently impact on the immunity of the shrimp. To maintain productivity, it is necessary to reduce the impact of stress and/or improve the immune response capability. Based on his experiences in commercial feed production and aquaculture, **Dr Wee Kok Leong**, Temasek Polytechnic, Singapore said that shrimp should be provided with more energy and/or other micronutrients at this stage to overcome the stress.

Feeds for the late grow out stages have generally been formulated with lower protein levels based on research that smaller fish require more energy and protein than larger fish. He cited examples where the crude protein levels decline from 37% in starter feeds to 33% in commercial *P. vannamei* grow-out feeds. In contrast, Wee suggested that in stressful grow out conditions, shrimp need higher energy levels, in terms of greater level of protein as shrimp has a preference to using dietary protein for energy. In addition to an increased availability of energy, high protein feeds has been shown to improve immune status. The production of haemocyanin, associated with the immune function in shrimp, is directly related to dietary protein level in the feed. Furthermore, shrimp fed a higher protein diet have been shown to be metabolically more efficient and will use less energy to maintain routine metabolic functions, ensuring more energy will be available for growth. It was suggested that feeds with higher digestible protein level, could be achieved through the use of higher inclusion rate of protein rich ingredients or the use of highly digestible protein rich ingredients.

However, Wee also cautioned that with such nutrient dense diets, it is imperative that great care must be taken to ensure proper feeding management is practiced to prevent over feeding. Otherwise, these high protein feeds will be a source of nutrients for further pond water eutrophication and creating the stressful environment that farmers are trying to avoid in the first place.

Nutrition and health

The needs of the animal for specific functions can be addressed with functional feeds. In the salmon industry, nutritional prophylaxis is common. **Dr Jacques Gabaudan**, DSM Nutritional Products in Thailand quoted the recent conclusion of a meeting of Nutreco scientists that 'there is far greater potential in functional feeds ingredients to support animal health and delivering benefits for farms and the environment'.

"The integrity of the gastrointestinal tract is essential for nutrient absorption and macrophages migrate to the lumen when there is a challenge. Macrophage defends against infections and to support the immune function the fish require the right nutrients at the right time. Infections increase nutrient demands. Functional feeds must be formulated to meet the nutrient demand when the immune system is challenged," said Gabaudan.

Functional micro-ingredients can be divided into nutrients such as the vitamins and nucleotides, non-nutritive immunostimulants such as β-glucans and others such as pre and probiotics, organic acids and essential oils. An unpublished report by Shiau showed that as dietary

Martin Guerin (left) and Joseph Kearns

nucleotides increased, both survival and the response to bacterial challenge (with *Streptococcus iniae*) improved.

The message was that a balanced nutrition is required to reduce the impact of infections, optimize the value of feed ingredients and minimize the environmental impact of farming. Feed to support the physiological functions of the fish and shrimp will result in improved productivity.

Feed processing update

Speaking on 'current challenges in shrimp feed pelleting', **Martin Guerin**, Gold Coin Group, Malaysia, said the recent progress in nutrition and processing technology, and changes in target species, farming practices, food safety requirements, and economic constraints, are redefining some ground rules in the production of shrimp feed and its interaction with the pond environment. The major shift is the dominance

of vannamei shrimp in intensive culture systems. In contrast to the black tiger shrimp, vannamei uses plant protein better, can feed in the water column and responds well to crowding. Higher volumes of feed can be distributed continuously via automatic feeders. High fiber from plant proteins pose new processing challenges. High biomass and smaller sizes at harvest demand smaller diameter pellets.

Food safety concerns and consumer demands, focus the attention on the microbiological quality of feeds, use of natural binders, and prevention of residues from contaminants in ingredients. Higher production costs demand optimization of all feed processing stages, from grinding to drying. Guerin said, "While pelleted feeds continue to dominate, the debate between pelleting and extrusion continues and the final answer will come from feed performance and farmer's satisfaction."

The status of extrusion technology for shrimp feed was discussed by **Joseph Kearns**, Wenger, USA. Capacity was an issue in the extrusion of small feeds but the recent development of diverging cone screws and oblique tube dies allow for an increase in capacity by 3-5 times and for a uniform product. Two oblique tube dies and splinter device will be able to give an output of 8-10 tonnes/hour of sinking shrimp feeds. In the US, shrimp feeds are being produced at 750 kg/hour with die opening of 0.4 mm. Higher capacities are possible for sinking feeds such as 0.8mm at 5 tonnes/hour.

"We learnt from Dr Addison Lawrence that small diameter feed with more frequent feeding means more pellets per kilogram. This could be more important in raceway systems where feeding frequency is higher. In the case of extrusion, industry has been limited by capacity. Now it is also possible to make the small feeds and use a wide range of materials without added binders. Historically research has shown that soybean meal and other vegetable proteins will be important and will partially replace fish meal in aqua feeds,"said Kearns.

With increased popularity of indigenous ingredients which require moisture at elevated levels, additional or better preconditioning are required. With demands on better food safety practices, feed equipment manufacturers are focussing on processes which minimise contact with the product. In using plant proteins, the problem is the lack of essential amino acids and optimisation of crystalline amino acids is limited. By working with partners, Wenger has added in an engineered liquid solution which improves the EAA profile of vegetable proteins, bringing it closer to fish meal levels.

The salmon model

The salmon industry consumes 3 million tonnes of feeds and the change in feeds composition is one of the major contributors to the expansion of the industry. **Niels Alsted**, Biomar, Denmark, said a major development in the industry was the change in biological FCR in the last 20 years, from 1.2 to below 1.15 in 2010 despite a major reduction in fish meal content. This is a result of increased knowledge about feed formulation but genetics and farm management also play a role. Some 100% of the feeds are extruded and with vacuum coating, produce more than 35% fat feeds. More than 80% of feed production cost is raw material costs and thus the raw material prices and recipe greatly influence feed cost.

Least cost formulation progressed from one based on total content of nutrients to availability and based on amino acids of total body. This then progressed to that based on available nutrients and energy for a fixed performance and later to least cost based on open formulation for a given performance calculated to give least cost per kg of product.

"In the next five years, the fish meal inclusion will come down toward 10-15% and the criteria is to get the fish meal from known sustainable sources such as within IFFO. However, the increasing use of fish oil in the refined oils market is threatening supplies for aqua and the challenge will be also be to find the necessary EPA/DHA sources," said Alsted

Lessons from poultry and swine nutrition

According to **Dr Robert Payne**, Evonik, Singapore, the principles of basic nutrition apply whether it is for land or aquatic species. Aqua feeds face issues such as rising costs of diets but at the same time need to develop in a sustainable manner. The poultry industry was highly dependent on soybean meal as their main protein source, but as the knowledge of their nutritional requirements improved, this has changed. In chickens, FCR has improved from 1.99 in 1998 to produce a 2 kg chicken to 1.77 for a 2.3 kg chicken in 2011 as a result of improved genetics and nutrition. Poultry production is no longer solely dependent on soybean meal, as indicated by the 30% reduction in the use of soybean meal.

"Both the swine and poultry industries grew quickly to fully integrated production systems and in the process faced growing pains which are now not much different from those faced in aqua feed production. As the industry was evolving through genetic selection, the ingredients available were expanding and becoming more complex. The progress was by learning to control variation of nutrient content in ingredients, identifying and formulating to meet individual amino acid needs, embracing the ideal protein concept, identifying and formulation on digestible amino acid basis, phase feeding and formulation based on optimal economic growth."

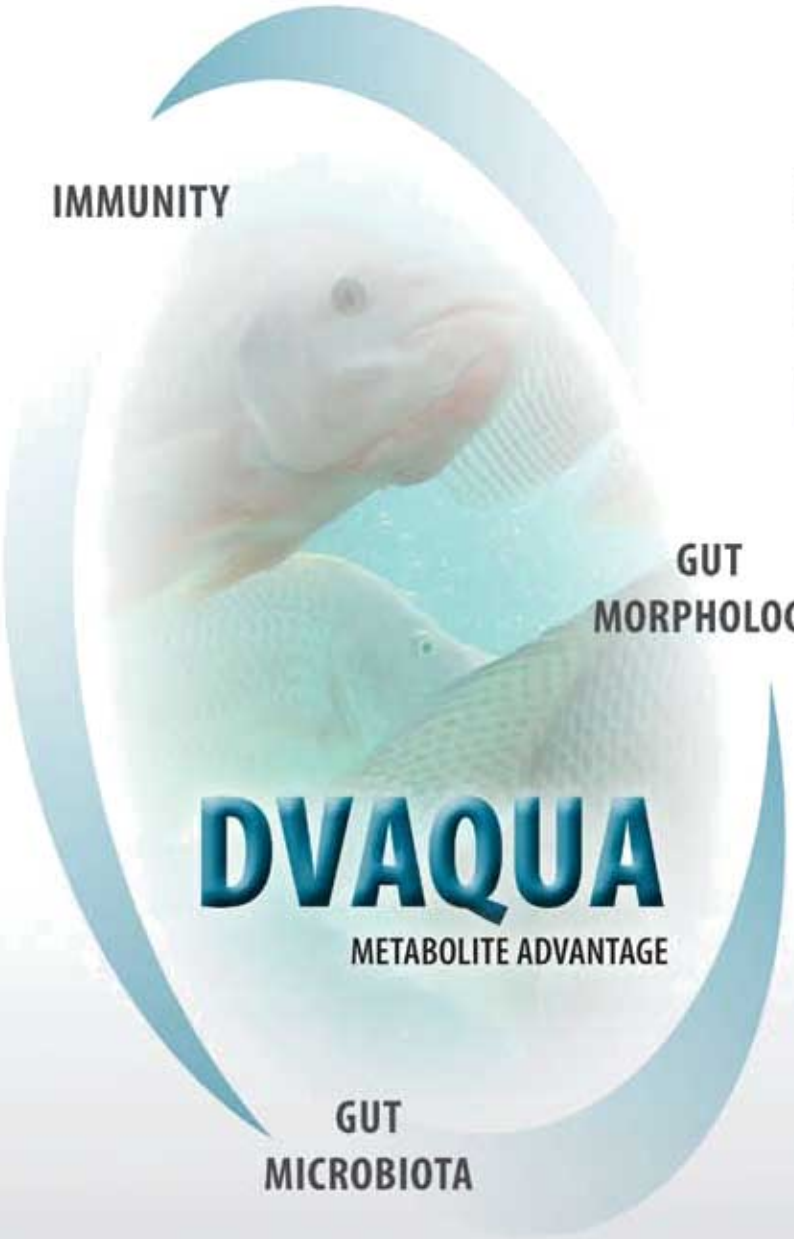
Payne said that high variability in nutrient content in raw materials leads to increasing diet variation which in turn increases the safety margin to meet specifications and finally increases feed costs. He showed that composition of fish meal from Southeast Asia is highly variable in terms of crude protein and amino acids composition. To compensate for deficiencies, the nutritionist may increase the safety margin and this impacts the feed production inventory.

"In seeking alternatives to fish meal, we need to more precisely define the animal's nutrient requirements especially the amino acids. In animal feeds, dietary protein is used for protein deposition and

Robert Payne (centre) and Dhanapong Sangsue (left), Evonik, Singapore.

From left, Albert Tacon, Victor Suresh and Serge Corneillie

Balance Their Immune System for Health and Performance.



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From Left; Frank Tan, Marine Life Aquaculture, Singapore, Craig Browdy, Irene Gomez, Corporate Media Services and Niels Alsted.

From left; Nguyen Thi Kim Phuong and Pham Thi Phuong Tien, Vinh Hoan Feed Mill, Vu Thi Ngoc Hanh, Alltech and Pham Van Chi, P& N Agrobusiness, Vietnam.

Pedro Encarnação (right) and Dr Chawalit Orachunwong, CPF, Thailand (middle)

Prof Ng Wing Keong, Universiti Sains Malaysia, at the freshwater fish feeds breakout session. He also led the panel discussion.

Vincent Fournier

carbohydrates and lipids for energy. This is not the case with fish and shrimp. In low fish meal diets, net energy utilisation is reduced but net protein utilisation remains unchanged. Fish species respond well to supplemental amino acids and in the salmon and tilapia, retention efficiency of total methionine and sulphur amino acids, is similar to poultry and swine."

The fish meal challenge

Various presenters touched on this. **Dr Victor Suresh**, Integrated Aquaculture International (IAI), based in Brunei questioned 'How close are we to complete replacement fish meal and fish oil in shrimp feeds'. Although fish meal levels in shrimp feeds have come down considerably, complete replacement of fishmeal is not yet a commercial reality.

"We know that fish oil may be completely replaced, but not when fish meal is also completely replaced. One question raised is to what level can fish meal and fish oil be reduced without reducing performance. Formulating low fish meal shrimp feeds requires the use of combinations of several ingredients since most feedstuffs have been shown to have significant nutrient and functional limitations and cannot be used individually at high levels (> 20%) in shrimp feed."

Suresh discussed the criteria for macro and micro- ingredients as practical alternatives for fish meal. He looked at palatability and attractability challenges and said that low levels of fish meal (3%,10%) do not improve attractability. Performance of black tiger shrimp fed diets in which all fish meal (dietary inclusion level varying from 20 to 25%) was substituted with either poultry by-product meal or soy protein concentrate showed that about 85% of growth achieved on fish meal can be achieved with either ingredient. The replacement diets are balanced for most known and measurable nutrients except for amino acids. Use of a novel methionine has recently shown promise in bridging the performance gap between diets containing fish meal and soy protein concentrate.

According to **Dr Albert G Tacon**, Aquatic Farms, USA, "The bottom line in a shrimp culture business is to have a low production cost for the shrimp farmer to stay in business. If the farmer fails, there will be no market for feed manufacturers. It is important for feed companies and producers to keep ahead of the competition and invest more resources into applied R&D."

He listed out some strategies to reduce costs which included improvements for feed ingredient and feed formulation. He said that the shrimp does not need fish meal but nutrients. Trials in Indonesia showed an effective diet for shrimp stocked at 75 pcs/m^2 contained feed with 20-25% feed grade poultry by-product meal with supplemental amino acids. Costs savings range from 5.7 to 7.9%.

In Japan **Serge Corneillie**, Alltech, reported on his work to use enzymes to reduce fish meal in marine fish diets. Over the last 2 years, he has worked at encouraging farms to use enzymes by reducing fish meal fish in diets by up 65%. The performance has been encouraging for red seabream where growth has been comparable with fish fed diets with 50% fish meal. Similar results were reported for tilapia and pangasius catfish. (see Issue July/August, p20-22 for full text)

New challenges in feeding shrimp

Dr Craig Browdy, Novus Aqua, USA looked at nutrition and health management in shrimp across culture systems and said. "Feeds drive profits but also directly affect water quality. This necessitates careful control of feeds and feeding rates particularly in reduced water exchange systems. Water stability is a key driver, which directly relates to the debate on extruded or pelleted shrimp feeds. All these amidst the need to grow shrimp quickly and efficiently.

"Feed formulation strategies differ depending upon the farm production model. Although both intensive and more extensive systems must strive to control feed conversion and maximize efficiencies, strategies for achieving these goals can differ. As the level of intensification rises, the density of the feed formulation and attention to fundamental requirements of the target species increases."

Browdy added that in biofloc systems, there is still a debate on the effects of feeds and feed types on the dynamics of low water exchange

ponds. Adjustment of carbon: nitrogen ratios can help prevent early cycle ammonia spikes but strategies emphasizing nitrifying bacteria and controlling floc densities can improve performance especially at high stocking densities.

Tacon and Browdy said that the recent use of automatic feeders for shrimp feed is a new challenge for feed manufacturers. With changes in feeding patterns such as increasing frequency of feeding (every 3-4 minutes), shrimp feeding in mid water, diurnal cycle, feeding to real demand, the feed manufacturer has to possibly adapt with shape, size and density of pellets and reviewing the water stability duration. The first feed mill with answers may have the lead.

New generation of ingredients

The application of a controlled hydrolysis process to fresh raw materials is able to generate higher level of peptides and free amino acids than found in classical raw materials. These enhance feed palatability, nutritional value and bioactive properties (antimicrobial, antioxidant, stress reduction), said **Dr Vincent Fournier**, Aquativ, France. Consequently, the use of hydrolysates can help to balance the feed formula for good zootechnical and nutritional performances.

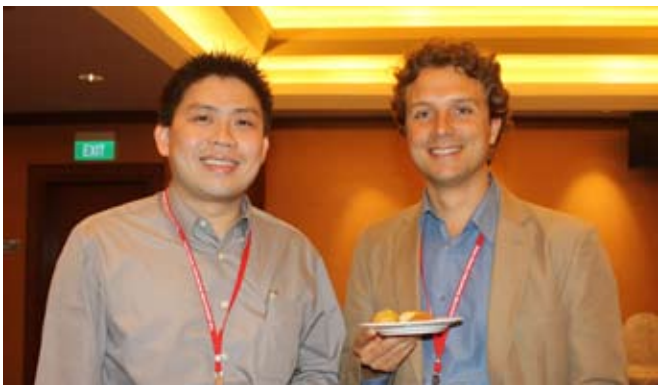
Many trials have been conducted in different species and experimental conditions to show the added value of the functional hydrolysates added to aqua feeds. In European seabass (*Dicentrarchus labrax*), the application of a hydrolysate was able to improve the performance of the diets whatever the dietary fish meal level evaluated (0%, 20% and 40%), thanks to an improvement of feed palatability and feed efficiency. In marine shrimp (*Penaeus vannamei* and *P. monodon*), some trials showed that application of such an ingredient is a way to add value to the feeds containing a high level of fish meal substitutes and to the commercial formula too. In omnivorous species (tilapia and catfish), even a low dosage of hydrolysate is sufficient to improve zootechnical performances and fish resistance to a severe exposure to ammonia.

Prof Shunsuke Koshio, Kagoshima University, Japan (right) leading a marine fish feeds roundtable. He also led the panel discussion.

"These results coupled to the literature on hydrolysate performance in fish, shrimp and even in terrestrial vertebrates are powerful signals of the potential of such ingredients to help to support a sustainable aquaculture growth," said Fournier

According to Suresh, n-3 highly unsaturated fatty acids from fish meal can partially or fully meet shrimp's requirement for the fatty acids. If fish meal and fish oil are to be completely removed from the feeds, the missing fatty acids will have to be supplied by other sources. Also, more data is needed on the requirements for fatty acids, especially for shrimp in commercial grow-out conditions for 3-4 months.

