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AQUA CULTURE
Asia Pacific

Better Yields in Bali Farms

WSSV Resistance in Vannamei Shrimp

Amino Acids in Aqua Nutrition

A Gap Analysis in Freshwater Fish Feeds

Cobia in China

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

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MALAYSIA *(JOHOR)*- Gold Coin Specialities Sdn Bhd/Gold Coin Biotechnologies Sdn Bhd, Tel: +607 237 0695 Fax: +607 236 1143 email: sp.koh@goldcoin-my.com

INDONESIA *(NORTH SUMATRA)* - P.T. Gold Coin Specialities Medan, Tel: +62 61 685 5127 Fax: +62 61 685 3452, email: p.zulkarnain@goldcoin-id.com

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INDIA *(CHENNAI)* - India- Gold Coin Biotechnologies Sdn. Bhd. India Liaison Office, No.1, B.V.R. Nagar, Alwar Thiru Nagar, Chennai 600087, India. Tel: +91 44 2486 8433 Fax: +91 44 2486 2091 email: v.ravi@goldcoin-id.com

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Editor/Publisher
Zuridah Merican, PhD
Tel: +603 2096 2275 Fax: +603 2096 2276
Email: zuridah@aquaasiapac.com

Editorial Coordination
Corporate Media Services P L
Tel: +65 6327 8825/6327 8824
Fax: +65 6223 7314
Email: irene@corpmediapl.com
Web: www.corpmediapl.com

Design and Layout
Words Worth Media Management Pte Ltd
Email: sales@wordsworth.com.sg
Web: www.wworthmedia.com

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3 Pickering Street, #02-36 Nankin Row,
China Square Central, Singapore 048660
Web: www.aquaasiapac.com
Tel: +65 9151 2420 Fax: +65 6223 7314

Editorial and advertising enquiries
Request for reprints and articles
Email: zuridah@aquaasiapac.com
Tel: +603 2096 2275 Fax: +603 2096 2276

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OUR MISSION

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

From the editor

Year in review 2011 : The Good, Bad and The Ugly

As we close the chapter of 2011, we realise the year has been bitter sweet for producers of marine shrimp, both vannamei and black tiger shrimp because of widespread crop losses to disease. Prices continued to firm since mid-2010 and successful farms should have had a good year with average prices higher by 20% year-on-year. Massive crop failures with the black tiger were more apparent this year, particularly in Vietnam. India had faced crop failures too and this was the driving factor for the country to open its borders to vannamei. Farmers attribute this poor showing in black tiger to the lack of domesticated brood stock and SPF fry.

Faced with its own supply problems, China's thirst for shrimp is evident with Chinese buyers seeking shrimp supplies at regional seafood events since November 2010. News reports said that its cross border shrimp trade with Vietnam is now rampant and Vietnamese processors are crying foul as they themselves seek supplies to run the processing plants. According to INFOFISH, China is already a net importer of shrimp and will be the second largest retail market for shrimp by 2020. Brazilian production estimated at 75,000 tonnes remains firmly in Brazil with the high real (BRL). Cheaper imports are not allowed to avoid the introduction of diseases. The future demand will continue to be from the rising middle class in emerging markets, led by China, Brazil and India. India is making a comeback with vannamei shrimp. The impact on prices is yet to be seen but India's farmers target the larger shrimp for export while smaller shrimp go to the domestic market.

On the technical front, the good news is with the freshwater prawn sector. Recently, the farming of vannamei shrimp in low salinity has been at the expense of this prawn. According to producers, prices are high but yields are inconsistent because of inbreeding of wild stocks and post larvae quality. Work in Indonesia is showing results with hybrid strains for faster growth. The latest is the output from a three year research program by Australian and Vietnamese scientists. We can now look forward to a new strain with 25% faster growth benefiting farmers in Vietnam and the region.

In June, the success of the higher floor price for Vietnam's pangasius was reported. It moved up 20% in value. In turn, this encouraged farmers to restart farming operations. Ex farm prices are better in VND value, albeit still close to the USD one dollar mark due to the exchange rate. At ESE 2011, 'sustainable' production was the by-word and this issue has been more relevant to pangasius than other freshwater fish such as the tilapia. At a seminar, Dr Pham Anh Tuan, Directorate of Fisheries reminded producers that retailers in the west are demanding sustainable fish whereas prices can be determined by demand and supply. After years of trials in the Mekong Delta, the implementation of vaccination for the bacteria *Edwardsiella ictaluri*, now under an 'observation license', is expected to make a difference on how the fish is farmed in Vietnam (see page 52). A full fledge vaccination for the pangasius is desired not only to overcome the scourge of farms but also give it a sustainability ticket. It will be on par with the salmon where regular vaccination programs feature as a sustainability practice.