Dr Thomas Wilson, Thai Luxe Feeds, and Dr Ram Bhujel, AIT, Thailand



Teddy Njoto, PT Matahari Sakti, Indonesia and Thomas Levallois, Aquativ, France

Tacon reported on a single cell protein produced from food grade waste. These contain 65-67% crude protein. The aquaculture opportunities for single cell algae are in larval feeds for rotifers, marine and in brood stock and maturation diets. The extracted biomass are protein rich as well as EPA and DHA. However, these are now too expensive to be considered for applications in aqua feeds.

Browdy also gave some food for thought in new formulation strategies and using nutrients to avoid an imbalance. Fish meal and fish oils will continue to be an issue. These include the use of supplementary amino acids, microbial enzymes such as phytases and proteases, use of chelated minerals and strategic inclusions of pallatants, attractants and growth promoters. He also suggested supplements such as organic acids, phytogenics, pre and probiotics to improve gut environment. Trace minerals chelated to amino acids are more absorbable and utilisable preventing mineral deficiencies which can be associated with higher inclusion of plant proteins.

Cost effective freshwater feeds

Feed formulation, feed quality and feeding practices for freshwater fish in Asia often reflect the use of low cost ingredients and those with poor nutrient profiles which result in under optimal performance by fish, said **Dr Pedro Encarnação**, Biomin, Singapore. Common ingredients are fish meal, soybean meal, meat and bone meal, rapeseed meal, peanut meal, DDGS, rice bran, cassava and broken rice. It is difficult to compare the diet of the freshwater fish to that of the marine fish as the former cannot have high value ingredients and fish meal is added either at low levels or none at all. Furthermore, current feed specifications for freshwater fish stipulate low crude protein at 20-36% and not as digestible protein.

Soybean meal is the major protein source at 20-30% and rice bran is the major feed ingredient at 24-40%. Lipid sources can be full fat rice bran or pangasius fat for tilapia and carp diets. Some of the threats of these ingredients are deficiency in lysine and high aflatoxin levels for peanut oil, variability in composition and mycotoxins in DDGS, high peroxide and mycotoxins in rice bran.

Encarnação discussed the gaps in feed formulations. New information in NRC 2011 recommends 28% crude protein in feeds for 600-1,000g tilapia but observed values are only 22-26% crude protein. For protein deposition, available protein is required. Thus, digestibility and availability of nutrients are key parameters.

"Plant based diets with low fish meal and meat and bone meals require mineral supplementation. Soybean meal and rice bran are rich in phytate, which unfortunately can reduce mineral and essential amino acid absorption. High levels create an imbalance and phytase and supplementary EAA are required."

His message is that feed mills should focus on cost effective feed targeting performance and not price, understand the characteristics and limitations of ingredients and focus on conversion of nutrients into biomass/products.

The panel discussions on key challenges and suggested strategies will be published in future issues.

TARS 2012 will be on the MARINE SHRIMP INDUSTRY. It will be held from 15-16 August 2012 in Phuket,Thailand.

Effects of potassium diformate (KDF) on growth and health of pangasius catfish in commercial ponds

By Kai-Jens Kühlmann and Christian Lückstädt

A higher protein digestibility and nutrient uptake led to a faster harvest by 19 days in this 8-month trial in the Mekong Delta, Vietnam.

In the past decade, the export of white pangasius fillets to EU countries was in high demand and hence, striped catfish production through intensive pond culture increased eight fold from 0.15 to 1.2 million tonnes per year in Vietnam's Mekong Delta (Bosma et al. 2009). This was the highest primary crop production of 200 to 400 tonnes/ha/crop (De Silva & Nguyen 2011). In 2009, 608,000 tonnes of Vietnamese striped catfish were exported mainly to the EU (37%) with Germany and Spain as the top two importers, while Asian countries and the USA imported 7% each, followed by Russia and Ukraine (6%, respectively), Mexico (5%) and Egypt (4%, Josupeit 2010).

Often, intensive pangasius production in ponds leads to farming setbacks and increased use of antibiotic growth promoters (AGP). However, a growing awareness from consumers and producers of aquaculture species has resulted in a demand for responsible and sustainable aquaculture. Since acidifiers such as diformates are one of various alternatives spearheading environmental friendly and

Table 1. Growth parameters of striped catfish (*Pangasius hypophthalmus*) during an eight month commercial farm trial fed with or without KDF† (Mekong Delta, Vietnam)*.

Month	Weight gain (g)			Mortality (%)			FCR			FPI**		
	Control	KDF	Δ (%)	Control	KDF	Δ (%)	Control	KDF	Δ (%)	Control	KDF	Δ (%)
1	15.4	19.8	28.3	1.7	10.9	534.8	1.1	0.4	-66.7	143.8	501.8	248.9
2	35.9	54.1	50.8	15.5	1.1	-92.1	0.5	0.9	65.1	582.2	622.7	6.9
3	81.5	116.7	43.3	0.8	0.8	-2.1	1.2	0.9	-21.7	694.2	1270.7	83.0
4	173.0	194.4	12.4	0.3	0.5	62.2	1.1	1.1	5.4	1583.8	1685.3	6.4
5	91.3	164.0	79.7	0.5	0.3	-28.8	2.1	1.4	-34.0	435.1	1186.7	172.8
6	213.1	148.7	-30.2	1.0	0.8	-22.2	0.8	1.2	50.8	2617.5	1214.0	-53.6
7	117.3	147.9	26.1	0.3	0.5	36.6	2.1	2.0	-4.7	544.9	720.1	32.2
8	114.0	186.3	63.4	0.3	0.4	14.6	1.2	1.4	16.5	951.9	1334.2	40.2
Final	841.4	1031.8	22.6	20.5	15.3	25.4	1.3	1.2	-7.7	5145	7283	41.6

† KDF: potassium diformate – trade name Aquaform® produced by ADDCON GmbH
** Initial Body mass: Control = 22.6g (n=20), KDF = 18.2g (n=20)*
*** FPI = Fish Productivity Index = Weight gain (g) x Survival (%) / (10 x FCR)*

nutritive-sustainable aquaculture approaches, positive effects to the growth and health performance had been obtained for salmonids (Lückstädt 2009), tilapia (Lückstädt & Kühlmann 2011) or white leg shrimp (Kühlmann et al. 2011). In the following study, the effects of potassium diformate (KDF), fed to striped catfish on a commercial pond farm trial will be discussed.

In an eight-month commercial farm trial, two ponds were stocked with striped catfish with an initial average weight of 20.4g (50 fingerlings/m²) and fed twice a day with a commercial diet containing 28% protein. Fish in the treatment pond received a 0.2% KDF (Aquaform®) containing diet compared to those in the control pond. Both ponds were widely separated to avoid intrusion. Individual fish sampling was conducted twice a month to monitor body mass development. Additionally, daily feed quantities and fish mortalities were recorded and weight gain (WG), feed conversion ratio (FCR), fish productivity index (FPI), protein efficiency ratio (PER = weight gain (g)/ protein intake (g) and productive protein value (PPV = gain in body protein (g)/ protein intake (g) x 100) were calculated. Harvested fish was commercially sold.

Improved growth

Initial results show that pangasius fed diets with 0.2% KDF-inclusion over the whole trial period averaged a 22% higher body mass (1,050g vs. 864g; Figure 1), 23% higher weight gain, an improved FCR by almost 8% and mortality reduction by 25% compared to the control group. Fish productivity index of KDF-fed catfish was likewise 42% higher compared to the control group (Table 1).

As a catfish pond in general shows no visibility below the surface, data on a monthly basis showed fluctuating performances between KDF-fed and control groups. After stocking, a disease outbreak (bacillary necrosis) affected fingerlings in the KDF-inclusion group, which initially caused mortalities of 10.9% versus only 1.7% for control fingerlings. FCR during the second month was very low for both groups probably due to substantial natural food intake. Furthermore, the control and KDF-fed fingerlings gained 35.9g and 54.1g, respectively, resulting in a 51% higher weight gain for the KDF-fed pangasius.

This trend of higher weight gain, similar or lower mortality and FCR with concomitant higher FPI was likewise observed throughout the culture period for KDF-fed fish. The exception was in the sixth month, when fish in the control group showed a higher weight gain and lower FCR compared to KDF-fed pangasius. Reasons for this fluctuation could be attributed to complex environmental influences partially 'stressing' the catfish during the grow-out period, especially the changing weather season (monsoon).

Higher PER

Often, increased growth performance or improved feed efficiency can be attributed to a better utilisation of nutrients. In the case of acidifying substances, this is frequently reported for protein utilisation. Therefore, the protein efficiency ratio was calculated during the culture period as well. Fish fed with the KDF-containing diet had a PER of 2.98, while catfish in the control group reached a PER of only 2.75 (Figure 2).

Therefore, the inclusion of potassium diformate has led to improved protein efficiency by more than 8%. This was further confirmed by the

Figure 1. Body mass development of striped catfish fed with and without 0.2% KDF inclusion during grow-out culture in intensive ponds, Mekong Delta, Vietnam (n=100)

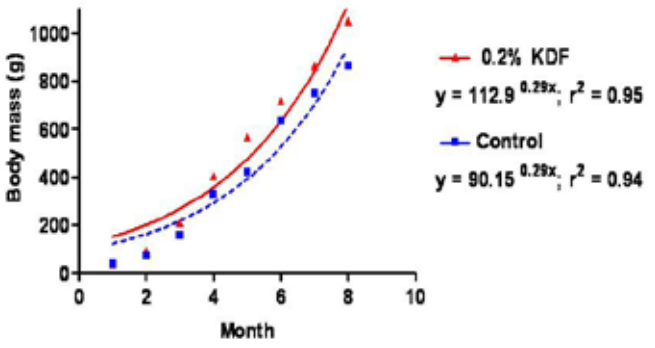
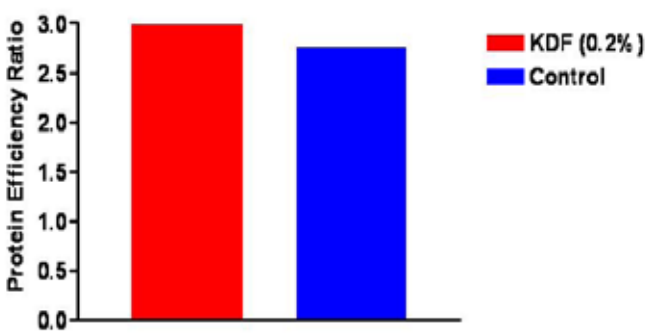


Figure 2. Protein Efficiency Ratio of striped catfish fed with and without 0.2% KDF inclusion during grow-out culture in intensive ponds, Mekong Delta, Vietnam.



productive protein value. Here, the index rose by 9.9% (221.0 for KDF fed and 201.1 for control, respectively). This indicated that pangasius in the KDF-fed group needed only around 453g of supplemented feed protein to produce one kg of fish protein, while the catfish in the control group needed 497g. The actual figures may differ, since the intake of natural food (which contains some protein too) could not be quantified.

Finally, faster growing pangasius in the KDF-fed group enabled the farmer to sell the fish earlier to the market and therefore reduced the culture period (with all related costs) by 19 days.

Summary

Based on the data presented above it can be concluded that a concentration as low as 0.2% KDF (Aquaform®) inclusion in commercial pellets showed strong effects on the overall performance in terms of growth and FCR, survival rate, nutrient utilization and FPI. We attribute this to the double-salt technology in producing a formic acid-formate-double molecule, which carries its active ingredients with efficiencies above 90% into the catfish intestine and counteracts gram-negative pathogenic bacteria in a slow-release mechanism. This thereby improved protein digestibility and nutrient uptake for the catfish. KDF-inclusion in commercial feeds is a sound alternative to antibiotics. These results give a strong argument for new ways in fish nutrition, especially for EU-export-oriented catfish farms.

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Yeast extracts supplementation can increase feed consumption in the white shrimp

By Philippe Tacon and Tanuttha Suyawanish

This was the preliminary finding from feed trials in Thailand using 15g shrimp.

Cages similar to the ones used in the trial

Although largely used in food business for their flavouring properties, yeast extracts are rarely used in animal nutrition for specific functions. More often, it is a source of nitrogen and vitamins and is sometimes used at quite high concentrations. Although, they can have some interesting functional applications in animal feed, there is little data in the literature on applications in the marine shrimp.

Yeast extracts are derived from the autolysis of baker's yeast *Saccharomyces cerevisiae* and can have different degrees of purification by the removal of yeast cell walls and further subsequent concentrations. Different grades of yeast extracts are available in the food industry with different savoury tastes, nucleotide content and protein levels, ranging from autolysed yeast (sometimes inappropriately called yeast extracts) to highly purified extracts. These extracts contain a high level of nitrogen, vitamins as well as highly digestible peptides and are very soluble.

The interest in using the compounds to increase feed consumption in aquaculture has different objectives; the most obvious being increasing growth and reducing feed conversion ratio. However a higher feed consumption in ponds, and especially in shrimp culture, a faster feed consumption, can reduced waste from the nitrogen present in uneaten feed and contribute to better water quality. A faster consumption can also reduce the leaching of key nutrients from the pellets.

In this article, we report on a small and simple experiment set up to study the effect of yeast extracts in shrimp feed consumption. Our idea was to simulate as closely as possible a farm environment with by using a standard feed formula and following standard farm practices.

Experimental design

A total of 300 shrimp *Litopenaeus vannamei* (ranging in weight from 14.5 to 16.5g) were placed in net cages or hapas, each measuring 3 x 6 m, in an earthen pond. The salinity was 26 ppt and the temperature 27.9-29.5°C. The animals were acclimatized in the pond for 4 days and were fed control diets at 5 % body weight/day day. Shrimp were given 4 meals/day.

During the trial, 4 feeding trays of 0.44 m^2 were placed equidistant in the four corners of the hapas. One tray corresponded to one replicate of each treatment. The total of 4 trays were used, in each hapa and represented 4 replications of each treatment.

The feed additives tested were all produced and commercialised by Lesaffre Feed Additives (LFA, France). Two of these are standard yeast extracts (YE1) and yeast extracts enriched with 6% 5'IMP and 5'GMP nucleotides (YE2) used as flavour enhancers. Both are from baker's yeast. The third treatment contained yeast cell walls from baker's yeast (YCW). The inclusion rate was 2kg/tonne for the extracts and 0.5kg/tonne for the yeast cell walls. These represented dosages recommended by LFA in feed for these products. The additives were incorporated directly in diets as indicated below. The final diet contained 35% crude protein. Water quality was checked regularly, to ensure optimal water quality for shrimp culture.

Shrimp were fed 4 times per day at 7.00, 12.00, 16.00 and 20.00 hrs. At meals 07.00 and 16.00, an amount of feed representing 50% of the meal feed ratio was put in each tray. The feeding rates were 1.6% and 1.8% body weight respectively for these meals. The amount of feed

was the same for all trays. After an hour, the trays were checked and feed pellets and shrimp, counted. The trial was performed for a total of 7 days but after 3 days, it was decided to stop the test in the afternoon because it did not bring any further results. Statistical analysis was performed using repeated measures ANOVA with the Duncan test.

Table 1. Composition of test diets (g/100g of feed).

Composition	Control	YE1	YE2	YCW
Fish meal (58% protein)	28	28	28	28
Soy bean meal	12	12	12	12
Squid meal	5	5	5	5
Shrimp head meal	5	5	5	5
Broken rice	18	18	18	18
Wheat flour	12	12	12	12
Wheat gluten	6	6	6	6
Yeast	2	2	2	2
Fish oil	1	1	1	1
Soybean oil	1	1	1	1
Lecithin	1	1	1	1
Vitamin Mix	0.25	0.25	0.25	0.25
Mineral Mix	0.05	0.05	0.05	0.05
Spirulina	0.1	0.1	0.1	0.1
Rice hull	8.6	8.4	8.4	8.55
Feed additive	-	0.2	0.2	0.05

Effects on feed consumption

Due to the high variation in the results between days, it was decided to average the data by pooling the 7-day experiment according to feeding time and treatment. So the results are expressed as the average of morning (n=7) and afternoon meals (n=3).

The repeated measure analysis showed a significant effect of the yeast extracts YE1 and YE2 on pellet consumption ($P<0.05$) compared to the control but not for the YCW diet. It also showed that there was no cage effect during this trial. We did not see any effect in the number of shrimp present in the tray leading to us to presume that the shrimp did not stay in the tray after or during eating (Figure 1)

We also observed that feed with yeast extract were consumed faster than in the other treatments. In the case of diet YE1, nearly all of the feed was consumed after one hour of feeding for the morning meal (Figure 2) . The effects are similar between the morning and afternoon meal. In the present study, we could not differentiate if the increase in feed consumption was due to a feed attractant effect, or a stimulation of feeding behaviour in the shrimp.

The effect was the same between both yeast extracts, both of which contained high nitrogen levels (between 50 to 63% protein equivalent). In

Figure 1. Number of shrimp in the feed trays after one hour of feeding.

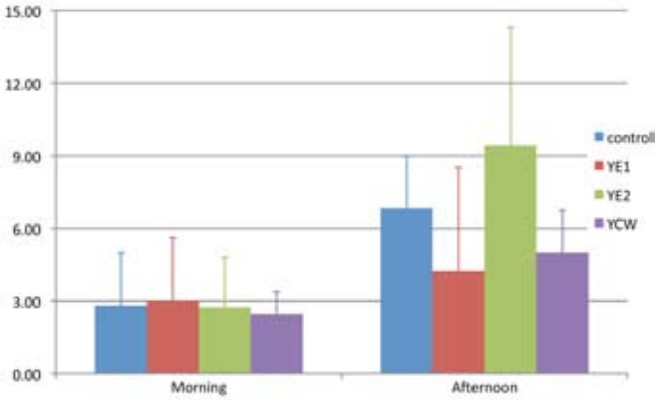
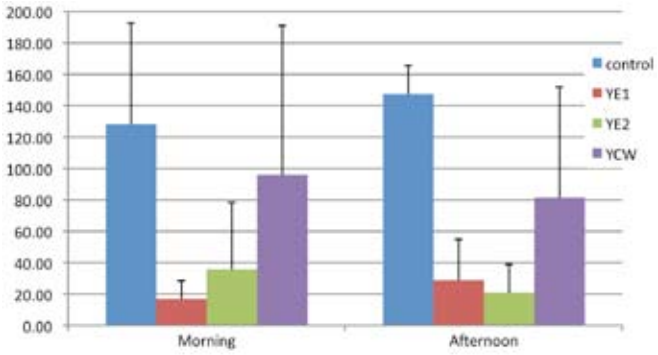


Figure 2. Number of pellets remaining in the feed trays after one hour of feeding.



addition, it did not seem that the higher percentage of nucleotides had an effect in triggering this higher feed consumption, even though it has been shown in studies that they have an inciting or stimulating effect when presented as individual compounds. We can speculate however, that the free amino acids from the yeast extracts released in the water could act as a powerful attractant for the shrimp in finding feed. Our observations in the present trial led us to postulate on the attraction effect.

One interesting aspect of this study is that the feed, being of a standard formula used in Thailand, contained yeast (ten times the concentration of yeast extract). Feed supplemented yeast extracts and containing yeast has a higher consumption by shrimp than the feed containing only yeast, or yeast cell walls and yeast. Therefore, it appears that the components which have been extracted from yeast and included at a relatively low concentration have a more potent effect than the same components but still present inside the yeast cell.

Similarly, even if the feed already contains squid meal, which is believed to be a powerful feed attractant for shrimp, the feed consumption can be further enhanced by the addition of yeast extracts.

Based on these findings, we conclude that yeast extracts represent a good candidate to increase feed consumption in shrimp at particular challenging times such as pond stocking, weaning in post larvae or presentation of medicated feeds. However, it would be interesting to duplicate this study with diets containing no yeast and to perform a growth trial with more challenging diets (lower fish meal or squid meal inclusion) to evaluate the effect of yeast extracts in shrimp nutrition.

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Algal concentrates in hatchery culture

By John S. Clark

Culture of uni-cellular algae is a prerequisite for successful operations in hatcheries for shrimp, crab and most fish species. Problems with algal culture and inherent disadvantages therein are described here, and an industrialised approach is used to produce specific algal compositions tailored to meet the requirements of the growing larvae.

It is estimated that over 40 species of uni-cellular algae are in use in the aquaculture sector. They are generally recognised as difficult to grow in mass culture, particularly in low light (cloudy) or rainy conditions. The most important factors to consider in algal culture are temperature, salinity, pH, light intensity, photoperiod and nutrient composition; the major expense in algal culture comes in the nutrient component.

Algae can require up to 17 different trace components in their culture medium. The cost of production is further increased due to the requirement for specialist technicians. Large scale culture increases the likelihood of breaches in bio-security, as pathogens can easily be transmitted from nearby culture tanks or via inadvertent introduction of insects etc. Generally speaking, only one algal species tends to be cultured per single farmed species, therefore nutrient composition becomes a critical factor especially when algae is entering its decline and death phases, and composition can therefore vary widely.

Since single species algae cannot provide all of the nutrients required by larval shrimp and fish, careful selection of a range of algal species which cover the spectrum of larval nutrient requirements would seem a logical progression. These said species of algae can be grown in a sterile, hermetically sealed, bio-secure environment. They can then be harvested at pre-determined times during the log phase of growth to optimize nutrient quality and consistency. Such algae can then be concentrated via centrifuge then packaged and stored prior to use.

Such a system is flexible in terms of algal composition in that formulations for fish and shrimp larvae can be tailored to meet the requirements of the larvae. Each combination is tailored to contain algal species which can fulfil the nutrient requirements of growing larvae, particularly in terms of protein/amino acids, lipid/essential fatty acids, vitamins, minerals, trace elents and carotenoids. This ability to manipulate the species composition and therefore the nutritional content is considered essential for successful hatchery operation regardless of target species. These concentrates are easily stored and applied to tanks and can also be used to enhance and enrich live feeds such as rotifers and *Artemia*. Its use reduces the need for mass culture tanks which can then be turned over to larval and nursery rearing and also reduces demand on labour time and equipment. Larval quality is improved and development is accelerated, resulting in healthier, stronger larvae which can be sold at a premium, thereby improving returns on investment.

The current study describes a novel, industrialized approach to negate these disadvantages and to place hatchery culture methods on a more consistent and stable platform. This strategy was designed and implemented by Meriden Animal Health, UK and is presented in the form of the PHYCONOMIX range of products.

A trial was run comparing live Chaetoceros (control algae) with a commercially available algal concentrate (PHYCONOMIX SHRIMP ZM) as food sources for larvae of the white shrimp (*Penaeus vannamei*) in Thailand. There were 3 control treatments and 3 test treatments in each study group. The tanks used were 5 tonnes and stocking density was 200 nauplii/litre. As well as their conventional feeds, the test groups were fed on SHRIMP ZM, twice a day to mysis 3 and then 3 times/day to 15 day post larvae (PL15) following the manufacturers feeding instructions. Survival, length, weight, length/weight ratio, gut/muscle ratio, feed consumption, hepatopancreatic *Vibrio* count and formalin stress test were all recorded during this trial. Scanning Electron Microscope (SEM) studies of the harvested post larvae were also conducted. The accumulated data allowed for a return on investment calculation to be made between the use of live and concentrated algae during larval shrimp culture.

Effects of a multi species algae diet

By the zoea 2 stage, an obvious size difference was noted (Li, pers. comm.). At the same time, the controls treatment experienced an outbreak of zoea 2 syndrome and a significant mortality occurred. It was noteworthy that water quality in the test tanks was viewed as superior to that observed in live controls. This has been mirrored in other trials (Pota, pers comm.; Somhathai, pers.comm).

The mean survival of 3 concentrate treatments ranged from 80-88% and was significantly higher than in the live controls (47-57%). Animals are significantly greater in length, being 12.6mm in length compared to 11.3mm and significantly heavier (1.52mg compared to 1.43mg) than the controls, which resulted in a significantly more favourable length/weight ratio of 1.29 compared to 1.20. Body weight and muscle depth are considered to be the most important factors in purchasing of post larvae. Feed utilisation seems superior in that the gut/muscle ratio favours muscle in the test groups (3.7 as opposed to

Figure 1. Comparison of exo skeletal structures in post larvae, left (control) and right (treatment).

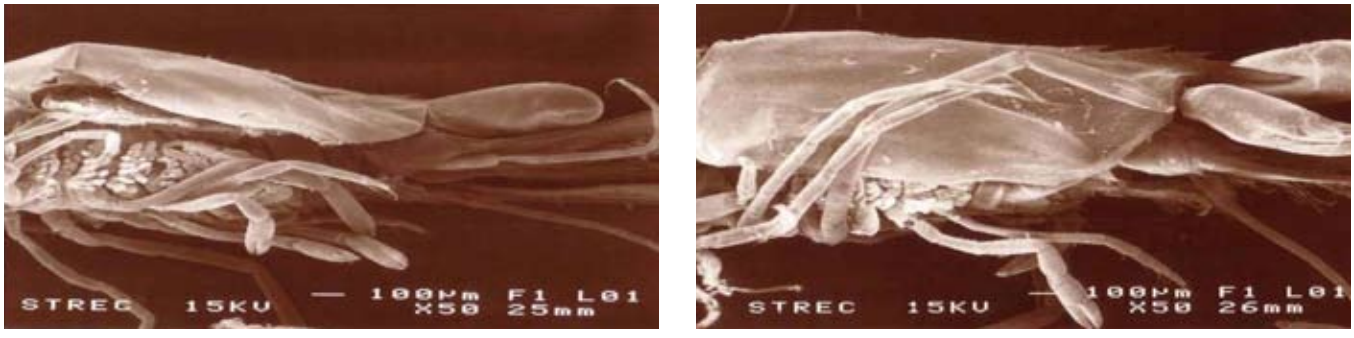


Figure 2. Development of compound eye in post larvae, left (control) and right (treatment).

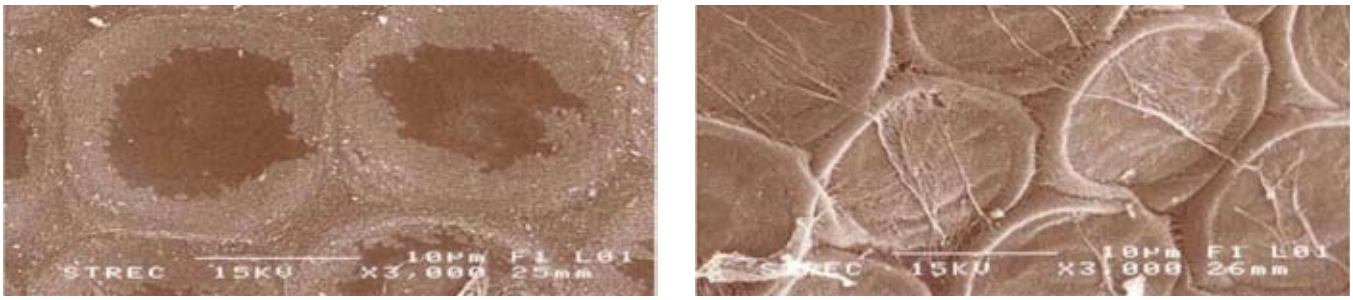
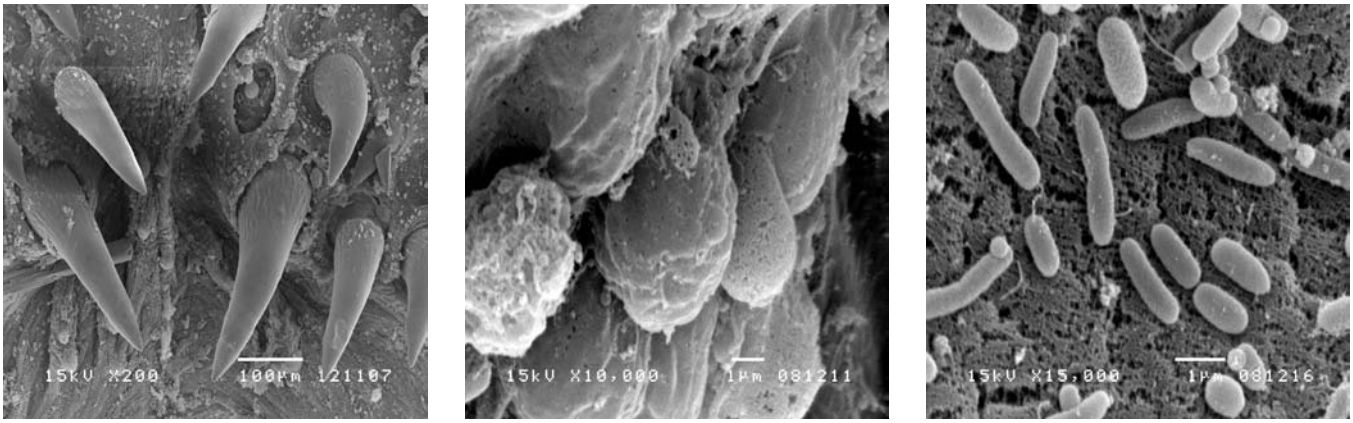


Figure 3. Developments in dentition (A), taste bud (B) and bucceal microbial flora (C) in Asian sea bass larvae fed the algal concentrate.



A B C

2.9) and this is manifested as an increased *Artemia* nauplius and flake feed consumption, which are 30-40% higher in the test groups.

The final post larvae are significantly stronger and more resistant to formalin stress as evidenced by survival rates of 100% compared to 75% in controls. SEM studies showed significant differences in exo-skeletal structure and strength (Figure 1) as well as in development rate of the compound eye (Figure 2). Such differences in stress survival and the structural improvement in the animals fed concentrates has significance to the grow out phase of farming operations.

Cost and return on investment figure prominently in any hatchery. the use of concentrates does in fact lead to more profitable production of post larvae This, coupled with the many advantages relating to ease of use, makes algal concentrates very attractive to hatchery operators.

A future for hatcheries

Anectodal evidence suggests that zoea 2 syndrome commonly experienced in many hatcheries is nutritional in origin but complicated by secondary invasion by bacteria or viruses (Li. pers. comm.). This study, in which no outbreak was experienced in the test groups, would tend to support that premise. The nutritional profile of a multi-algal species diet will be more complete than a single species diet and this will aid in the protection of target animals.

The improved water quality using concentrates may simply be a function of improved shrimp larval health leading to improved vigour and appetite. It was noted that feed consumption rates were higher but were non-detrimental to the larval environment. In such an environment and with a much more complete, nutritionally balanced dietary regime, it is not surprising that survival, growth, feed intake and resistance to stress are all significantly improved.

The developmental and structural advantages seen in the harvested post larvae are of considerable interest to grow out farmers. In Figure 1, an examination of the carapace by SEM reveals the carapace to be thin and pliable, and therefore more prone to damage. By contrast, the carapace of animals fed on concentrate appears much denser and stronger, and would therefore be capable of resisting much more handling stress. Such considerations are of vital importance to farmers.

Even in the case of the compound eye, the eye seems incomplete in the controls (Figure 2) and this will of course impact on feeding behavior. It seems in general the concentrate fed animals are more developed than controls and therefore more suited to the rigours of pond life. Advantages are therefore not restricted to simple survival and growth. There are many other advantages that may escape direct attention but become evident on deeper study.

This developmental advantage is also observed in trials with concentrates in the nutrition of larval fish. In a recent study on larval sea bass (*Lates calcarifer*) apart from the advantages in terms of survival and growth, significant developmental acceleration was observed in development of dentition (Figure 3A), taste bud (B) and buccal microbial flora (C).

When factors such as ease of storage, ease of use, nutritional consistency, absence of potential pathogens, reduced labour cost and freeing of tank space are considered alongside the aforementioned performance superiority, the future of algal concentrates as a significant tool in hatchery culture seems secure.

Acknowledgements

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A winner in production of marble goby fry

Early and complete weaning from day 40 prepares uniform size fry for fast growth with formulated feeds

In most Asian seafood restaurants, the freshwater marble or sand goby *Oxyeleotris marmoratus* is regarded as one of the best tasting freshwater fish with few bones, more akin to a high value marine fish. Menu prices are not too exorbitant at SGD 80/kg. Ex-farm the fish is sold at SGD 35/kg and prices for the fish have remained high with demand higher than supply. The production of healthy and uniform 6 cm (100g) fingerlings for stocking requires almost 8 months from the egg stage. The grow-out to market size of 600g takes 8 months and a further 4 months is required to produce 1kg fish.

Singapore's Marine Life Aquaculture (MLA) started work on the breeding and nursery of the marble goby in 2010. Currently the production is 10,000 monosex juveniles/month using 10 pairs of brood stock. These are only sufficient to supply grow-out in farms in Singapore. An expansion in production will be possible when the hatchery moves to larger premises on Pulau Ketam, off Changi on the northern coast of Singapore. MLA is already a leading supplier of barramundi fry and fingerlings to cage farms in Malaysia, Indonesia and Singapore. It also produces four- finger threadfin and golden trevally fry and fingerlings (see Aqua Culture Asia Pacific, issue March/April, 2011).

The breeding technology for the fish is well known. Induced spawning of 250-300g mature fish in a ratio of 1:1 (female: male) using available hormones such as HCG (human gonadotropin) and LH-RH (Luteinizing hormone-releasing hormone) is the common practice. Spawning and early larval rearing occurs only at 5-10 ppt, ideal for MLA's hatchery located close to the sea. Eggs are deposited onto artificial substrates which facilitates egg collection. Hatching occurs within 3-5 days at 25 to 29°C. Intensive larval and nursery stages take place in indoor recirculation systems.

The bottlenecks faced by most hatcheries are during the larval stages because the fish has a small body size of 4mm long, and the small mouth size of 0.1mm limits the range of live feeds suitable for the fish. Low survival (25%) over the 40-day hatchery cycle is common as the post larvae shift from endogenous to exogenous food sources. This is the stage which determines the success and failure of any marble goby hatchery. Some hatcheries have only survived a year.

4 month old fry

Tan Kay Hock with a brood stock

Early weaning

Larvae are fed on live feeds such as rotifers and copepods from day 3 to 20 and later on a combination of rotifers, artemia and micro diets from day 15 to day 30. The weaning stage usually starts from day 30. Micro diets are usually a combination of high protein feeds designed for the marine larval fish such as Otohime, Inve and Gemma Micro.

"This is the critical part of any hatchery operations. During this stage which is usually two months, our target is a survival of 50%. Larvae of 0.1 cm are initially stocked at 10,000 pcs/m^2 and after a month, when the larvae reach 3 cm, the density is reduced to 5,000/m^2. Grading is carried out on day 7 in the first month and on day 10 in the second month. The prerequisites are that feeding has to be continuous, up to 18 hours per day. Tanks need a steady current flow. Stocking density should be high to encourage crowding which in turn prevents the territorial behaviour of the fish. However, overfeeding should be avoided," said Tan Kay Hock, chief technical officer. Tan developed the larval rearing and nursery protocols as well as the recirculation water system at MLA.

"We have noticed that if feed is adequate, the cannibalistic nature of the fry will not manifest. Initially we introduce the micro diet by feeding 1-2 hours followed by live feeds. After day 40, full weaning can be achieved. Light and optimal water quality parameters are essential. Weaning is to prepare fry for frozen feed or dry diets in commercial farms."

Nursery

The nursery stage occupies 6 months. During the first two months, the stocking density of 3cm larvae is 500 pcs/m^2. Tanks with a surface area of 20m^2 are used throughout the nursery cycle. Stocking density is 10,000 pcs for the first 2 months and grading is essential at 15 days. In the second stage of 2 months, the maximum density is reduced to only 8,000/m^2 and survival improves at 80% in stage 2. In stage 3, stocking density goes down to 6,000/m^2 and survival is 85%. "In general, the survival rate from larval to fingerlings of 10cm averages at 10%," said Tan. "Now, it will take us 4 months to grow fish from 2cm to 10cm sizes."

70 day (3cm) fry

Future farming technology

It is recommended that this highly carnivorous fish is farmed at high stocking densities in fibreglass tanks. However, the extensive grow-out of 100g fish in earthern or lined ponds and in individual net cages in ponds/tanks is common in Malaysia and China. It grows well in freshwater as well as brackish waters. The stocking size in outdoor nurseries is 3 cm. Average production is 15 kg/m^3. An intensive recirculation water system indoor farm in Taiwan produces 90 kg/m^3 of fish. Fish of 200 g are cultured for one year and are fed grouper feeds with a feed conversion ratio of 1.5.

Tan listed a range of problems in the grow-out of the fish. Aside from the limited supply of fingerlings and the large size variation of hatchery produced fingerlings, farmers face high mortality from diseases. Grading is required as usually fry show a large size variation. In high density culture, weaned fry will easily feed on dry pellets which helps in maintaining good water quality throughout the cycle.