Through the year, we have reported on developments in the marine fish sector. Besides challenges with fingerlings supply and quality, the recent gathering of aqua feed stakeholders in Singapore commented that the main issues with this sector is the lack of focus on moving away from fresh or trash fish and that feeds are not formulated for specific species. Having just returned from the European Aquaculture Conference, I learnt about the efforts of several institutions in Europe working on marine fish to improve feed efficiency and benefit the small and medium enterprises. In Asia, we look forward to such effort, perhaps starting with an ASEAN alliance to undertake joint research as the cultured species are shared by many countries. The objective would be coordinated research to improve efficiency with data for the private sector to follow through with products that benefit the industry.

The shrimp and freshwater fish sectors have the international commodities of vannamei and pangasius and tilapia, respectively but we will need to put in more effort to develop a 'flagship' species in the marine fish sector if Asia is to contribute more to the global fish supply.

We wish all readers a HAPPY AND PROSPEROUS NEW YEAR!

Zuridah Merican

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Faster growing giant freshwater prawn

A third generation giant freshwater prawn *Macrobrachium rosenbergii* that grows 25% faster than other cultured strains.

This was the result of a giant freshwater prawn (GFP) project which is a collaboration between scientists at the Queensland University of Technology (QUT) in Australia and research staff at the Research Institute for Aquaculture No 2 (RIA2) in Ho Chi Minh City, Vietnam, says a report from QUT. Funding and support for this work was provided by RIA2 and the Vietnam government.

Professor Peter Mather, the Biogeosciences discipline leader at QUT, said "The main objective is to provide farmers in the Mekong Delta with a more productive GFP culture strain for their local industry. By shortening the production cycle, there will be more income for the farmer. Freshwater prawn aquaculture is a huge industry in south-east Asia worth more than AUD one billion per year.

"Through a family selection program on the prawn, PhD student Hung Dinh, a research scientist at RIA2, has produced a faster growing third generation prawn. Technical support for this work came from the WorldFish Centre in Penang, Malaysia. Hung's breeding work was conducted in Vietnam and he received amazing help and support from the RIA2 workers at Cai Be research station, south of Ho Chi Minh City. They maintained his selected families whilst he was here at QUT."

During the three-year selective breeding program, the Vietnamese scientists combined three GFP strains from Vietnam and Malaysia into a single breeding stock. They then took the synthetic line and picked the best families and the best individuals within those high-performing families. This breeding program led to a significant breakthrough with this faster growth improved culture strain. Two of Mather's other students, QUT PhD researchers Hyungtaek Jung from South Korea and Norainy Husin from Malaysia, are using this strain to identify key genes that affect the growth rate of giant freshwater prawns.

Hung Dinh (right) with Peter Mather

"These genes can be used as markers to identify fast-growing individuals while they are still of small size," he said. "If similar genetic markers also exist in other crustaceans, we may be able to use them to produce fast growing culture strains for other species as well. A paper on this has been accepted in PLoS Biology, a peer reviewed journal and is the first genomic analysis of this species and this will provide a resource for novel gene discovery in this species. Hyungtaek Jung, the first author, used samples of animals from Hung's project (fast and slow growing families) for his analysis."

Mather added that Norainy is working on identifying gene markers (mutations) in genes that influence individual growth rate in GFP. This shows that this GFP work has a very international participation, drawing much expertise from young Asian scientists. The research team at QUT has recently also introduced giant freshwater prawn strains to Fiji as part of an Australian government-funded project to assist aquaculture development in the Pacific region.

ASEAN Seafood Federation (ASF)

This is a regional grouping, established in 2009 and Prof Nguyen Huu Dung is the current chairman on behalf of Vietnam which holds the Chairmanship from 2011 to 2012.

He is also vice president of Vietnam Association of Seafood Exporters and Producers (VASEP). The aim of ASF is to establish a forum for members to freely and openly exchange views, cooperate on quality standardization, inspection and certification, labelling and packaging, share trade and market information and production technologies. The common vision is sustainable seafood.

The leading national seafood producers and exporters' associations of ASEAN countries are members namely; Brunei Darussalam Aquaculture Producers Alliance Cooperative (BAPA), Fresh & Frozen Seafood Association of the Philippines (FFSAP), Indonesian Frozen Seafood Association (AP5I), Malaysian Frozen Food Processors Association (MFFPA), Myanmar Fishery Products Processors & Exporters Association (MPEA), the Thai Frozen Food Association (TFFA) and the Vietnam Association of Seafood Exporters and Producers (VASEP).

"Members hope to manage production and exports in the region more effectively, to improve quality, safety and value of products, to increase technical, environmental and social standards and marketing. The new organisation is also expected to reduce inter-country rivalry and conflicts in the region while ensuring better commonly-accepted standards. Closer cooperation in production and marketing by the ASEAN countries could have a greater impact and control over the global markets," said Dung.

Members have specific roles; Vietnam on production and technology, Thailand on food safety assurance and marketing, Myanmar on cooperation on securing production inputs, while Indonesia, the Philippines and Malaysia are to handle logistics.

"We believe that Public Private Partnership (PPP) is important for achieving sustainable development goals. It will give us opportunities to improve the quality of service, cost-effectiveness, financial services and investment. Implementation can be faster too. Among these are an ASEAN Seafood Exhibition, a website and a professional magazine for the ASEAN seafood industry," said Dung.

Fast and furious growth in vannamei shrimp production in India

Industry is pleased with the surge in production but there are concerns too.

Whilst many shrimp producing countries battle with diseases and adverse weather conditions, vannamei shrimp production in India is expected to reach 60,000 tonnes by the end of 2011. India stands apart from the other vannamei shrimp producers in the region. Farmers have settled for stocking density around 40 post larvae/m^2 to produce good yields of 25 to 40 pcs/kg. This suits them, with power shortages and the lack of infrastructure. The minimum days of culture (DOC) is 110 to a maximum of 150 days, to get larger 20-25 pcs/kg shrimp.

Average harvests are 8 tonnes/ha from a range of 6 to 12 tonnes and there are two crops per year. Survival rates are good, at 70% and problems are limited to white spot syndrome virus, slow growth and vibriosis. Production is mainly targeted for the export market although the local market is fast expanding for the smaller 50-60 pcs/kg shrimp.

The farming of the vannamei shrimp was allowed in 2009 but with restrictions. The Coastal Aquaculture Authority (CAA) issues permits to qualified farms at the maximum permitted stocking density of 60 post larvae/m^2. In the guidelines for culture, registered farms must have established biosecurity measures as well as an effluent treatment system (ETS). Farms with zero water exchange systems will be encouraged to farm the shrimp. Approved farms cannot culture any other crustacean species.

Initially culture was limited to large farms, mainly in Andhra Pradesh, where improved infrastructure and biosecurity measures are in place. Now there are small farms around Chennai and in Orissa farming the shrimp. Although in Gujarat, vannamei shrimp is also cultured, the dominant species is still the black tiger. Farms in West Bengal have remained with black tiger shrimp farming.

However, as pressure from the farming community increased, CAA has come out with a procedure to provide a letter of permit (LOP) quickly. The suitability of farms is checked by authorities from district level communities (DLC) with respect to biosecurity and ETS. Farms are required to have biosecurity measures, such as crab fences, to prevent entry of diseases . With this, more areas have started to farm vannamei shrimp.

"A positive side to this development is that the increase in production is reviving many processing plants which had stopped operations because of a lack of black tiger shrimp material. In June with a surge in harvests and a shortage of processing plants in the east coast, shrimp were being sent to plants on the west coast. To avoid potential issues with antibiotics, the Marine Products Exports Development Authority (MPEDA) is closely monitoring production. We have imposed a pre harvest test (PHT) for antibiotics where the farms give a sample of shrimp before harvesting for export. A certificate is then issued to the processing plant," said Saifuddin Anis, deputy director, MPEDA.

Initially, the control on vannamei shrimp farming was also through the supply of post larvae. Based on the capacity of hatcheries, CAA also issues import permits for SPF brood stock. Hatcheries can only produce specific pathogen free (SPF) post larvae from imported brood stock which in turn are required to undergo a 5-day quarantine at the centre in Chennai operated by the Rajiv Gandhi Centre for Aquaculture (RGCA). Gradually, supply of post larvae increased when CAA registered more than 68 hatcheries to produce vannamei post larvae.

Large size vannamei shrimp from Gujarat, picture by Manoj M Sharma

Thampi Sam Raj, program director at the RGCA, part of MPEDA and which operates the Aquatic Quarantine Centre at Neelankarai, Chennai, said, "Vannamei shrimp is bringing changes to India's shrimp industry with the revival of abandoned farms and former black tiger shrimp hatcheries. However, there are more concerns. We worry that some hatcheries will resort to using pond reared brood stock to meet supplies. The good side is that in May to June, ex farm prices rose to INR 250/kg (USD 5.15/kg) for 40 pcs/kg. At the farm level, although they should have adequate biosecurity measures in place, we still worry about the introduction of disease such as white faeces syndrome from poor adherence to standard operational procedures and inadequate waste water treatments. In addition, poor post harvest handling may affect prices.

"We will also overcome the constraints with quarantine of SPF brood stocks entering the country when we expand to accommodate twice the current capacity. This is expected in eight months. A multiplication centre is also in the pipeline with Hawaii's Oceanic Institute (OI), following a recent MOU. The Visakhapatnam hatchery on the east coast will be modified for operations by the end of 2012" said Sam Raj.

According to industry, RGCA has done an excellent job with the quarantine system but hatcheries face a limitation in the supply of SPF brood stock. Lack of quarantine space is the bottleneck. It was suggested that the government may need to reassess the quarantine system and adopt random sampling. With more imports of SPF brood stock, the issue of hatcheries using pond reared brood stock may not arise. This will also regulate post larvae prices, currently at INR 400/1,000 (USD 8.16/1,000) but was INR 800/1,000 (USD 16.3/1,000) during the peak demand in January.