"This is one of the most promising freshwater fish species. It has a high value and demand from restaurants is increasing. It also has a high flesh yield. Furthermore, transportation of the live fish only requires individually oxygenated bags. It grows well in high stocking density in tanks rather than ponds. However, at the grow-out stages, we will need to overcome several constraints. Selective breeding for size and disease resistance is the future. As the fish reach full maturity at 300 g and males grow faster, we believe that monosex culture should be the way forward. Single sex fish can be achieved with hormonal treatment or hybridisation in the short term and genetics in the long term."

Freshwater prawn in Bangladesh: An over-winter nursery to increase output

By Prabal Barua, Jewel Das and Md. Abul Hossain

A new business to nurture late season post larvae during the colder months for the next grow out season. This is a step toward a two-crop per year production cycle.

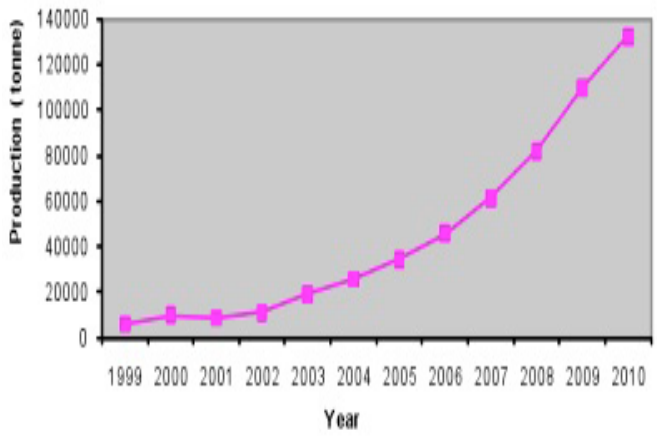
Bangladesh is a major producer of the freshwater prawn *Macrobrachium rosenbergii*, locally called galda. The total area under prawn farming in Bangladesh is estimated to be around 50,000 ha (Khondaker, 2009), and around 600,000 people are directly involved in prawn farming, marketing and associated activities. Together with the marine shrimp, the freshwater prawn is a high value product for international markets, mainly in markets in the US, Europe and Japan. In 2007-08, Bangladesh exported 49,317 tonnes of prawns and shrimp valued at USD 445.41 million, of which the freshwater prawn contributed 30% (DoF, 2009).

Freshwater prawn production in Bangladesh using extensive or traditional methods is widespread in the south-western part of the country. In greater Khulna, prawn farming uses large enclosures called 'ghers'. These ghers were used for black tiger shrimp *Penaeus monodon* farming but after the outbreak of diseases, farmers seasonally farm the freshwater prawn. It is estimated that the greater Khulna, Jessore and Faridpur regions account for 90% of the national production.

Ponds or ghers are used for prawn farming with variable culture practices. Of the total fisheries production in Bangladesh, 65% comes from aquaculture and the remaining 35% from capture fisheries (DoF, 2009). A recent report estimated the country's prawn production at an average of 400-500 kg/ha. It is also estimated that prawn production costs (inputs plus some labour) varies from BDT 250 – 350/kg (1 USD = BDT 70) with a sales price of BDT 350-650/kg (Ahmed, 2008).

There are more than 80 hatcheries but only a fraction of these were operational in 2008. The total demand for prawn post larvae (PL) is assumed to be 550 to 600 million based on the total culture area of 50,000 ha. The stocking density of post larvae varies based on the culture pattern: monoculture, polyculture, rotational culture, integrated culture, PL based culture and/or juvenile based culture. Since only 110-120 million PLs are produced in the country, it is assumed that the balance of PL supply are imported from neighbouring countries or are wild caught (Ahmed, 2008; Winrock International, 2006).

Figure 1. Production of *Macrobrachium rosenbergii*, 1999-2010 (DoF, 2010) .



Prawn farmers are happy to harvest large size prawns

Over winter nursing

In the wild, the prawn spawns during the wet season. In a hatchery with quality feed, improved management and higher temperatures, brood stock may spawn two to three times during the breeding session. As such, freshwater prawn farming in Bangladesh is handicapped with this seasonal supply of PL, both from the wild and hatcheries.

The growing season typically starts in April using wild caught PL and in May with hatchery produced PL. Harvesting is usually completed by November or December. Ponds remain idle until the following April or May. Natural supply of PL ends by August to September and prices drop as farmers are reluctant to stock ponds just before the winter season. This is the main reason why there is only one prawn farming crop per year in Bangladesh whereas in other countries, two to three crops are common.

Introducing a nursery concept

The nursery phase allows for a favourable prawn rearing environment for 45-60 days and stocking into ponds at larger sizes. This shortens the grow-out cycle and, in the case of Bangladesh, farmers can harvest before winter. Based on the availability of brood stock, it is possible to produce 7-8 cycles but most hatcheries limit PL production to 2-3 cycles, to the months of April to July, because of the demand situation.

There is also a seasonal pattern in PL demand. Farmers with perennial water bodies get the early season juveniles, available during the last week of March to April. The third and fourth production cycles of PL are available up to October. The price of first cycle PLs are usually high and prices drop fast for the remaining cycles. Prices during the September-October period are only a third to a quarter of that for the first cycle PL. As prices are low, these late-season PL are ideal for an over-wintering nursing project. After 120 – 150 days, juveniles can be sold for stocking in ponds.

Winrock International (WI) is an international non profit organisation with its headquarters in the US. It has a long history in Bangladesh and

The inside view of a prawn hatchery in Chittagong

Experimental hapa for overwintering of the prawn

in other countries working to build capacity in agricultural research, agricultural extension and natural resource management. The group is currently working as a partner for Katalyst and has been working successfully since July 2004 to implement targeted interventions in Bangladesh for market development of the maize, poultry and freshwater prawn sectors.

Winrock International-Katalyst (WI-K) has taken the initiative to commercialise an over-wintering process for late-season PL in the Greater Khulna, Jessore and Faridpur region. In the greater Jessore areas, WI-K designed a methodology and selected three service providers to set up three nurseries and to provide juveniles to grow-out farmers and demonstrate a new culture pattern of *Macrobrachium rosenbergii* during the early season.

Nursery operations

Three ponds, each with a water area ranging from 0.44ha to 2ha were selected for the experiment. Ponds were rectangular in shape with sandy-loamy soil. Water depths range from 1.5-2m and pond bottoms were cleared of unwanted materials. The WI-K consultant encouraged nursery operators to apply rotenone powder at the rate of 6.25kg-7.5kg/ha.

After 30-45 minutes, dead fish were removed. Agriculture lime or dolomite was applied at 250kg-375kg/ha after 7-8 days. Ponds were fertilized with organic and inorganic fertiliser to produce natural food, 7-8 days after liming. After 5-7 days, when pond water is green or light brown to green in colour, farmers set up net cages or hapas into the pond and stock 10-15 PL for 24 hours to test the suitability of pond water.

Farmers stocked 10-12 day PL collected from the hatchery at a density of 20-25 PL/m^2. They also stocked silver carp *Hypophthalmichthys molitrix* or Indian carp,

Catla catla fingerlings at 5-8 and 8-10 fingerlings/ha respectively. After 48 hours, water was checked again. This was done with a small net in the evening. If 5-6 PL is caught in each catch at every haul, this was considered as good survival rate of PL. Each month, sampling is carried out to check the growth rate, health condition and survivals. The farmers used a "Quality Gold Nursery" feed during the initial two months and afterwards they used prepared feeds such as boiled wheat, mixture of oil cake, rice polish and fish meal. The feeding rate starts from 50-80 g/ha and ends up at 200-250g/ha daily. Farmers are advised to avoid excessive application of feed and fertiliser and agitation of pond bottom. Application of lime was done regularly at 280-400 g/ha.

The farmers sold the juveniles gradually and this was completed by the end of April. However, during 2009-2010, a prolonged winter and foggy weather badly affected prawn production because moulting behaviours were slower in this season. Farmers are able to sell the juveniles at a higher price of BDT 3-5/juvenile. In comparison, during the stocking time, prices of PL dropped to as low as BDT 0.70-0.90/PL.

Hatchery reared prawn larvae

Conclusion

Compared to other major producers such as China, Vietnam and Thailand, the productivity of freshwater prawn farming in Bangladesh is extremely low. With the use of these cheap over winter juveniles, an early crop can increase national productivity. In addition, the program has been successful in developing the prawn farmer's knowledge on better pond preparation, liming, fertilisation, nursing, grow-out management, harvest and post-harvest techniques. Furthermore, most farmers showed an interest to have an early crop which is a step towards producing two crops in a year in the coming season.

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Bali leads in this 'mini lobster' production

A profitable small scale business for the local live freshwater prawn market

The freshwater prawn *Macrobrachium rosenbergii*, is cultured in almost every corner of Indonesia, producing 684 tonnes in 2009. Farms on Jawa Island and Bali were the major contributors at 388 and 288 tonnes, respectively in 2009 (DPKI, 2011). This production in 2009 was almost half of the peak production of 1,199 tonnes in 2006. Since then production has dropped to 989 tonnes in 2007 and 942 tonnes in 2008.

Size 25-30pcs/kg prawns from the holding tank

There is a cyclic decline in production of post larvae every two years, said Indonesian researcher Wartono Hadie at the Agency for Marine and Fisheries Research and Development. The common practice is to stock ponds of less than 1,000 m^2 at a density of less than 10/m^2. This is to ensure high survival and avoid cannibalism. Similar to China, Vietnam and India, the culture system is either monoculture, polyculture with carps or other fish, or combined rice/prawn farming. Expansion of its farming is constrained by the short supply of hatchery produced post larvae which in turn is hampered by brood stock quality and disease problems.

GIMacro

Recent production is based on the 'genetically improved *Macrobrachium rosenbergii*' or GIMacro which achieved a commercial breakthrough in 2001. It is the result of selective breeding at the Freshwater Research Station in Sukarmandi. This was developed using stocks from the Musi, Kalicupang and Cimanuk rivers. This gave a 30% higher growth than the previous stocks. The prawn has a smaller carapace section and a concurrently larger tail portion by 13.7% (Trobos, 2006). The GIMacro brood stock was distributed for post larvae production in the government hatcheries in Jogjakarta, Probolinggo (East Java), Sukabumi (West Java), and Klungkung in Bali.

Currently scientists are continuing to develop newer hybrids using stocks in Kalimantan, Sumatra, Jawa and Papua New Guinea. This is yet to be released and will have a higher survival rate and a reduction in the size of the carapace by 15-25%. There are studies to adapt the species to varying salinities and to explore the phenotypic plasticity of the genes. The aim is also to use the prawn to replace vannamei shrimp culture which is hampered with disease problems.

Increasing production

Demand for the prawn is increasing such as in the Jogjakarta area where the production is 15 tonnes/month and producers can supply only 30% of the requirement, according to a report in Trobos (July, 2011). The prawn is popular because of it culinary versatility as well as the presence of steroids in the head area, said to be good for fitness. In Jogjakarta-Solo, farmer Jaro Cahyono, has adopted a simple technology to increase stocking density to 20-25 fish /m^2. This involves the installation of bamboo shelters in the ponds to create increased space for the prawn. The system was later termed an 'apartment cultivation system'. The result is a harvest of 1.5 to 2 times more than the extensive system. However, there are specific criteria to be followed to prevent cannibalism. Some of these involved using bamboo shelters to form squares with sides of at least 20 cm and adjusted to the approximate length of prawns to prevent prawns from being in contact with one another. Good water quality and adequate flow are important, otherwise aeration is required.

Small scale industry in Bali

In general, throughout the archipelago, farming of the freshwater prawn is usually a small scale activity such as in Gianyar, Bali. This district is the largest producer of the freshwater prawn with a yearly production of 189 tonnes (DPKI, 2008). Nyoman Mudana has four culture ponds and a holding tank located among the padi fields in Pring Desa Pring, Kecamatan Belah Batuh. Nyoman started as a labourer managing the ponds and 20 years later, has taken over these ponds. In the flow through water system, the 300 m^2 earthern ponds are stocked with 2,000 post larvae (6 post larvae/m^2). According to Nyoman, after 2

Wartono Hadie

Nyoman Mudana and daughter in front of one of his ponds

months, he will do some culling of the juveniles. However, at a lower stocking density of 1,000 post larvae, culling is not necessary.

Partial harvesting is practised whereby the first harvest after 6 months is 40 kg of 25 pcs/kg size, followed by a second harvest of 15 pcs/kg size at 7 months. At the 8th month, the balance is harvested. The production achieved during these harvests are indicators of growth performance as there is no sampling of the stock during the grow-out period. Growth performance is not satisfactory if the first harvest produces only 30 kg of 25 pcs/kg prawns. A large size variation in the stock is obvious as there is no sorting and separation into male and female stocks, and because male prawns grow faster.

"The farm does not face any major disease problems and if there is an unusually high mortality, it would be because of water quality," said Nyoman. Slow growth of the juveniles is a problem and this is related to the source of the hatchery produced post larvae. In purchasing his seedstock, Nyoman will visit the hatchery and choose the tank with the longest post larvae, known to result in a survival rate of 80% at harvest. Post larvae from the government hatchery in Klungkung perform better and cost IDR 45,000/1000 PL whereas the private hatcheries will sell 1,000 PL for IDR 35,000. Also, he believes that the best post larvae come from the Jogjakarta hatchery belonging to the Provincial Fisheries Office. With these PL, he said that it would be possible to start harvesting at 5 months as compared to 6 months with those bought from a local hatchery in Bali.

This small business is profitable for Nyoman who sells the size 25 pcs/kg prawns at IDR 60,000/kg ex-farm. The highest price was IDR80,000/kg. The costs of inputs are only post larvae at IDR 80,000 and feed which costs IDR 250,000 for a 50kg bag. The total amount of feed used for each cycle is 150 kg. The prawns are sold live to a broker. Bali has the advantage of a demand from hotels and restaurants where the prawn is known as the 'mini lobster'.

Culture of the redline snakehead

The potential of using pelleted feeds to culture fish

By M.A. Haniffa, M. James Milton and Ajaz Ali Bhat

Air breathing fishes form about 13% of marketable freshwater fishes in India and among them the murrels or snakeheads, belonging to Channa genus are highly priced from INR 200-350/kg (ex-farm USD 4 to 7.8). These fish are particularly popular in Andhra Pradesh and Tamil Nadu because of flesh quality, taste, flavour, nutritive, recuperative and medicinal properties. Globally, there are about 28-30 species and about 10 species of Channa have been reported in India.

Table 1. Ingredient composition (g) and costs (INR) of diets.

Ingredient	Diet 1		Diet 2	
	Composition	Cost	Composition	Cost
Fish meal	300	15.00		
Wheat flour	150	3.75		
Soy flour	150	6.00		
Tapioca	100	2.20		
Chicken intestine	300	0.75	1000	
Total	1000	28.00	1000	2.50 (transport charges only)

In India, *Channa striatus*, *C. marulius*, *C. punctatus* and *C. diplogramme* are high value food fish. Unfortunately, Indian fish farmers are unable to culture snakeheads extensively due to the limited availability of fingerlings as well as the non-availability of pelleted feed. Moreover, hatchery seed production is a difficult task as the fish is carnivorous and cannibalistic. During grow-out, farmers often encounter failures due to sudden outbreak of diseases such as the Epizootic Ulcerative Syndrome.

Redline snakehead

Redline snakehead, or *C. diplogramme*, is also referred to as the giant, toman and red snakehead. Juveniles show two black longitudinal stripes with a bright orange intermediate area while adults exhibit a broad dark longitudinal stripe with dots. The distribution of *C. diplogramme* is in the Coromandel (Malabar) and Western coasts of India. Recently this species has been recorded from the central regions of the Western Ghats. The maximum length recorded was 130 cm and weight was 20 kg. It resembles *C. micropeltes* in colouration but differs in the presence of gular scales.

Wee (1982) cited *Channa marulius* and *C. diplogramme* as the two fastest growing snakeheads, more than one metre in length and weighing over 20 kg. Lee and Ng (1991) said that *C. diplogramme* is a highly prized food fish in Malaysia and grows in cages where it is fed on tilapia. Cage culture of *C. diplogramme* is successful in the lower Mekong basin of Vietnam where *C. diplogramme* and *C. striata* collectively comprise the second most important cultured fish group.

Feeds and nutrition

Among the four species mentioned above, the redline snakehead grows fastest. It is a voracious feeder and accepts pelleted feed. In the present 6 month study, we looked at the growth performance of the fish fed on a formulated diet. This was compared to fish fed chicken intestines, the most common feed used by farmers. Our aim was also to improve growth of fish by increasing feeding frequency to 4 times/day.

Feed trial

Redline snakehead fingerlings were collected from the Pamba River and transported to the CARE Aquafarm and acclimatised in the Rheotaxis unit for a period of 5 days. During the acclimation period fingerlings were fed a formulated feed. Following this 200 fingerlings (18.60 ± 1.30g) were stocked in each culture pond (6m x 5m x 1m).

Fingerlings of the first pond were fed at 5% body weight with a formulated diet whereas those of the second pond were fed chicken intestines (Table 1). Each month, 30-40 fish were sampled using a drag net for length weight measurements. Fish were harvested after a period of 6 months, and feed conversion ratio and specific growth rate (SGR) were calculated.

Table 2. Survival and growth performance of redline snakehead fed the two diets.

Parameters	Diet 1	Diet 2
Weight of fingerlings (g)	18.6 ± 1.30	18.02 ± 2.06
Final weight (g)	360.5 ± 1.02	355.41 ± 1.62
Survival (%)	72.6	88.0
FCR	2.40 ± 0.62	2.38 ± 0.72
SGR	1.01 ± 0.16	1.12 ± 0.20
Production (kg/30m^2/6months)	52	62
Production (kg/m^2/day)	9	11.3
Production (tonne/ha/cycle)	17.3	20.65

Redline snakehead

Harvest of redline snakehead

Harvesting

M. James Milton (right) and Ajaz Ali Bhat (second left) at the Asia Pacific Aquaculture 2011 in Kochi, India.

Table 1 shows the cost of ingredient and diets. Fish meal and chicken intestines were the major ingredients in diet 1, whereas diet 2 comprised only chicken intestines. The approximate cost of diet 1 was INR 28/kg whereas diet 2 cost only INR 2.5/kg for transport charges. Survival and growth performance of fish fed on different diets are shown in Table 2. Snakehead fed on chicken intestines showed better survival (88%) when compared to formulated diet (77%).