In 2012, industry estimates a production of 160,000 to 200,000 tonnes of shrimp from India and vannamei will comprise 60% of this production. This means that however much authorities in India hope for black tiger shrimp to lead in production, the current success in the industry will favour vannamei shrimp. The domestication and selective breeding program in the Andaman Islands have reached the second generation and by January 2012, the first batch of SPF post larvae will be commercially available, said Sam Raj.

News in Brief

AD for shrimp down but up for the pangasius

Antidumping (AD) duties were reduced sharply in the final results of the fifth AD duty administrative review (POR5) on frozen shrimp from Vietnam. The lowest was for Nha Trang Seafood which went down to zero from 4.89%. The new rate for Minh Phu Corp is 1.15%, Camimex, 0.83% and the rest at 1.04%. Although the final duty rate of POR5 is lower than that of the preliminary result announced by the US Department of Commerce (DOC) on March 2011 (1.52%), authorities in Vietnam were unhappy as DOC did not comply with the WTO ruling against a zeroing calculation.

In the case of the pangasius, the seventh review raised duties to 15%, with the exception of Vinh Hoan whose margin was zero. The valuation was based on that from two surrogate countries, Bangladesh and Indonesia. The Vietnam Association of Seafood Exporters and Producers (VASEP) will work to request DOC to use only Bangladesh for valuation as it did before (Vietfish International, September/October 2011).

Less shrimp from Thailand

In Thailand, shrimp producers have lowered their growth forecast for exports to 5% from an earlier estimate of 8%. Exports will likely decline to 379,400 tonnes because of hot weather and floods, said Panisuan Jamnarnwej of the Thai Frozen Foods Association (TFFA) in the Bangkok Post in September. He added that exporters face lower demand from Japan because of the March 11 tsunami and continuing weakness in the US and European economies which consume 45% and 18% of shrimp exports, respectively.

Producers need to adjust production to smaller shrimp to suit demand from consumers. The US prefers 12- instead of 16-ounce packs. TFFA has advised producers to look at East Asian markets such as South Korea, China and Hong Kong. Infofish has indicated that China will be the second biggest retail market by 2020, after the US. At the same time, supply from Thailand is expected to be less by 15% and with lower supply from Vietnam and Indonesia, prices will rise by 40%. Next year, Panisuan expects a better outlook on demand as global conditions improve.

More seafood to come from aquaculture

Australia produces 243,000 tonnes of fish and seafood annually, valued at AUD 2.2 billion; and this is insufficient to meet the national demand according to Mike Hall, Principal Research Scientist at the Australian Institute of Marine Science in a statement in The Australian. Two thirds of the production is caught while the rest is produced by farming salmon, tuna, prawns, oysters and mussels in pens, tanks and on racks and ropes around Australia's vast coastline. Demand is from local and foreign consumers of Australian seafood and Australians are eating 5% more seafood a year. Hall said that the only solution is for an urgent, dramatic and planned expansion of fish farming efforts, to fend off an impending supply shortage. Imports are currently valued at AUD 1.3 billion and the hope is that the federal government, as part of its embryonic National Food Plan, will soon earmark aquaculture, as a local food producing industry and give it the highest priority for rapid growth.

Norway to help Indonesia double output

Indonesia's Maritime Affairs and Fisheries Ministry will team up with Norway, to produce 22.39 million tonnes of fishery production by 2015. Norway was chosen for its advanced technology in aquaculture as the Ministry changes focus to aquaculture from fisheries to achieve production targets, according to the Jakarta Post. At a seminar involving Norwegian fish farming firms showcasing new aquaculture technology, Aquaculture director general Ketut Sugama said that the new technology would promise improvements in genetics, feeding systems and disease prevention. These could be applied in offshore areas in Lombok, as Indonesia has yet to fully develop its potential there. "Genetic improvement allows fish to gain one kg in six months instead of a year, which is what we have at present. Faster growth would result in higher production and a larger export trade, and disease prevention technology would protect fish against necrosis and virus infections, which are common among fish."

Super-intensive stacked raceway shrimp production

This new shrimp production technology was created by shrimp culture pioneer, Dr Addison Lawrence at the Texas AgriLife Research Mariculture Laboratory. The patent-pending technology, known as super-intensive stacked raceways, is able to produce record setting amounts of shrimp such as 25 kg/m^3 of size 1.1 ounces, known as U15 shrimp (30g). It uses either zero water exchange and/or recirculating water. The shrimp grow in four columns of raceways stacked four stories high. These raceways are long tubs with circulating water of only 5- to 7-inches (12 to 17cm) average depth. As the shrimp develop, they are transferred to a raceway below. Juvenile shrimp are added to the top raceway, while the more mature shrimp in the lower raceways are harvested.

However Lawrence said, "These tanks require stringent control and supervision, and 24/7 monitoring with computers tracking the shrimp." A world-wide license for the new technology has been awarded to Royal Caridea and sub-licenses are being considered for other countries, including Ecuador, Chile, Colombia, Mexico, Canada, China, Germany, Czech Republic and Russia.