Irrespective of diet, snakehead reached about 360gm after a culture period of 6 months in both culture ponds. During the 6 month culture period, 52 kg and 62 kg of snakehead were harvested from the first pond and second pond, respectively. The difference in the harvest was due to the higher survival with fish fed diet 2. Otherwise the FCR (2.38:1 to 2.4:1) and SGR (1.01 – 1.12) did not vary. Production was estimated as 9g/m^2 /day in the first pond and 11.3g/m^2 /day in the second pond. Harvests were extrapolated to 17.3 tonnes/ha/cycle with diet 1 and 20.65 tonnes/ha/cycle with diet 2 (Table 2).

Irrespective of the diet supply, test individuals showed a fast growth rate of 42 to 66mg/g/day during the first two months, followed by a lower growth rate of 20mg/g/day during the fourth month which then slowed to only 8 to 9 mg/g/day during the last two months (Table 3).

Table 3. Growth of redline snakehead (mg/g/day)

Month	Initial weight (g)	Final weight (g)	Growth rate (mg/g/day)
Diet 1			
0 – 1	18.60	55.73	66.54
1 – 2	55.73	127.71	43.05
2 – 3	127.71	144.18	4.30
3 – 4	144.18	231.87	20.27
4 – 5	231.87	292.16	8.67
5 – 6	292.16	360.50	7.79
Diet 2			
0 – 1	18.02	51.39	61.73
1 – 2	51.39	115.48	41.57
2 – 3	116.48	139.83	7.03
3 – 4	139.39	223.39	19.91
4 – 5	223.39	280.16	8.47
5 – 6	280.16	355.41	8.95

Profit margins

Table 4 shows the estimated costs and returns of redline snakehead production in a 30 m^2 model pond. In one cycle, the capital cost was estimated as INR17,000 and working cost was INR8,600 and total expenditure was INR25,600. We have calculated that the fish farmer can obtain INR15,600 at an ex-farm price of INR300/kg. There will be no profit in the first half of the year. However, during the second half of the year the farmer can earn INR 7,000, since the farming requires only working cost and not the capital cost.

Table 4. Estimated cost (INR) and returns of red line snakehead production in a model pond of 30m^2 (10m x 3m) area.

Capital cost	Diet 1
1. Construction of pond	5,000.00
2. Construction of net enclosure	1,000.00
3. Motor, water pipes and electricity	10,000.00
4. Miscellaneous	1,000.00
Total	17,000.00
Working cost	
1. Cost of 200 fingerlings @ INR 3 each	600.00
2. Fish feed	4,000.00
3. Electricity	2,000.00
4. Fertilizers, maintenance and repair of pond	2,000.00
Total working capital	8,600.00
Grand total	25,600.00

Table 5 highlights the expenditure and the revenue generation for *C. diplogramme* culture for the period of one year based on the results obtained from the current experiment

Table 5. Estimated expenditure and revenue generation for *C. diplogramme* culture up to 1 year.

Total harvest (kg)	After 6 months	After 12 months
Total revenues at ex farm price of INR 300/kg for snakehead	15,600.00	15,600.00
Less: Total expenses	25,600.00	8,600.00
Net revenue	-10,000.00	7,000.00

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Moving the pangasius up the value chain

Options on certification for the pangasius industry to move from 'quantity' to 'quality' and increase market access.

In the first four months of 2011, 199 companies exported 208,400 tonnes of the pangasius, valued at USD 513 million to 129 countries. The value of the pangasius continues to move up and it was 20% higher than in 2010. Although exports to the US, Mexico, and Brazil increased, the major markets in EU (Spain, Poland and Germany) decreased their imports. The slow growth was attributed to competition with other whitefish (Vasep News, 2011). However, the marketing of the fish to Europe has also been somewhat unpredictable because of the frequent adverse publicity by international media leading to negative perceptions among consumers. European buyers are the most exigent in their demands from food safety and hygiene of the products to sustainability, environmental and social issues in the production process.

After 10 years of rapid increases in production to almost 1.3 million tonnes in 2010, industry leaders would like to see the value of the pangasius rise faster than volume. They have asked that the competition should not be among pangasius producers within Vietnam but with other white fish producers and globally too.

Dr Pham Anh Tuan, Directorate of Fisheries said, "Retailers are demanding a sustainable fish. The aim of this forum is to get producers to understand the options available for certification. However, prices will always be determined by demand and supply. Certification is voluntary and producers that move from conventional to certified production may have the lead with better demand from importers."

"There is no doubt that the industry will need to 'move towards sustainable production' as the consumers are looking at environment and ecology, social responsibility, traceability, fish health and welfare and food safety assurance, "said **Dr Nguyen Huu Dung**, Vasep. In Vietnam, aside from price volume fluctuations and supply demand imbalance, some of the challenges are with quality assurance, fighting with bad practices, current sharp increase in inputs costs, waste water management and market and product diversification.

This technical workshop on certification systems in sustainable aquaculture was a joint effort between organisers; Directorate of Fisheries of the Ministry of Agriculture and Rural Development (MARD), WWF, VINAFIS and Vasep. Vinafis is the Vietnam Fisheries Society, an organisation with more than 800 local branches and representing all the aquaculture producers of Vietnam. The main aim of the workshop was to introduce options on certifications. It was attended by major pangasius producers and processors, government and research institutions, NGOs, other stakeholders in the pangasius supply chain and importers.

Flavio Corsin (left) and Jeffrey Peterson, GAA

Presentations included trends and prospects on the marketing of the pangasius in Europe and the US. Public and private sector collaboration in sustainable pangasius was detailed by the International Collaborating Centre for Aquaculture and Fisheries Sustainability (ICAFIS), the Dutch Sustainable Trade Initiative (IDH) and the World Wildlife Fund (WWF) whilst presentations from the certification schemes gave details on available standards for pangasius.

Progressing in certification

Steps to sustainable farming started in 1996 and certification has progressed with 49 pangasius processing plants (45% of the total) certified or being certified to GlobalGAP or BAP (Best Aquaculture Practices) certification, said Dung. Some 45 pangasius farms covering 1,000ha (16% of total area) have been certified by GlobalGAP, BAP or AquaGAP. Five farms are implementing the Aquaculture Stewardship Council (ASC) standards.

In June, Vasep News reported that QVD has received BAP certification for its 22ha Tan Hao farm producing 8,000 tonnes of pangasius in Dong Thap. Two pangasius farms of Docifish will be ASC certified by 2012. This is for 6,000 tonnes of fish to produce 2,000 tonnes of finished product. It already has GlobalGAP certification for five ponds producing 1,500 tonnes of fish since 2010. The 48ha farm of Hoang Long Seafood has a GlobalGAP certification. Anvifish has GlobalGAP certifications for its two farms in An Giang Province and will be applying for BAP for its two SQF certified farms. Cafatex will soon have two farms certified GlobalGAP and other standards for its 150ha of farming areas. Both Cafatex and Hoang Long Seafood said that certification would help them to enter markets and overcome technical barriers in the European markets.

In the implementation of ASC standards for the pangasius, one requirement is ASC compliant feed, although the ASC does not have standards for feed manufacturers. Several buyers, processors and farmers have asked ICAFIS to work with several feed manufacturers to develop 'ASC compliant' feed. The full range of pangasius feed, called CAT is being produced by Tomboy JSC/ Skretting Vietnam/Nutreco. The feed was officially registered in Vietnam, and is fully 'ASC compliant'. This is a major step forward towards achieving compliance to the ASC standards for pangasius. It is expected that up to 10,000 tonnes of this feed will be produced by the end of 2011 (Vasep, 2011). Although the prices will be higher than the conventional feeds, the demand has exceeded supply, said **Flavio Corsin**,

ICAFIS, and there are now several other feed companies stating that they are producing "ASC compliant" feed.

Buyers trust

Where is this demand on certification coming from? According to **Jeffrey Peterson**, GAA customers will tell that they trust their buyers to look for their interest. To date there are two BAP certified processing plants for the pangasius and one farm in Vietnam. Peterson said in certification requirements, what makes BAP standards stand out is the community relations Sludge management is peculiar to pangasius. There are also standards on fish meal usage, fish meal in, fish meal out and animal welfare.

Peterson emphasised on environment and effluent management and on the calculation for the annual effluent volume. In assessing sludge output from the ponds, the approach was to look at the loading index and to evaluate a farm's impact through its annual output. Sludge output has an ecological impact on the land and water. The dilemma is what to do with the sludge especially in farms where almost all the available land is used for ponds. In the case of the BAP standards, there is a requirement for a sedimentation basin to prevent negative impacts on surrounding land and water.

GlobalGAP is a business to business initiative and certification for the pangasius was available since 2009, said **Valeska Weymann**. In outlining some details on the standards, she said that there is an e-learning platform for auditors. Trials for the standards were carried out in Vietnam in two cage farms, four pond systems and two hatcheries. GRASP applies to the pangasius farms and covers, among others, worker representation, self declaration of good social practices, compliance to wages and overtime regulations and no minors employed. The GlobalGAP fees will depend on the annual production in live weight of the facility.

Bas Geerts, the new director of standards, ASC said that in September, the first training is scheduled for certification bodies who are interested in becoming accredited for the ASC pangasius standard. Pangasius is high on the list and the final steps to certify pangasius farms should be completed over the next few months. In discussing costs of certification, he said that the annual audit would take 1.5 to 2.5 days and the farmers hire the certification body. The company should be ready and at least six months of records are required. There will also be a fee for the logo.

A common standard is fish in/fish out (FIFO) ratios of feeds. Some audit questions will be on feed characteristics in relation to fish meal and fish oil. Farms are being asked not only to use fish meal and fish oil from responsible sources, but also to reduce the amount of fish products included in the feed . The process is more easily compliable in large farms with feed mills and farms but will be a challenge for small independent farms. In the near future, the animal welfare component will play a larger role. The industry will need to prepare for a better understanding of this component. 'Minimising stressful conditions for the animal' indicates the maturity of the industry.

In the audience, Dr Le Thanh Hung, Nong Lam University (right) with Ms Dao Thi Thu Hang, Aqua Business Unit Manager, Provimi Vietnam.

Bas Geerts, ASC (left) with Dr Pham Anh Tuan and Jan Gilhuis, IDH

Sustainable Aquaculture Platform (SAP)

SAP is a Dutch Sustainable Trade Initiative (IDH) and ICAFIS led initiative with the participation of European traders to develop sustainable pangasius. This is to build a precompetitive service platform to support local processors and producers to comply with ASC certification and up scaling of ASC volumes into European markets. It will work towards 16,500 tonnes of fish for the production of 5,500 tonnes of fillets by 2011, 60,000 tonnes of fish (20,000 tonnes of fillets) by 2012 and by 2013, 100,000 tonnes (about 33,000 tonnes of fillets which will be equal to 15% of the European market. The aim is to move more producers up the value chain, from conventional to certified.

The SAP builds on several other supporting initiatives for the pangasius industry. The sustainable pangasius supply project (SPSP) has the participation of Anova, three processors/farms and about 30 small farmers. Others involved are GIZ (Germany development agency), WWF, GlobalGAP and IDH. The target is 10,000 tonnes/year in 2011 and 2012. The WWF-supported aquaculture improvement programs (AIPs), will provide support for individual farms to identify gaps to achieve ASC compliance and provide technical support to help farmers in becoming certified. SUPA projects funded by the Dutch Government organises applied research for improved sustainability of feed and water management. Collaborators include Vinh Hoan, a leading pangasius producer and processor, feed industry, RIA2 and Wageningen University in the Netherlands.

"In the future, we hope that the SAP governance will include MARD, WWF, VASEP and VINAFIS to provide advice, IDH to bring the views of buyers, ICAFIS to operate SAP and adopt a multi-stakeholder approach", said Corsin.

Among the stakeholders at the seminar, it was accepted that the retailers are demanding quality and sustainable fish. The concern is benefits to the farmer. Will there be a price premium for certified products and will this price premium be available to the farmer? In the case of to be ASC certified producers, the price premium on feed alone may erode the already small profit margins of pangasius farmers.

Corsin said, "All these efforts will lead to a huge selling point for the pangasius, once we have a good brand image. It is also important that all in the industry start to work together to achieve certification"

Vietfish 2011

The road to better quality and certification

The mission of VASEP-Vietnam Association of Seafood Exporters and Producers is to create a trade environment for the country's seafood exporters.

Vuong Quang Khanh, marketing manager (left) and Duy Phan at the Caseamex booth. In an earlier report, issue July/August 2010, there was a wrong picture of Vuong Quang Khanh. We apologise for this and the inconvenience caused.

A major role of the association is to enhance the competitive of Vietnam's seafood and the reputation of products from Vietnam. With the latter in mind, VASEP has been pushing companies towards certification. The result of this was clearly demonstrated with seafood and producers and exporters displaying information on their road to certification, albeit mainly with the pangasius sector.

A year on, the industry in Vietnam continues to adapt. The major pangasius and shrimp producers continue take over farms of small farmers and have more control on production. Many are now fully integrated from hatchery, feed mill, grow-out and processing, such as Hung Vuong, Vinh Hoan and Minh Phu. Hung Vuong operates more than 250 ha of ponds producing 100,000 tonnes of fish and has recently expanded its feed production capacity. Minh Phu has more than 1,000 ha of shrimp ponds in Bac Lieu, Camau, Kien Giang and Soc Trang. Caseamex now has four farming areas of 160 ha. Production is 300 tonnes/ha/crop and there are three harvest per two years. The cycle is 6-7 months per crop. One farm is GlobalGAP certified and three others are on the way. These farms supply raw material for its exports of the pangasius mainly to Europe.

According to Duy Phan, at his booth, 2011 is a good year for prices. The GlobalGAP certified farm gains a premium of US 10 cents/kg but there are costs for the certification. The average ex-farm price was VND 25,000/kg in June and rose to VND 26,000/kg in July. Processors have accepted these fluctuations which are related to the supply from farms. Duy said that when prices are high, farmers start producing and vice versa. Caseamex also processes shrimp but have stopped operations because of the nationwide shortage of raw materials.

Adding value to Vietnam seafood

Bureau Veritas organised a seminar to update stakeholders in Vietnam on the latest international food safety regulations and standards in the seafood to meet export markets requirements. In his welcome address to an audience of mainly seafood processors and buyers, **Laurent Galloux**, Seafood Manager, BV introduced the company, an independent certification and inspection body with a global presence. It provides certification, pre certification audits and gap analysis and has a dedicated team for the seafood sector. Clients include Auchan, Casino, Carrefour, Metro, U and Davigel.

Christelle Vigot, Bayong Seafood presented steps in sourcing seafood and an example of a successful partnership between Vietnamese producers and key customers. How these can be implemented in Vietnam is by working together. Customer testimony is important. In the project, the key customer was Davigel, a Nestle company which directly imports, mainly frozen products, from every country and has three plants in France. It distributes to customers with 500 trucks. The range of products is from starters to dessert. It does not do any business with retailers. The products go to institutional restaurants (schools, hospitals, army etc) and commercial restaurant chains and delis. The emphasis is food safety for the first group and quality for the second.

Food safety is not negotiable i.e. there should not be any antibiotic residues, no heavy metal content; products must conform to local, French and European regulations, no chemicals, forbidden food additive, glazing etc. Products should also comply to sustainable development and information on producer, fish, environment and supplier are required.

Usually, attention is on the selection of a reliable supplier as long term and trustworthy relationships are valued. There are many audits and pre-shipment inspections are by third parties such as SGS and BV. The products are assessed at the receiving point and also by the company' s own laboratory. The target is sustainability where 38% of the seafood is eco certified such as by MSC, FOS etc. The target by 2013 is that 50% of seafood is from sustainable sources, either farm or wild.

At the BV seminar, Christelle Vigot (left) and Laurent Galloux

Vigot showed the example of sourcing for an aquaculture product from the 100% integrated Caseamex, specific for Davigel. Specific feed which complied with requirements was formulated. Ponds were exclusively dedicated to this production and at each step, there was a technical team from the feed company Ocialis to ensure specifications are followed in the field. Pre-shipment auditing was carried out. Traceability was from brood stock to the finished product. Each partner in the program was responsible in the delivery such as raw materials for feed was audited by BV. The success was also attributed to the open discussion among parties. The result was a premium pangasius.

Laurent Galloux also gave a general introduction on MSC standards and **Evelyne Mazareylat**, GGP Food Asia Manager discussed the global mapping of BV seafood service. The ASC standards for pangasius and tools to achieve compliance was presented by **Dr Flavio Corsin** and **Do Thanh Muon**, BV Vietnam updated on new requirements on GlobalGap Aquaculture version 4 and the extension to compound feed manufacturing.

Ta Thi Bich Ngoc (right) is building a resource centre for technology such as a recirculation aquaculture system for the tilapia.

Aquaculture innovation for excellence

Signing documents; Nguyen Tran Nghiem Cung, representing Vinh Thinh Biostadt and Francisco Saraiva Gomes (right).

Two shrimp farmers seeking specific answers on current disease problems with vannamei shrimp.

As it moves into industrial farming, industry in Vietnam will need to overcome production woes. Novus Aquaculture brought regional experts to interact with local shrimp farmers and answer some of their needs in a half day seminar held in conjunction with Vietfish 2011 from 28-30 June in Ho Chi Minh City. Prior to the seminar, **Francisco Saraiva Gomes**, Executive Manager, Novus Aqua Business signed agreements with two Vietnamese companies; Vinh Thinh Biostadt JSC and Vina Livestock JSC. Vinh Thinh Biostadt markets products such as probiotics and has established sales and technical teams in the field

During the seminar, Gomes, who is responsible for strategy and the supply chain team presented perspectives on the development of the aquaculture industry in Asia. He said that aquaculture is a less mature industry and is growing slowly as compared to pork and chicken. Sustainable industrialisation will mean higher production, efficiency, sustainable resources, creating markets and value. There are lessons to be learnt from the Mediterranean, where there was a collapse of prices until the sector agreed to restrict production. This shows that there is a need to do overall marketing for the future of the industry. In industry maturation, there is a need to foster innovation and knowledge created by faster and innovative research. Integration requires eco-functions. Overcoming diseases will require integrated solutions. Vietnam requires a three fold sustainability solution; economical, social and environmental.

White faeces in shrimp

Dr Niti Chuchird, deputy director of Aquaculture Business Research Centre, Kasetsart University, Thailand presented information on the disease scenario in Thailand and the region. He said that most farmers would have experienced white spot disease syndrome and white faeces syndrome with white hepatopancreas and white gut caused by bacterial pathogens. The main factors for this are poor pond conditions, high organic loads and low dissolved oxygen which makes shrimp weaker and more susceptible to infections. These can be solved with probiotics, immunostimulants such as beta glucans and recently organic acids have been proposed. He mentioned the study on the organic acid Mera™Cid which was added in feed and fed to shrimp. They then conducted a challenge test with *Vibrio harveyi* and concluded that it can reduce the bacterial load in the gut.

Some of the questions from the audience were on the causes of white faeces. Recent investigations have identified gregarines and bacterial as possible causes as well as microsporidia. This has been a serious disease for Thailand's shrimp farmers and they are following these protocols, said Chuchird. "If white faeces are seen floating, they check for feed in the gut and if more than 40% are eating, the infection may be reduced. If shrimp have stopped feeding, this implies high organic load and steps should be taken to reduce this, such as with *Bacillus* bacteria. After the shrimp has started feeding, small amounts of feed are given using a feeder." Chuchird added that in Thailand, in some ponds with a high density stocking, an aeration system which diffuses small bubbles is used.

On what is causing disease in ponds in Vietnam, Dr Craig Browdy, executive manager, Aquaculture Research, Novus International advised farmers that it is prudent to go back to fundamentals such as pond cleaning, use SPF-specific pathogen free post larvae and control secondary infections to prevent the problem. When there is an infection, experts should be brought in to undertake diagnostics and find solutions.

Two other presentations dealt with nutritional health. **Dr Nguyen Huu Thinh**, head of Fish Pathology Department, Nong Lam University discussed the importance of nutrition in the animal immune system and **Dr Le Thanh Hung**, from Nong Lam University presented information from trials conducted to evaluate the different zinc sources and Mintrex Zn in juvenile pangasius catfish. Final mean body weight and weight gain fed the Mintrex Zn supplemented diets were higher than for fish fed diets supplemented with zinc sulphate.

Trade at FITA 2011

Industry support for FITA 2011 held from 17-19 July in Bali, Indonesia, came from various sectors. There was the Indonesian Feed Mills Association (GPMT)'s aqua feed division, a grouping of 13 producers comprising PT Central Proteinaprima (CP Prima), Gold Coin Indonesia, Grobest, Wirifa Sakti, Haima, CJ Feed Jombang, Global, Mabar Feed, Malindo Feedmill, Matahari Sakti, Sinta Prima Feedmill, Suri Tani Pemuka and Wonokoyo Jaya Corporindo. The newest member is CJ Feed Jombang, which started to produce feeds for the marine shrimp in 2007. PT Matahari Sakti is a producer of shrimp and marine fish feeds and PT Sinta Prima Feedmill is the leading freshwater fish feed producer.

Two aqua feed pioneers displayed their products. **PT Suri Pemuka (STP)**, fully owned by the Indonesian agro group Japfa Comfeed, pioneered marine fish feed production in Indonesia. Currently for marine aquaculture, it has feeds for the pompano, barramundi and groupers. Feeds for the pompano are slow sinking and floating and for the grouper only slow sinking. Protein levels range from 46-50% for the barramundi, pompano and grouper starter feeds. **CP Prima** is the Indonesian arm of the Charoen Pokphand Thailand group. Products in Indonesia cover the major fish species and marine shrimp. At its booth, the company marketed its pre-starter feeds in powder form for freshwater fish, replacing tubifex worms. The starter feeds for larger fry are presented as crumbles and floating pellets.

GPMT was active at the conference session too. **Denny D. Indradjaja**, chairman of Aqua Feed Division gave an overview of recent development in the aqua feed sector. In comparison to total animal feed production in the country (10.45 million tonnes), the volume of aqua feed was small at only 11% (1.026 million tonnes) in 2010. Fish feed consumption has been on the increase for the last three years but volumes have fluctuated for shrimp feed. Consumption of shrimp feeds is expected to increase in 2011 as during the first half, the consumption in the open market reached 90,000 tonnes. Imports of aqua feed are on the decline.

Monatjatur K (left), Suhartono and Teguh Saputra at PT Tequisa Indonesia

Some of the challenges in aqua feed production were discussed such as using local raw materials such as palm kernel meal, earthworm meal, feather meal, fish silage, sorghum and maggot meal. However, many of these have disadvantages such inconsistent protein levels in palm kernel meal and copra meal, insufficient volumes of earthworm meal to meet the demand for commercial feed production

At CP Prima, Denny D. Indradjaja (second left) with (from right), Dr Dean A Akiyama, SIS, Abu Bakar Ibrahim, Blue Archipelago, Malaysia, Leonardo Tiro, Global Gen, Indonesia, Dr. Nyoman Adiasmara Giri, Centre for Aquaculture Research and Development, Jakarta, Haris Muhtadi, CJ Feeds and Ronnie Tan, Blue Archipelago, Malaysia

and difficulties in storage for fish silage. Another presentation at the Nutrition session discussed the steps for the production of cost effective feeds to meet an expected demand of 3.6 million tonnes in 2012 when the country expands fish and shrimp production. It also details the steps for upgrading standards and controlling quality of aqua feeds.

A popular micro diet for marine fish hatcheries is Otohime, produced by Marubeni Nisshin Feed Co, Japan. The feed was introduced by **PT Tequisa Indonesia** based in Cengkareng, Jakarta. The protein levels range from 50-53% for the granular feed for young larvae. According to Monatjatur, some 70-80% of grouper hatcheries in Indonesia use these feeds. These are mainly located in Bali, Situbondo, Lampung and Batam. These feeds are expensive but there are no local producers of feeds in the 250 microns to 1 mm size range. Local marine feed producers are STP, Grobest, Cargill and Matahari Sakti and the local starter feeds start at 1.0 to 2.2mm. A cost comparison of the same size feeds show that prices of Otohime feeds at almost 1.8 times than the local equivalent.

Shrimp autofeeders at the booths of PT Tequisa (left) and Blue Aqua International.

The focus at the booth of **Directorate General of Aquaculture** of the Ministry of Fisheries and Marine Affairs was technology transfer. The Aquaculture Research Centre in Lombok introduced the technique for the collection of puerulus of the spiny lobster *Panulirus sp* comprising collectors hung from tripods on the water surface. In 2009, lobster production increased to 339 tonnes from 292 tonnes in 2008 (DPKI, 2011). The main culture area is Lombok Island adjacent to Bali, where there is already a thriving business to collect the wild seed stock for sale or for on growing.

Seed production of the humpback grouper *Cromileptes altivelis* is being encouraged by the National Brackishwater Aquaculture Centre (BADC) in Situbondo. There is a good demand for this high value marine fish, both locally and for export. This grouper specie has been targeted for expansion alongside the *Clarias* catfish and seaweed. The estimate of grouper production in 2010 showed an increase to 18,805 tonnes from 8791 tonnes in 2009 (Budidaya, 15/2011).

BADC is one of the many major centres conducting research and training in hatchery and culture of marine fish in Indonesia. Others are in Lampung and Batam. The centre focuses on the humpback, tiger, giant and hybrid grouper, pompano and milkfish. Together with the Network of Aquaculture Centres in Asia Pacific (NACA) BADC will be conducting the 7th Regional Grouper Hatchery Production Training Course from 25 September to 15 October. This is a hands-on intensive training from egg handling through to harvest of fingerlings.

Shrimp culture and health management

At the booths of **Blue Aqua International** and **PT Tequisa Indonesia**, there were displays of automatic shrimp feeders. The latter showed a microcomputer automatic shrimp feeder, which has a radius of 18-20 meters. The capacity is about 100 kg of feed.

In food safety monitoring, **Kinglab Indonesia** has a range of products. There is DuPont Qualicon's Bax® system, which has real time PCR assay for *Vibrio* as well as detection for *Listeria*, *Staphylococcus sp* and *Salmonella*, among others. It also has B100 scientific ELISA assays for contaminants from melamine to bacteria and afflatoxins. In pond side detection of shrimp diseases, there is the IQ+ system developed by Genereach, Taiwan. This processes eight samples in one hour.

Industry at FITA, from right Rudy Purwono, PT Matahari Sakti and wife, Lois Darminto, PT Utama Terus Jaya Makmur, and Samuel Winata, East Java.

At the Directorate General of Aquaculture booth, Rokhmad M. Rofiq (left) and colleagues

Focusing on Asian Aquaculture

A new set of opportunities for this 33-year-old global provider of aquatic tools and technical solutions, as AES directs marketing activities in Asia.

AES has been active in trade shows in Asia. Ricardo Arias (middle) and Yoshi Hirono (left) participated in the Ninth Asian Fisheries and Aquaculture Forum as well as the 9ISTA tradeshow in Shanghai in April 2011. They will be at the China Seafood and Fisheries Exhibition in Qingdao, China. Also in the picture is Darryl Jory

When it first started in 1978, Florida-based Aquatic Eco-Systems Inc. (AES) concentrated on the aquaculture markets in North and Latin America. Some years ago, it expanded to markets in Africa and Europe. Now the company has added Asia, the forefront of aquaculture, to their focus. AES wants to address the concerns of and, at the same time, learn from the industry in Asia, which is a very different market than that of Latin America.

In his annual message, Todd Childress President stated, in part, "…2010 was a good year for AES as we saw our sales grow, added jobs to our workforce and saw many of our customers experience a similar story. Future growth, however, will come from our ability to adapt to an ever-changing world market. The globalization of aquaculture will usher in new opportunities overseas for AES as we open our first subsidiaries outside the US in 2011…" Childress continued, "We are investing significant resources in new products and new markets as we capitalize on our longstanding expertise and focus on 'greener' technologies."

The company has a large range of products in its portfolio. Together with the supply of equipment for aquaculture enterprises, it also offers technical expertise in aquaculture. In Asia, AES is already involved in setting up small recirculation systems for marine fish in Vietnam, Japan and Korea. In R&D, the matching of systems is critical to control the various variables in experiments. AES also has a division that is working with universities to develop specific research to meet R&D requirements.

The Asian Focus

"We have been a global company for many years. True, our focus has been in North and Latin America, where we have worked with integrated farms, mainly in shrimp, salmon and tilapia aquaculture. Asia is a new opportunity for AES. The industry comprises a large number of small and individual farms and there are a myriad of species in Asian aquaculture. Nevertheless, we would like to bring our technology to Asia and play a role in strengthening sustainable aquaculture. In the process, we are eager to gain new knowledge from the Asian industry," said Ricardo Arias, aquaculture sales director. Arias has been with AES for the past 20 years. His aquaculture experience included working with tilapia and *Macrobrachium* prawn farming and directing an aquaculture experimental research and training center in the Dominican Republic. He also studied aquaculture in South Korea.

"There are three key things we offer: selection, service and solutions. Selection is shown in our more than 13,000 products, with a variety of equipment that is designed and manufactured by our AES team. Service is demonstrated through our workshops and efforts to introduce our clients to new, applicable information and techniques. Solutions are offered by our team of customer service technicians, all of whom have tremendous industry expertise and are more than happy to offer the AES standard of free expert advice an unparalleled quality in the industry.

"We realize that Asia is a market with many suppliers and we are ready to be competitive. Our competitive advantage rests on the fact

that we have a solution to offer at every level, from the most basic to extremely high-tech systems," said Arias.

"We have a range of equipment for both large and small farms. These include everything from water quality monitoring systems to custom aeration systems for hatcheries and the entire farm. Basically, we can provide the solution by tailoring the equipment to the specific needs of the farms. We have equipment to move and pump water, biological and mechanical filtration as well as aquaponics systems. Additionally, our R&D department is actively involved in researching and applying alternative energy solutions, both solar and wind power, to a variety of equipment," said Yosuke 'Yoshi' Hirono, regional manager Asia-Pacific.

"The technical support comes from the team of aquaculturists and biologists in our main office. Our staff has a total of >400 years of actual hands-on experience in aquaculture. This experience and knowledge has been gained worldwide and with many different species. We work with customers to guide them in selecting the best equipment for their applications, and the right solutions for their needs.

"An added value that we offer is our database of Tech Talks, a bank of knowledge that houses information on topics from aeration to chemicals to water pumps, and everything in between. Rather than taking a great deal of time looking through technical books, people can visit our Tech Talk database and simplify the process," added Yoshi, a pioneer in the shrimp aquaculture industry. Yoshi began his research at the University of Miami and was later involved in industrial shrimp aquaculture with Ralston and Purina in Crystal River, FL, in the 1970s. He has also worked in Ecuador and Panama, farming *P. vannamei* and *P. stylirostris*. His expertise spans more than thirty years. Yoshi joined AES in 2006 and is responsible for the Asian market. With this knowledge base, AES sees the possibility of bringing workshops to Asia in the near future.

One-Stop shop

Robert Heideman founded Aquatic Eco-Systems in 1978. Heideman and AES began working on the betterment of lakes and waterways in the Orlando area by focusing on lake aeration and destratification. Through his research, Heideman developed highly efficient synergistic airlift diffusers for lake aeration. In the 1980s, AES moved into the aquaculture industry, developing its own brand of equipment, Sweetwater®. AES also distributes a variety of products that are in line with the company's focus on improving efficiency and sustainability in aquaculture.

AES is a world leader in lake management systems. Since 1978, it has aerated 500,000 acres (167,225ha) of lakes using its complete solution Great Lakes® synergistic airlift technology, comprised of oil-less compressors. In Asia, AES designed, supplied and installed an aeration/stratification system for the 255-acre (85.2ha) Chern Ching drinking water reservoir in Taiwan. Chern Ching, a 45-year-old, man-made reservoir, was highly eutrophic. Dissolved oxygen levels were less than 1 ppm at the bottom and ORP values above the sediment layer (in some places up to 13 feet thick!) were -400mV. The AES Great Lakes® aeration system brought rapid improvement that exceeded the criteria set by the Taiwan Water Authority. The Taiwan Water Authority declared the operation a success on all accounts, including a significant improvement in water clarity. The cost of treating the reservoir's water (to make it drinkable) was significantly reduced.

"At Aquatic Eco-Systems, we are proud to be a one-stop shop. We offer more than advice and solutions; we actually can provide the products needed to implement the solution for any of our clients' needs." Looking to the future involvement AES will have in Asia, Arias concluded, "There are several projects that AES is interested in pursuing. We would like to see some alternate sources for pumps, aeration and filtration systems. We also have great interest in aquaponics systems and on R&D of solar energy for small farms to run pumps and other small systems."

New aquaculture diagnostic platform

In intensive shrimp farming, it is the norm to build up bio-security measures for disease control. Molecular diagnosis has been applied for shrimp viral disease detection over a decade. Its high sensitivity and specificity help the industry to detect the viruses in a short time. Polymerase chain reaction (PCR) laboratories which contain many costly instruments such as PCR thermal cycler, high speed bench top centrifuge as well as gel electrophoresis makes disease management expensive and tedious for small scale farmers. The PCR laboratory became a disease management tool that only can be operated by large farms.

Taiwan based aquaculture health and diagnostic company GeneReach Biotechnology Corporation, is focused on R&D on viral diagnosis associated with penaeid shrimps and marine fish. Since 1997, it has developed several detection systems for white spot syndrome virus. The IQ2000™ was the first commercial kit available for early diagnosis of the disease in shrimp and its carriers. This became the method adopted for a routine detection of diseases in commercial shrimp farms.

Recently, it has introduced IQ Plus system. This new aquaculture diagnostic platform is composed of the IQ Plus extraction kit and IQ Plus reaction kit. IQ Plus extraction is a column-based DNA/RNA co-extraction kit which is easier and faster than the traditional extraction procedure. DNA and RNA of shrimp sample such as the pleopod can be extracted together in 10 minutes. The sequence in DNA extraction is shown in Figure 1.

The extracted DNA/RNA is amplified by insulated isothermal PCR (iiPCR, Figure 2) which is based on the nature of thermal convection.

"With the special design of the iiPCR device, we can create a stable temperature gradient (50~95°C) for the three steps of PCR reaction denaturation at 95°C, annealing at 60°C and extension at 72°C. Using POCKIT, one PCR cycle takes only about 20 seconds. Therefore, the reaction time per run takes only 50 minutes, and is much faster than a traditional thermal cycler," said Simon Chung, marketing and sales director.

The reagent of IQ Plus WSSV Kit is based on TaqMan probe real-time PCR system. By measuring the fluorescence signal, no electrophoresis is needed. The results will be shown on the LCD screen and automatically saved in a SD card.

The detection system of POCKIT has two optical channels (Figure 3); one for FAM and another for JOE (Channel 1-FAM: WSSV ; Channel 2-JOE: internal control). This design makes multiplex detection possible. According to these two channels' signals, it will be possible to get the virus signal and internal control signal at the same time. All samples are run using a universal program, so the users only need to press the Run button to start the reaction and do not need to select any more parameters. The results are shown as '+' and '-', which are easy to interpret.

IQ Plus system

Sensitivity assay

In order to identify the sensitivity of this new system, IQ Plus WSSV was compared to a well known commercial WSSV PCR detection kit -IQ2000 WSSV Detection and Prevention System which is OIE certified.

A ten-fold serial dilution of known WSSV nucleic acid with WSSV-negative genomic DNA was used to compare the sensitivity of IQ Plus and IQ2000. Results showed that all data of IQ Plus were compatible to those of IQ2000. This suggested IQ Plus is as sensitive as IQ2000.

With its high sensitivity, easy-to-use, and short turn-around time, IQ Plus System provides shrimp farmers a powerful pond-side tool for aquaculture disease management.

More information: www.genereach.com; Email: sales@genereach.com

Figure 1. Nucleic acid extraction.

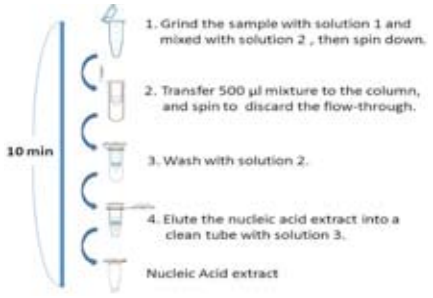


Figure 2. iiPCR Amplification.

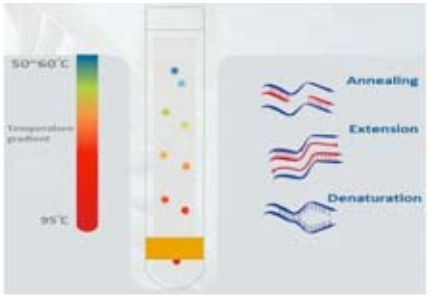


Figure 3 Fluorescence Detection.