Lotte Mart targets black tiger shrimp

Korea's Lotte group which operates two retail stores in Vietnam focuses on all shrimp varieties but especially whole black tiger shrimp sized 10-15 pcs/kg. However to be distributed by Lotte Mart, Vietnam goods and seafood must ensure international standards such as competitive prices and taste suitable to Korea and other countries. Lotte, which has the most modern distribution systems in South Korea and Asia, owns 203 trade centres in 4 countries: 2 centres in Vietnam, 92 in South Korea, 85 in China and 24 in Indonesia. Lotte Mart looks for its suppliers based on primary criteria such as competitive pricing, best-sellers and good quality.

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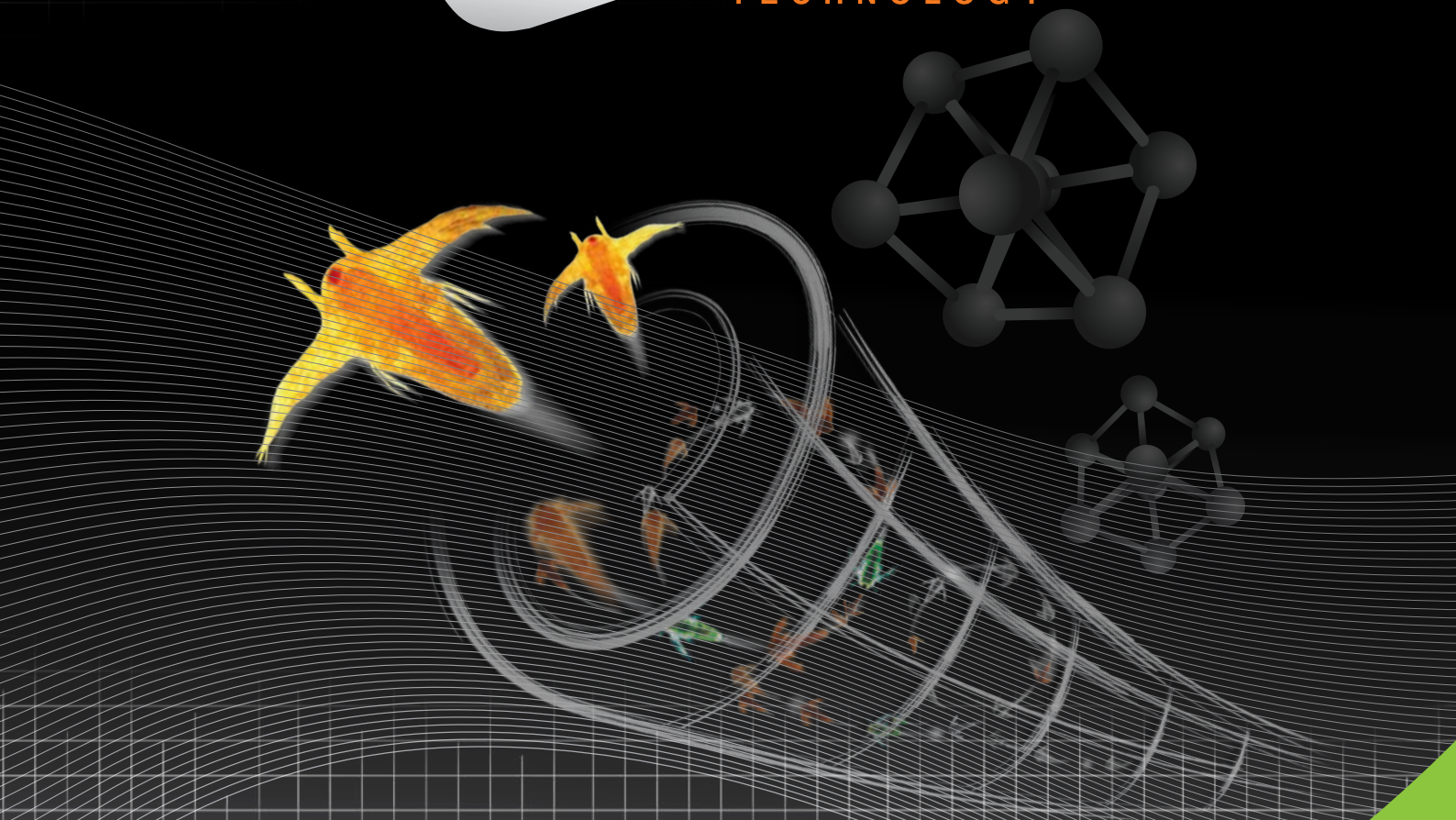

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Comments from Industry

The emphasis on the pathology of a disease reflects an outdated approach compared to modern veterinary and human medicine which also use epidemiological investigations, says Dan Fegan

I would like to comment on your editorial in the July/August issue (Volume 7 No 4) of the magazine where you discuss the issues around disease outbreaks and the current problem of EMS (early mortality syndrome) in several countries. In your final paragraph, you ask whether farmers continue to take risks while we wait for diagnostic results to identify any potential causative pathogen(s).

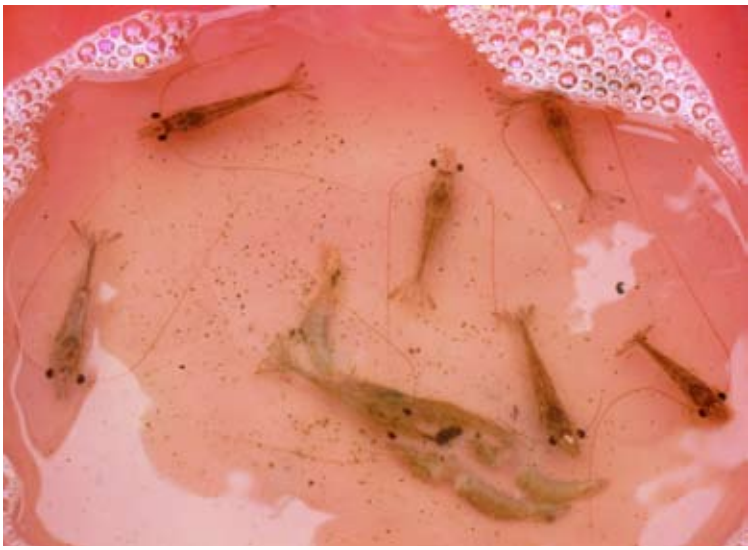
This neatly encapsulates an important weakness in much of our current thinking on disease outbreak investigations in aquaculture where the major emphasis is given to finding and identifying causative agents of a particular disease. This emphasis on the pathology of a disease reflects an outdated approach compared to modern veterinary and human medicine which also use epidemiological investigation.

I had the privilege of attending a masterclass on epidemiology for aquaculture organised by the Australian Centre for International Agricultural Research (ACIAR) and Aquatic Animal Health Research Institute (AAHRI) in Bangkok in 1996 taught by the late Chris Baldock. Having struggled through the Yellow Head Virus (YHV) and White Spot Syndrome Virus (WSSV) outbreaks in the previous two years, this course really opened my eyes to a large and structured discipline that could be applied at the farm level to investigate and manage disease issues. Like many others in the industry, I had come from a marine biology/fisheries background where the training did not include elements of veterinary medicine beyond some limited pathology lessons. The population-based approach immediately made a lot of sense when applied at the farm level and although Chris' background was in livestock, the basic principles were exactly the same.

Unfortunately, since then, the application of epidemiology in aquaculture disease seems to have languished and we largely continue with the old paradigm of pathology-based investigations.

Pathology (the study of disease at the individual animal or organ level) and epidemiology (the study of patterns of disease in populations) are used in tandem to

a) find and identify any pathogenic agents associated with the disease and
b) identify and control any other risk factors that are associated with the spread of the disease between individuals, ponds, farms or countries.



EMS in 30 day old shrimp in Vietnam

Modern epidemiology recognizes that Koch's postulates, which many of us grew up with, are insufficient when applied to many diseases that may have several factors contributing to cause an outbreak. In the case of WSSV, it is well known that infection alone does not always lead to disease and that it is the combination of infection by whitespot virus together with other factors such as season and temperature that results in an outbreak of disease.

Neither approach on its own will help to develop an appropriate response to disease outbreaks nor result in an appropriate biosecurity plan for future prevention. Pathology may provide a series of diagnostic features, identify a causative agent and possibly the means of transmission between individuals but this alone will not help to determine ways to minimise the severity and spread of the disease within and between populations.

Epidemiology can identify factors that contribute to the severity and spread of the disease, and allow us to minimize these risks but will not necessarily be able to provide robust biosecurity protocols without knowing the kind of pathogen we are dealing with and how the disease can be diagnosed.

It is generally forgotten today but in the early stages of the WSSV outbreaks in the mid-1990's, we had no idea what was the causative agent of the disease. However, by looking at the pattern of outbreaks in large numbers of ponds and farms, it quickly became clear that there was a strong association with the source of post larvae.

This allowed us initially to try to limit infection by restricting post larvae supply to hatcheries without a previous history of WSSV outbreaks. This was not perfect since some post larvae from hatcheries that had been clean subsequently came down with WSSV. Fortunately, we had fairly good records to track outbreaks and possible contributing factors which made the job much simpler, something that is not necessarily the case today.

It was after the identification of white spot virus as the causative agent, and the development of PCR testing technology by the team at Mahidol University, that we were able to actually test post larvae and minimise the entry of infected post larvae into farms using diagnostic tests. At the same time, studying the seasonality of the white spot

outbreaks showed that the risk could be further reduced by reducing stocking or production in the rainy season when the white spot disease was more prevalent. Even today, the recommendations of Dr Chalor Limsuwan to keep post larvae at elevated temperatures to eliminate or inactivate the virus represent a combination of pathology investigations on the effect of temperature on the course of white spot disease in individual shrimp and epidemiological applications to eliminate low temperature as a risk factor at the population level.