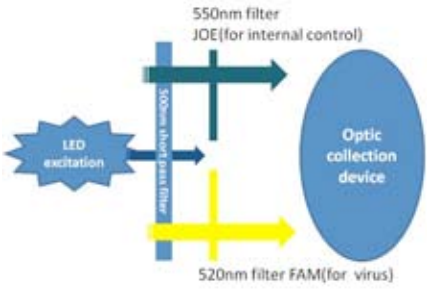
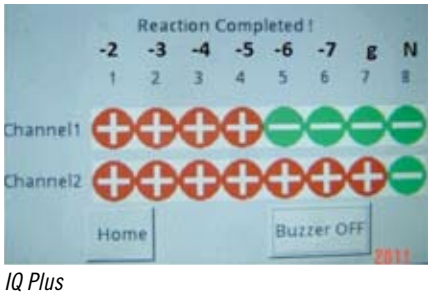
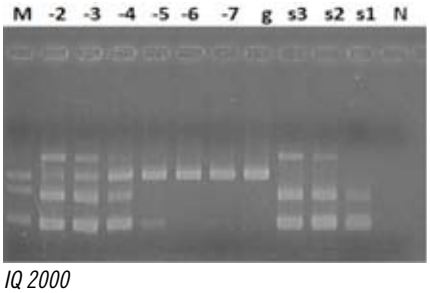


Figure 4. A comparison of sensitivity with the IQ2000.



IQ Plus



IQ 2000

M: marker
-2: 100-fold dilution
-3: 1000-fold dilution
g: WSSV negative genomic DNA
S3: 1000 copies WSSV DNA plasmid standard
S2: 100 copies WSSV DNA plasmid standard.
S1: 10 copies WSSV DNA plasmid standard.
N: Negative Control

Ready to market vaccine for pangasius catfish

Recognised as the only pharmaceutical company focusing on aquaculture, PHARMAQ started the 'pangasius project' in 2006. The objective is to reduce the use of antibacterials and mortality, and improve food safety and environment in the pangasius farming sector.

Over five years, scientists from Can Tho University, University of Stirling Bayer Vietnam and PHARMAQ have collaborated in developing, documenting and registering efficacious vaccines for the pangasius fish. The wet lab set up in Hong My hatchery in Dong Thap Province was used for conducting clinical experiments, which formed the basis for vaccine development. At the end of 2008, the optimal vaccine formula was selected for production in Overhalla in Norway. Field trials followed by working with farmers in the Mekong Delta. The result is 'ALPHA JECT ®Panga1, an oil based vaccine against bacillary necrosis in pangasius (BNP), caused by the bacteria *Edwardsiella ictaluri*.

At a seminar for the local industry, the PHARMAQ team from Norway and Vietnam announced that Vietnam's Department of Animal Health (DAH) is expected to allow commercial import license for the purpose of field observation of the vaccine ALPHA JECT ® Panga 1.

In his welcome address to farmers, technicians and government representatives, Dr. Nguyen Huu Dung, Vice Chairman of VASEP said that he was pleased with the developments and that a company was established in Vietnam to help look at farmers' woes. The urgency for a vaccination program was justified by the survey conducted by Dr Tu Thanh Dung, Can Tho University in the Mekong Delta. She said that in the case of bacillary necrosis of the pangasius, the disease is acute in fingerlings and juvenile fish. Farmers have used various antibiotics for disease treatment and over the years, these have led to multiple antibiotic resistance to *E. ictaluri*. While the diseases remained, the level of resistance to known antibiotics has been increasing. Naturally, farmers have been increasing the doses of antibiotics.

Approach to developing a vaccine

"To implement a vaccination program, we need to be innovative and do this correctly and be dynamic. We need to adapt to the farmer's needs and have a team spirit between us and the farmers. The development and implementation of a vaccination program is a continuous process and the first approved vaccine will not solve all the problems. For example, the Norwegian salmon industry saw a gradual reduction in operational costs as it moved from using antibiotics to vaccination. We hope to see the same trend in the pangasius industry", said clinical development manager, Vo Thanh Tung, PHARMAQ, Vietnam.

Efficacious laboratory trials were carried out using a total of 880 juveniles at 14g average body weight in controlled lab conditions. These were divided into two groups of 440 each. Fish from one group was injected with a 0.05ml/dose of the vaccine. The other group was injected with sodium chloride. Vaccinated fish from the tanks were challenged at 2, 10 and 20 weeks post vaccination by injecting 0.1ml of a bacterial suspension of *E. ictaluri*; previously isolated from diseased pangasius in Mekong delta. There were two replicates for each treatment and respective controls. A quick response to the vaccine was shown after 2 weeks and the immune period was not less than 20 weeks.

Tung added that the safety trial conducted in lab condition with the required double dose per smaller fish (10g) of 3 different vaccine batches showed no abnormal behaviour, no mortality or any impact on the fish growth but the vaccine will remain in the abdomen of fish as droplets of vaccine and these will disperse as the fish grow.

From left: Vo Thanh Tung, Jan Oppen Berntsen, Dr Tu Thanh Dung (Can Tho University), Kjersti Gravningen, Pham Cong Thanh (technical and marketing manager) and Morten Nordstad.

Dr Kjersti Gravningen, director, Asia said that for markets in EU, USA and Japan, the quality of fish is very important. The company holds a Good Manufacturing Practise (GMP) license, a pharmaceutical standard equivalent to Global Gap for fish farming. The standard ensures that products are consistently produced and controlled according to its specifications. Traceability and transparency is critical in vaccine production.

Gravningen answered several questions likely to be raised by consumers whenever there is a new vaccination program. "Is this safe for human health? The vaccinated fish has been consumer evaluated for safety according to the EU regulations, 37/2010. PHARMAQ vaccines contains inactivated antigens in an emulsion and will not spread any diseases. There will be no need for a withdrawal period. Will there be residues and GMOs? The issue of GMOs (genetically modified) does not arise either. What is the impact on the environment? The product is sterile and the impact on the environment will be much less, than current practices as a healthy fish will have better feed conversion and less wastage of feed."

The evaluation of efficiency and benefits of vaccination was presented by Nguyen Van Nam who has a 80ha farm. His message to the audience of farmers was that the vaccine ALPHA JECT® Panga 1 showed good protection during the outbreak of bacillary necrosis in pangasius. During a field trial conducted in his farm (November 2009) a total of 92,000 fish were vaccinated.

A video showed the steps in implementation of vaccination. On the pond dyke, vaccination is carried out by a trained team around an injection table. Immediately after the injection process, fish are returned to baskets in a water tank which when full are quickly taken on motorbikes for restocking into the respective ponds. Another method is to transfer the injected fish to the ponds using a water trough which runs all the way from the table to the ponds. The third option would be to pump the fish back into the ponds.

"We see this as an important milestone for PHARMAQ and for the pangasius industry in Vietnam. We believe this is an opportunity for the industry to improve on quality. This is the way forward to more sustainable and safe food for the global market. The next step is to implement vaccination in a commercial scale. In the future, we will also invest in new generations of vaccines for Vietnam, as we have learned that fish health management is a dynamic process and we expect new diseases to appear," said Gravningen.

nutriad
applying nature

Specialty feed additives and strategies at aquaculture seminar

On August 23, Nutriad organised a technical seminar on aquaculture in Ho Chi Minh City, Vietnam. The seminar was attended by more than 50 aquaculture producers, including representatives of large farms and aqua feed mills.

During the seminar, Nutriad's country sales manager, Hoa Nguyen, introduced the audience to the global business focus of Nutriad as an international supplier of specialty feed additives with emphasis on its Aquaculture Division. Alexander van Halteren, Nutriad's aquaculture expert supporting the market in Vietnam, presented different strategies to optimize formulation cost, improve feed efficiency and farmer's profitability in the production of marine shrimp and pangasius catfish. The seminar updated the aquaculture sector in Vietnam on Nutriad's highly specialized product portfolio to improve feed efficiency and health for fish and shrimp.

Results from collaborative field trials with Vietnamese farmers illustrated the cost-efficiency of the new formulation strategies. By organising such a meeting, Nutriad demonstrated its commitment and support to its customers. "I am sure that the objectives of organizing the seminar have been met, with key customers having received interesting information on the progress we obtained during the past year from evaluating our products in the Vietnamese market and in other parts of the world", said Hoa Nguyen, who evaluated the seminar as a valuable initiative. He also saw a great opportunity to improve productivity and sustainability of farming in Vietnam by applying the range of specialty additives and technical support offered by Nutriad's Aquaculture Division. More information: www.nutriad.net

Miss Vietnam presented Nutriad's gift to Dr.Nguyen Nhu Pho and Tran Ngoc Dinh, directors of Tan Sao A, Nutriad's distributor for aquaculture products in Vietnam. On the right is Nguyen Dinh Hoa, country manager.

Biomin

Asia Nutrition Forum in October

This leading company in the global animal health and nutrition industry, has announced the dates and venue for the company's biennial event, BIOMIN Asia Nutrition Forum. The forum will cater specifically to the Asian audience, spanning over six cities across Asia from 10 to 21 October, from Cebu to Pattaya, Coimbatore, Chang Sha, Zheng Zhou and Tokyo. The theme of the forum is "Sustainability: defining the basics, addressing the essentials, introducing NutriEconomics®".

"The great challenge in agricultural science today is to produce sufficient food in a sustainable system that will feed the 9 billion people expected to be on this earth by 2050" says Professor David Farrell, a key speaker. "As the price of food escalates and food riots are happening amongst the poor, we must get smarter to meet the challenge. There are solutions and there will be costs."

With more people to feed and finite resources to depend on, the feed and animal production industry has to grow profitably without compromising the ability to meet future needs. Targeting key industry professionals from the poultry, pig, dairy and aquaculture sectors, the forum will feature an impressive panel of leading industry experts: David Farrell, professor from the University of Queensland; John Baize, president of John C. Baize and Associates; Robert Van Barneveld, professor from the University of New England and consultant research scientist (Nutrition) of Barneveld Nutrition Pty Ltd, and Maximilian Schuh, consultant and experienced veterinarian in diseases of swine and cattle.

The team from Biomin will be Jan Vanbrabant, CEO of Biomin Asia; Guan Shu, technical manager and Jim He, technical nutrition manager, Biomin Asia; Wolfgang Markert, director, Development Department and Franz Waxenecker, director, Innovation Management, Biomin Holding Gmbh.

Delegates can gain insights on various topics that address sustainability from different facets. Presentations will explore the solutions to feed the growing population, define the basics of sustainability using the NutriEconomics® program and look into the implications of commodity trade on animal production. In addition, discussion will be on feeding the livestock in 50 years, review the ban of AGP in Europe and the expectations and trends of antibiotic growth promoter use in Asia. Biomin will share the latest mycotoxins survey. More information: www. anf.biomin.net

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November 1-3, 2011
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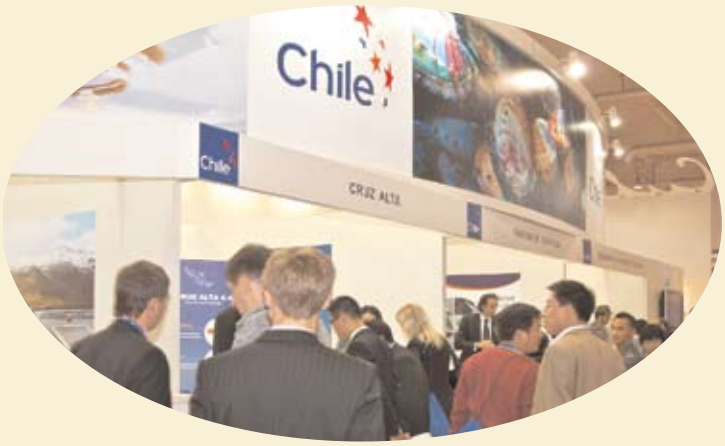
16th Annual Show



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Industry and academic collaboration to nurture the next generation and improve aquaculture in Vietnam

When Novus International, a global leader in animal health and nutrition, made its commitment to aquaculture, it wanted to extend its innovative science-based programs to the industry in Asia. Vietnam, an emerging aquaculture powerhouse, was envisioned as a prime location to site their Novus Aqua Research Centre (NARC) in 2008. After one and half years in operation, NARC has provided significant contribution to the aquaculture and scientific community, not only in Vietnam but also globally. The facility carries out fundamental research in aquatic animal nutrition, health and environment using the state of the art equipment and wet labs in the 1,000 m^2 space. There are five separate recirculation aquaculture systems (RAS) comprising of 1000 litres, 340 litres and 80 litres tanks which compliment those available in Nong Lam University. The labs have capabilities in areas such as molecular biology, protein and biochemical analyses, flesh quality, microbiology, microscopy and water analyses. There is also a feed preparation lab which provides the researchers the flexibility to formulate and produce experimental diets for nutritional trials.

NARC concentrates its research efforts on targeted research by working closely with feedmills and farmers to better understand the most current needs for aquaculture production, such as reducing feed costs, improving animal health and flesh quality and achieving sustainable practices. For example, NARC has been working in collaboration with researchers from Nong Lam University on determining the nutritional requirements of the pangasius so as to fill in the knowledge gap in the scientific community. Their research on trace minerals have found that chelated minerals are more bioavailable to the animal. This is significant for the farmers who realise the need to ensure optimal nutrition and to reduce the environmental impact of our farming systems. All their significant results are translated to the industry by through field visits, literature, seminars, conferences and training sessions. During the recent Vietnam Fisheries International Exhibition (Vietfish), held in Ho Chi Minh City, a seminar which included local and international speakers was very well attended and served as a platform for Novus International to forge closer communications with industry stakeholders.

"Novus International is developing tools for understanding and managing the animal gut environment as this can be an indicator of the overall health status of the animal, and modulation of the gut environment is critical in the optimization of animal production. Gut environment modifiers (GEMs) range from organic acids, prebiotics, probiotics to essential oils. These proprietary products have been used to modulate the gut microflora in animals such as shrimp and pangasius catfish and we have repeatedly demonstrated that these products are able to reduce mortalities when the animals are challenged with a bacterial pathogen. Particular to the Vietnam aqua industry is the work on flesh quality. We are seeking the possible eitiologies and solutions for the problem of pangasius catfish with tainted pink and yellow flesh. We are also focused on understanding the nutritional requirements and disease challenges and how we can help overcome these through the nutritional route," said, Dr Ooi Ei Lin, Aqua R&D Manager. She runs the centre with a staff of 2 PhDs, 3 MScs, administrative and technical staff.

Ooi Ei Lin (right) with Pham Minh Anh

Novus recognizes the importance of training a new generation of aquaculturists by transferring knowledge and technology innovations to people around the world who can use them to improve agricultural practices in their local communities. Novus initiated the Novus Graduate Scholarship (NGS) program in 2006 to support the research and work of students and professors in agriculture. With the establishment of NARC, the NGS program has been successfully extended to Vietnamese scholars. The Vietnamese interns complete the research component of their post-graduate University degree under the close supervision of NARC researchers. Examples of recent thesis projects include, methionine and zinc requirements of pangasius catfish, influence of zinc on immune status, efficacy of a novel yeast in tilapia, use of dietary phytase for phosphorous sparing, efficacy of a prebiotic for health etc. NARC also hosts international researchers who work alongside our experienced research staff on all related activities. Later this year, NARC will be hosting a PhD student from Stirling University, Scotland for a 3 year research program to work on developing immune assays for the pangasius.

Aside from NARC's core focus on research and development, it is also involved in a 5-year project to improve the livelihoods of poor, rural, smallholder farmer households in the Mekong Delta, Vietnam with its project partner, Heifer International. The project, now in its second year, aims to sustainably improve the health and nutrition of local poor households through a training program which focuses on subsistence and small-scale farming methods and animal husbandry.

In conjunction with Novus' 20th Anniversary this year, NARC will be celebrating its third year since its inception. In the coming years, NARC endeavours to work closer with the farmers through collaboration with their recently appointed Novus Aqua distributors in Vietnam.

Pioneering product for use in aquaculture hatcheries

Meriden Animal Health is launching a unique breakthrough product for the early days of larval rearing which mirror's an optimal wild hatchery diet. PHYCONOMIX is a ready to use range of products, available in a liquid and powder form, designed to fulfill the nutritional requirements of shrimp and fish larvae.

The importance of optimal nutrition during the early periods of life is paramount in any living species. In aquaculture as with other animals, the young are vulnerable and adequate nutritional provision for fry and post larvae reduces risk of mortality and poor development.

Shrimp and fish larval nutrition is generally poorly understood. Specific nutrients involved in optimal growth, survival and immunity can be missing in standard dietary regimes or at best, present at levels capable of negatively impacting larval quality and quantity. It is generally accepted that essential fatty acids, phospholipids, vitamins, trace elements and carotenoids figure prominently in this scenario, and delivery methods for such nutrients must also be optimal to ensure maximum delivery to target organs.

Both shrimp or fish larvae have a requirement for optimum nutrition and it has been shown that Phyconomix can meet these requirements, without the need, cost, labour or disease risk of having to produce algae within the hatchery. More information: sales@meriden-ah.com; www.meriden-ah.com

At World Aquaculture 2011

An organic zinc source for tilapia diets

At the conference held in Natal, Brazil, the use of additives was one of the major topics. NOREL's Aquaculture Product Manager, Waldo Nuez, presented data on the inhibitory activity of GUSTOR Aqua and ECOBIOL Aqua against the main pathogens affecting shrimp and tilapia production. These two products are effective tools to promote adequate gastrointestinal health, thus these results created great interest among participants. More field trials will be available soon.

One challenge faced by aquaculture today is use of diets high in vegetable ingredients. Many plant ingredients are low in zinc and contain phytate, which forms insoluble complexes with zinc in the stomach. Zinc is a trace mineral involved in the activity of several important enzymes associated with key metabolic pathways. Thus the formation of these zinc-phytate complexes results in deficiency, retarded growth and poor immune response, as well as excessive excretion into the water. In its effort to support sustainable aquaculture practices, Norel has developed a soluble zinc salt chelated to methionine, BIOMET Zn Aqua.