In the current situation with EMS, I strongly believe that we need to expand the disease investigations to include epidemiological studies to better understand the factors that are associated with the spread of the disease from farm to farm and country to country. As a syndrome (ie we do not know what is the 'cause'), we need to keep an open mind as to whether it is caused by a single pathogen, a combination of pathogens or has a multifactorial cause (including a convergence of environmental factors).

Epidemiological investigations will help us to better understand any potential risk factors that contribute to the outbreaks and perhaps allow us to take steps to eliminate or minimize these, even if we do not have a clear idea of the pathological agent(s) involved. This represents a far better option, in my opinion, than waiting until we get a consensus on diagnostic results and give the 'syndrome' a name.

Dan Fegan is Regional Technical Manager – Aquaculture, Cargill Animal Nutrition Bangkok, Thailand. He can be contacted at Tel: +66 2 263 2929 ext 369 Fax: +66 2 263 2950 Mob: +66 84 874 8066

Better yields in Bali farms

By Zuridah Merican

Three farm managers in Bali, Indonesia attribute their success with consistently high yields of the vannamei shrimp to quality SPF post larvae, proven culture technology, vigilance on diseases and quick response to changing climate conditions.

The changes in culture technology may be specific to each farm but the common goal is prevention or control of diseases, mainly infectious myonecrosis virus-IMNV (or locally known as 'mio') and MPP or slow death syndrome in vannamei shrimp. These steps are required to adapt to inclement weather conditions. Most farms now practise a low water exchange and reduction in the pond carrying capacity. Overall, the three farm managers below said that the key factors to their repeated success are vigilance and careful monitoring to have better control of pond water conditions and sufficient aeration to prevent a plankton crash. More observations on feed consumption resulted in improvements in feed conversion ratios.

Ali Muntaman (middle) with technicians, Eko Prasetyo (left), and Faza Amin

Ponds at PT Makara

PT Makara

On North Bali's Kecamatan Grogak, Buleleng, Singarajah, the farm of PT Makara covers an area of 5 ha with 15 grow-out ponds, each averaging 3,500m^2. Ponds at the farm are fully cemented. There are three reservoir ponds covering 1 ha. The water intake is 300 m from the shoreline and water is filtered and treated prior to use.

Since 2010, Ali Muntaman has been managing the farm successfully. In this farm, Ali is assisted by 35 technicians for the grow out and reservoir ponds. With 23 years of experience managing farms in Jepara, Bali and Lombok, Ali is well known in the industry in Indonesia in running a successful shrimp business and for his acumen and technical capability in shrimp culture. He is also a consultant to two other farms and moderates an online forum for shrimp producers (communitasteknisiudang) to share culture technology and problem solving in shrimp farming.

According to Ali, "The principle used here is simple. In each pond of 3,500m^2, we run 18 aerators (18 hp) 24 hours from stocking to harvest. We have positioned the aerators at strategic positions to ensure that shrimp do not have any stress. In 95 days, we can achieve 35/kg shrimp even though the stocking density is 140 post larvae/m^2. We have the advantage that the water salinity is relatively stable at 37 ppt. I believe that calcium is the most critical parameter."

The target production is 36 tonnes/ha/cycle and farm has three cycles over 13 months. Three weeks is allocated for drying and pond preparation in between cycles. The farm practices an all-in all-out schedule. The total yearly production was estimated at 450 tonnes. Ponds are only stocked with post larvae (PL10-11) from a hatchery in Rembang in East Java. Partial harvesting is practised with the first harvest when shrimp reach sizes 45-57/kg usually at 87days of culture. Some 30% of the shrimp are harvested. This is followed by a complete harvest at 115 days when shrimp reach 35/kg.

"We are now in our third cycle and in 118 days we have shrimp of 30 pcs/kg. FCR is 1.5:1 and we use feeds from PT CJ Jombang and PT CP Prima. We start feeding immediately after stocking and in the early stages, we reduce the amount recommended by feed companies. Our preference is for higher quality post larvae which cost IDR 34 each in comparison with other supplies at IDR 30 each and IDR 28-27 each for post larvae from local broodstock. PT CP Prima feeds are bundled with post larvae. However, we are pleased that we can achieve an average daily growth (ADG) of 0.3g/day over 113 days. We feed 6 times/day and the last feeding is at 3am. Other farms only feed 4-5 times/day. We do face disease problems such as 'mio' and MPP. If mortality is 15% at 1.5 months of culture, we will harvest all of the shrimp."

The culture technology was developed by Ali and he said that this can be applied to all ponds that are HDPE or cement lined. He is uncertain on its application in all soil ponds. Aside from feeds, the major cost at the farm is electricity and petrol for the generators which is 16% of the total cost. Currently, this works well at prices of IDR 64,000/kg for 40/kg shrimp (July).

"It will be possible to use this technology to increase stocking density to 200 PL/m^2 but water depth must be 1.5m and not deeper," said Ali.