In a trial conducted at Tanta University (Egypt), this organic source of zinc was evaluated in tilapia fed a phytate containing diet. The basal diet was supplemented with three different zinc sources: Biomet Zn Aqua (200 g/tonne feed), zinc sulphate and zinc propionate, each group being supplemented with the same amount of zinc. Results showed that the Biomet Zn Aqua increased zinc availability in body tissues, increased enzyme activity and enhanced both digestibility and performance. When compared to zinc sulphate, these positive results can be attributed to the additive passing through the stomach intact. When compared to zinc proteinate, Biomet has greater assimilation via the intestinal epithelium. In conclusion, this is is a cost-effective solution to avoid zinc deficiency, promote health and performance, and reduce water pollution. More information: Waldo Nuez, wnuez@norel.es

New CEO

Swiss based Chemoforma Ltd has announced that **Dr Klaus Hoffmann** is the new CEO of Chemoforma Ltd from September 1, 2011. He will replace and take over the responsibilities of Dr Peter Koeppel, who has recently reached his retirement age.

Hoffmann obtained his PhD in 1991 from Free University in Berlin, Germany and following this, completed postdoctoral fellowships on 'Genetics of eucaryotes' at the Society for Biotechnological Science In Braunschweig, Germany and later in Sandoz Pharma in Basel, Switzerland and at the Biocenter of the University of Basel, Switzerland.

He joined Chemoforma as manager of Scientific Services in 2001. In this capacity, he was responsible for quality control and safety of all of Chemoforma's products. In following years, he became increasingly involved in the marketing and sales of the company's products in Asia and other countries around the world.

The appointment of Hoffmann guarantees that Chemoforma has excellent future prospects for maintaining its extraordinary reputation for innovative and high quality products as well as superior services for its international network of distributors and clients. **Dr. Peter Koeppel**, has been appointed as senior advisor of Chemoforma Ltd. and director of its affiliate, Pro Bio Ltd. and, therefore, will continue to serve and maintain his close relationship with all clientele and associates of both companies. More information: info@chemoforma.ch

New director Asia Pacific

Global animal health and nutrition company Alltech has announced the promotion of Matthew Smith to Asia Pacific director. Smith has been with the company for 15 years, most recently serving as the general manager of the company's New Zealand branch.

Commenting on the appointment, Alltech vice president Steve Bourne said, "Alltech is experiencing tremendous growth in the Asia Pacific market, up 21% year to date. Without doubt, this region offers the greatest opportunity to Alltech globally, given the population size, demographics, rising income levels and the propensity and desire for meat consumption. With the experience and leadership of Matthew, along with a number of other strategic changes within the region, we have full confidence that Asia Pacific will become the first billion dollar region for Alltech."

Smith has worked extensively in the Asia Pacific, Europe and North America regions for Alltech. In 2003, Smith was responsible for developing Alltech's forage programme in Europe while serving as Sil-All® global product manager.

"It is our desire to ensure that Alltech remains fully engaged with the evolving needs of the local feed industry and is well-positioned for proactive work within the rapidly growing Asia Pacific region," said Smith. "We have a superb team in place with a firm devotion to the future of the region and the industry, and they are fully committed to Alltech's long-standing tradition of acting swiftly to meet the needs of local customers."

The company currently has a presence in more than 17 countries throughout the Asia-Pacific region. Alltech China was established in 1994 but the company has been in the Asia-Pacific market since 1986 through their first distributor in Japan. The company's other recent strategic changes in the Asia-Pacific region include:

- An increased investment into seven local production facilities with continued implementation of its unparalleled AQS quality control system, which exceeds global standards and regulations. The region is supported by a team of 14 analytical technicians providing on-site quality control. In order to meet growing consumer demands, Alltech plans to open three additional production facilities throughout Asia and the Pacific over the next three years.
- The relocation of the Asia Pacific Bioscience Centre to Tianjin, China will provide increased support to the swiftly growing Chinese market and focus on Alltech's latest foray into pioneering natural technologies. The Programmed Nutrition approach views the total animal throughout its life and uses specific feeding and feed management strategies to manage growth and product quality. It is not simply a change in feed formulation or supplementation strategy but a strategic shift in animal nutrition.
- With the recent opening of Alltech Algae in Kentucky, the Asia Pacific region is preparing to commercialise the opportunities expected to arise through this USD 200 million facility, including the development of algae-derived feed products. More information: www.alltech.com

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Third International Symposium on Cage Aquaculture in Asia

16-19 November, Kuala Lumpur, Malaysia

This symposium in Kuala Lumpur is organised by the Malaysian Fisheries Society, Asian Fisheries Society and the Department of Fisheries, Malaysia. Similar to its predecessor, CAA2 held in Hangzhou, China in 2006, it will continue to look at the commercialisation of both marine and freshwater cage aquaculture in Asia which is increasing rapidly. The symposium will be an opportunity for industry to learn about developments in other regions and for scientists and all stakeholders to exchange views and network. To date, the organisers have confirmed the following speakers in the plenary session.

The CAA3 symposium and 20 booth trade show will be co located with the Malaysian International Seafood Exposition (MISE) at the Putra World Trade Centre in Kuala Lumpur. MISE is Malaysia's premier seafood event held biennially.

Plenary on 'Securing the future for marine finfish aquaculture in Asia.'

Dr Michael A. Rimmer

Dr Michael A. Rimmer, ACIAR Field Support Office in Makassar, South Sulawesi, Indonesia. The key points of his presentation will be that the high diversity of species cultured, and the frequent shifts in production trends between various species makes it difficult to focus effort on developing advanced technologies for a limited range of species. Despite this, there is a clear need for improved technologies, particularly in regards to compound feeds and fish health management. The continued development of cage aquaculture in Asia is likely to be dualistic. On the one hand, there will be large-scale or 'industrial' scale farms that focus on a limited range of species that are amenable to large-scale culture (e.g. barramundi, pompano, cobia) for the global 'white fish' market. In contrast, small-scale farmers will continue to be a major feature of Asian cage aquaculture. Increasingly, small-scale farms will need to focus on species that do not compete for the 'white fish' market that can be more efficiently produced by large-scale farms (e.g. groupers and snappers).

Plenary on 'Cage aquaculture in Malaysia – towards realising new key economic areas.'

Ahamad Sabki Mahmood, director general of the Department of Fisheries. Malaysia aims at turning the agro-food sector into a competitive and sustainable industry to ensure sufficient food supply. Cage aquaculture in Malaysia is a fast developing sub-sector and is being promoted continuously by DOF under the Fourth National Agriculture Policy (NAP 4). The current trend in marine cage aquaculture in Malaysia is to move away from traditional small scale systems to large business models. The sector recorded a production of 34,154 tonnes in 2010 with a double digit growth, consecutively in the last three years. Emphasis is now on integrated cage aquaculture (i-CAGE) development and this will be one of the Economic Transformation Programme (ETP) of the government.

Plenary on 'Cage Culture in Asia – Feeds and Feeding Perspective'

Dr. Wee Kok Leong

Dr. Wee Kok Leong, Temasek Polytechnic, Singapore.

Special sessions

The special session on Seafood Trade & Certification will have seafood experts discussing trade and marketing issues affecting the industry in Malaysia. Tentatively, speakers will discuss trends in marketing seafood in Asia, challenges in exporting to the main markets, development of new markets and the future for seafood in Asia.

Farmer's day

The aim of the half day Farmer's day which will be held on Friday 18 November is to look at key challenges facing the country's cage culture sector and provide some strategies, particularly in health and feed management. Presenters will also discuss developments in industrial cage farming in the region.

Wednesday 16th November				**Concurrent events**
0800 - 0900	Registration			
0900 - 1230	Special Session: Seafood Trade and Certification			
1400 - 1740	Session 1: Policy and Regulatory Drivers in the Socio-Economics of Cage Aquaculture			
Thursday 17th November				
0800 - 0900	Registration			
0900 - 1040	Opening Ceremony			
1100 - 1245	Plenary 1& 2			**CAA3 & MISE Tradeshow**
1400 - 1740	Session 2: Site Selection and Environmental Management	Session 3: Production, Technology and Systems	Session 4: Species Selection and Seed Production	
Friday 18th November				
0900 - 1030	Plenary 3 & 4	Farmer's Day (0900 – 1240)		
1100 - 1700	Session 5: Biosecurity and Health Management	Session 6: Feeds and Feeding		**CAA3 & MISE Tradeshow**
1700 - 1740	Closing Ceremony CAA3			
Saturday 19th November Post-Symposium Tour 0800 - 2200				**MISE Tradeshow & CAA3 Tradeshow (1030 – 1500)**
Sunday 20th November				**MISE Tradeshow**

More information: CAA3 Email: caa3@asianfisheriessociety.org; cageculture3@gmail.com Web: www.asianfisheriessociety.org/caa3/
MISE web:www.mise.com.my

Aquaculture Europe 2011

Organisers have announced that Aquaculture Europe 2011 is promising to attract even more participants than AE10 in Porto with over 600 abstracts received. The event will be held on Rhodos, an Island in Greece and close to Turkey. It will be the event for aquaculture professionals, academics and others interested in the aquaculture industry. Sea bass, sea bream, trout, tilapia, mollucs, nutrition, health, are just some topics that will be discussed during the conference.

The farmers day at Aquaculture Europe 2011 on Wednesday Oct 19 will focus on all on various aspects of the aquaculture industry. All Greek, Turkish and European farmers are invited to participate during this Industry Forum. This forum also attracts farmers and professionals from the Middle East, and other European countries. The Industry Forum is open for all trade show visitors and for all conference participants.

Plenary speakers

Lara Barazi-Yeroulanos

'The importance of aquaculture for EU food production' will be presented by Lara Barazi-Yeroulanos, CEO, Kefalonia Fisheries S.A., Greece. Kefalonia Fisheries S.A., founded in 1981, was the first fish farm established for the production of Mediterranean sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus auratus*) in Greece. The company produces and sells over 3000 tonnes annually of organically farmed, sustainably harvested bass and bream which are sold in Europe, the United States, Canada and Russia.

Barazi-Yeroulanos will address the current state of the industry in Europe within a global perspective and will ask what we mean by sustainability today and what it might mean in the future. She will look beyond 2020, taking into account society and what we might be consuming, and most importantly the implications of future developments in technology.

Marc Vandeputte

'Selective Breeding – lessons learned from terrestrial animals and status of aquaculture implementation" will be presented by Marc Vandeputte, INRA-IFREMER Fish Genetic Improvement group, France. Vandeputte will look at selective breeding as a key methodology in improving the performance of livestock. Questions for the future are; the level of genotype by environment interactions; the ability to produce monosex and eventually sterile fish to have the best quality level, secure breeding investments and avoid problems with escapees; the impact of mating systems (mass spawning) on the design of breeding programmes and the ability to select for new traits to get 'robust' animals, adapted to a changing environment and rearing practices.

Albert G.J. Tacon

'Sustainable Aquaculture Feeds: Global trends and outlook, with particular reference to marine fish feeds' will be presented by Albert G.J. Tacon technical director, Aquatic Farms Ltd, USA. The key points of his presentation will be:

- Global trends in compound aquafeed production by major species group and country;
- Global trends concerning feed ingredient usage by major species group and country;
- Future prospects concerning feed ingredient selection and usage;
- Importance of fish in the Mediterranean diet and role of sustainable aquaculture feeds;
- Research needs and priorities towards sustainable aquaculture feeds.

More information: www.easonline.org
Trade show: Email mario@marevent.com (Mario Stael); www.marevent.com

What can you expect from Aqua Culture Asia Pacific in 2012

To date, our feature articles and coverage of aquaculture in the Asia Pacific region have brought to you the issues and challenges facing the industry. This will continue in 2012 and we expect more developments as aquaculture plays its role as the leading source of seafood for the global market. In order to be sustainable, we must learn how to control diseases in shrimp and marine fish while reducing costs of production through optimization of feeds ingredients and feed management. AQUA Culture Asia Pacific can be a vital tool for your marketing needs. During this 8th year of our publication, we invite you to join us to look at opportunities and how we can help market your products and services.

Volume 8 2012						
Number	**1 - January/February**	**2 - March/April**	**3 - May/June**	**4 - July/August**	**5 - September/October**	**6 - November/December**
Issue focus *Recent developments and challenges for the next step*	Aqua feed Production	Health Management	Sustainable & Responsible Aquaculture	Food Safety & Traceability	Culture models	Hatchery & breeding technology
Industry Review *Trends and outlook, demand & supply*	Marine Shrimp	Groupers	Catfish	Marine fish (Cobia/Sea bass)	Tilapia	Freshwater Fish/Prawn
Feeds & Processing Technology *Technical contributions influencing the final value of aqua feeds*	Feed additives Processing technology	Micro-nutrients Extrusion	Product quality Feed management	Feed enzymes Good manufacturing practices	Feed probiotics Post pellet additions	Novel feed ingredients Formulation
Production Technology *Technical information and ideas*	Pond Management & Biosecurity	Biofloc /Aeration technology	Genetic Improvement	Recirculation Aquaculture Systems	Certification and Regulations	Hygiene & Food Safety
Aqua business *Feature articles*	Experiences from industry, including role models, benchmarking and opinion articles in shrimp/fish culture					
Markets	Market trends, product development and promotions at local and regional trade shows					
Show Issue *Distribution at these events as well as local and regional meetings* **Show preview in prior issues*	**FIAAP Asia, VICTAM Asia & GRAPAS Asia 2012**, February 15-17, Bangkok Thailand* **Aquaculture America 2012**, February 29 - March 2, Las Vegas	**Skretting Australasian Aquaculture 2012 (AA12)**, May 1-4, Melbourne* **8th Philippines Shrimp Congress**, May 9-11	**Vietfish 2012**, June 26-28, Ho Chi Minh City, Vietnam	**TARS 2012** August 15-16, Phuket, Thailand **AQUA 2012**, September 1-5, Prague, Czech Republic	**17th China Seafood & Fisheries Exposition 2012**, November, China	

Disease diagnosis and control in marine shrimp culture

October 10-21, 2011, Bangkok, Thailand

The Shrimp Biotechnology Business Unit(SBBU), BIOTEC, Thailand Science Park, in cooperation with the centre for Shrimp Molecular Biology and Biotechnology (CENTEX SHRIMP), is offering a biology and pathology of shrimp course focusing on disease diagnosis and control in marine shrimp culture. It will be conducted by Dr. Tim Flegel and colleagues and will be held from October 10-21 at the Faculty of Science, Mahidol University at Bangkok, Thailand.

The course will consist of comprehensive lectures on the life cycle, anatomy, physiology and immunology of the black tiger shrimp. It will include information on the nature and diagnosis of all major pathogens and practical laboratory training. The focus on shrimp anatomy and on techniques for disease monitoring and diagnosis will range from gross observation to light and transmission electron microscopy and advanced molecular biology techniques. Registration is limited.

More information: Fee: USD 950/person. Application deadline: September 30, 2011.
Email: sbbu@biotec.or.th; Sirintip Dangtip (sirintip.dan@biotec.or.th) or Pattakarn Naksiltachodom (pattakarn.kha@biotec.or.th)

White shrimp farming and biofloc systems

October 10- 21, 2011, Bangkok, Thailand

This is a 2-week training course on the state of the art of farming practices. The course will be conducted by experts from the Asian Institute of Technology (AIT), Kasetsart University, Thailand and the Technion University, Israel. It will include several technical and field visits and comprises two distinct modules described below.

Module 1: White shrimp farming including water quality management, shrimp nutrition and feed management, pond bottom/soil management and probiotics, shrimp health management, profitability and financial analysis and management of environmental issues/concerns.

Module 2: Biofloc systems in white shrimp farming including the principles of biofloc systems, inoculation, feed application, abc of biofloc systems design and management, use of biofloc technology in extensive and semi intensive systems, sustainability of biofloc systems, review of practical experiences worldwide and economic analysis.

Module 1 will commence from October 10- 14 and module 2, from October 17- 21. Participants may attend either one of the two modules or both. The course will be at AIT and field trips will be conducted in Thailand. The course is designed for shrimp farmers, aquaculturists, fisheries officers, coastal zone managers, researchers, academicians, NGOs, development workers and business entrepreneurs.

More information: Fees for the course only; USD1,500/person/module and USD 2,500 person/course. Web: http://extension.ait.ac.th/unit/are

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

2011

September 16-18
6th Strait (Fuzhou) Fishery Expo
Fuzhou, Fujian, China
Email: xmcdw@163.com
Web: www.fishexpo.cn

September 29-October 2
AGRI INDO – The 3rd International Exhibition on Agri Food & Dairy, Agri Livestock & Poultry, Agri Fishery & Aqua Culture
Jakarta Indonesia
Web: www.agri-indo.com
Email: info@kristamedia.com

October 18-21
Aquaculture Europe 2011
Rhodes, Greece
Email: Registration: worldaqua@aol.com
Trade: mario.stael@scarlet.be
Web: www.easonline.org

October 26-28
Aquamar Internacional IX Expo
Sonora, Mexico
Email: zoila_lopez@aquamarinternacional.com
Web: www.aquamarinternacional.com

November 1-3
16th Annual China Fisheries & Seafood Expo 2011
Qingdao, China
Email: seafoodchina@seafare.com
Web: www.chinaseafoodexpo.com

November 16-19
Third International Symposium on Cage Aquaculture in Asia
Kuala Lumpur, Malaysia
Email: caa3@asianfisheriessociety.org
Web: www.asianfisheriessociety.org/caa3/

November 21-25
Eighth Symposium on Diseases in Aquaculture
Mangalore, India
Email: kalkulishankar@gmail.com
mircen@sanchartnet.in
Web: www.daa8.org

December 8-10
SIFSE2011- 6th Shanghai International Fisheries and Seafood Expo
Shanghai, China
Web: www.sifse.com
Email: sifsecommittee@163.com

2012

February 15 – 17, 2012
FIAAP Asia, VICTAM Asia & GRAPAS Asia 2012
Bangkok Thailand
Email: andrew.west733@ntlworld.com
Web: www.victam.com

February 29 - March 2
Aquaculture America 2012
Las Vegas, Nevada
Email: worldaqua@aol.com
Web: www.was.org

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

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

FIAAP Asia 2012

AQUAFEED INGREDIENTS, ADDITIVES, FORMULATION

VICTAM Asia 2012

AQUAFEED PROCESSING TECHNOLOGY

15 – 17 February 2012 · Bangkok International Trade and Exhibition Centre, Bangkok, Thailand

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The conferences
Aquafeed Horizons Asia 2012, The FIAAP Conference 2012, Petfood Forum Asia 2012, The Thai Feed Conference 2012

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Thailand Convention & Exhibition Bureau

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Further information
For additional information and **free** visitor registration visit:
www.fiaap.com or **www.victam.com**

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