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Size 64/kg shrimp after 80 days

South Bali

Close to Negara in South Bali, this is one of the several farms operated by one of Indonesia's shrimp pioneers, Nefo Ng. His other farms are located in Sumbawa, Bali and East Java. Some of the ponds were renovated when Ng took over the farm. These are lined with HDPE with soil bottoms. Previously, ponds had cement sides. There is no central drain to remove the sludge. There are 23 grow-out and two reservoir ponds. Water intake is direct and water is treated with 15 ppm of a trichloride (90%) in the reservoirs prior to channelling to ponds. In this part of Bali, water salinity is variable, ranging from 30-33 ppt and with the rains, salinity declines to 25 ppt. This is when supplementation with calcium is required.

Kukuh (second right) and technician with Bambang Setyo Raharjo (right), technical support and Budi Rasdiyono (second left), sales supervisor, East Area, at PT Gold Coin Indonesia (Specialities).

The uniqueness of this farm is the positioning of aerators which pushes the sludge into one end and facilitates easy removal either manually or by siphoning. This is the style developed by farm manager, Kukuh Widodo, a graduate in water quality management. Kukuh has been with Ng for six years and believes that the ideal pond water salinity should be 20-30 ppt for best shrimp growth.

The ponds are 3,700 to 4,000 m^2 in size and are 130-140 cm deep. Some ponds are stocked at 110 PL/m^2 with post larvae from PT Suma Marine, a hatchery owned by Ng. Some 10 days before stocking, pond water is treated with pesticides. The shrimp stock of 60/kg is harvested completely after 80 days. Eight ponds are stocked with post larvae from a PT CP Prima hatchery and for these ponds, partial harvesting is planned.

"We have only started partial harvesting in this cycle and how we will manage will depend on conditions and market demand. Usually we start with 1.5 to 1.8 tonnes of 67/kg shrimp which is after 75-80 days of culture. The plan is to do a second harvest when shrimp reach 40/kg or we may keep the shrimp up to 180 days for larger shrimp. Now (July), the offer prices are IDR 50,000 for 70/kg whilst it was IDR 52,000/kg in June."

The average harvest is 21 tonnes/ha and the lowest achieved was 15 tonnes/ha. The farm used to stock at 170 PL/m^2 but has reduced this to 110 PL/m^2. Kukuh is aware of the carrying capacity and feels that it should be reduced in accordance with pond conditions. He has seen 'mio' in some ponds and survival was only 40-50% and has

Feeding time

View of ponds

linked this to poor water quality and weather conditions. At higher temperatures, shrimp feed more, affecting pond water quality. There is also the proliferation of blue green algae at higher temperatures.

"We have incidences where shrimp of 70-80/kg at 110 days were just eating and not growing while FCR rose to 2:1. The usual FCR is 1.6:1 and from day 1, we use Gold Coin's Ecofeed. I look at the needs of the shrimp and have opted for lower crude protein feeds. In addition we supplement feed with vitamin C. We feed 5 times/day and start with the first feeding at 7.30am and the last feeding at midnight. "

In comparison to other farms in Bali, Kukuh has managed to keep cost of production at IDR30,000/kg for 80% survival rate with size 31-32/kg. The highest cost is for feeds at 50%. Besides post larvae, other major costs are for energy, chemicals and pond treatments.

Pond where aerators push sludge to one end

Concrete ponds with sampling platforms at Wira's farm

Sampling of shrimp

Seririt Kalanganyar

In North Bali, tight biosecurity at the farm of Wira Cahyadi Wangsa is mandatory to prevent diseases. It is more critical in July/August when temperatures fluctuate and the chances of diseases occurring are higher. It is the responsibility of Wira's 23 year old son Suryanaga Kencanawangsa to be on the constant alert for any signs of diseases. Morning temperatures are 24°C and in the evening, it rises to 28°C. The wind is also strong during this period and when this happens, shrimp seek shelter usually in areas with high loads of hydrogen sulphide, said Suryanaga.

The 20-year old farm has 27 ponds of which 23 are used for shrimp grow-out. There are three reservoir ponds for treatment of water with trichloride and one is used to hold milkfish brood stock. Pond sizes ranged from 3,500 to 4,000m^2. Stocking density has been constant at 130-150 PL/m^2. Shrimp are grown to 40-35 pcs/kg after 3.5 months.

Currently, the farm uses a range of feeds from PT Gold Coin Indonesia (Specialities). The higher protein starter feeds with 42% crude protein (Supreme) is used for the post larvae. Some 12 to 15% of production uses this range of feeds containing 40% of crude protein for the grow-out stages. It also uses the Forte range which has been specially designed for vannamei shrimp and the Eco range, to cut down on costs of feeding. Feed FCR is usually around 1.4:1 but has risen to 1.7:1 when there was an incidence of mio at the farm.

Suryanaga has been learning shrimp farming for 1.5 years, since returning from his studies in Australia. He is pictured with the feed supervisor who has been with the farm since it was set up.

The author acknowledges the assistance of Haris Muhtadi, CJ Feeds for the information on PT Makara and Budi Rasdiyono, sales supervisor, East Area, at PT Gold Coin Indonesia (Specialities) for the other farms.

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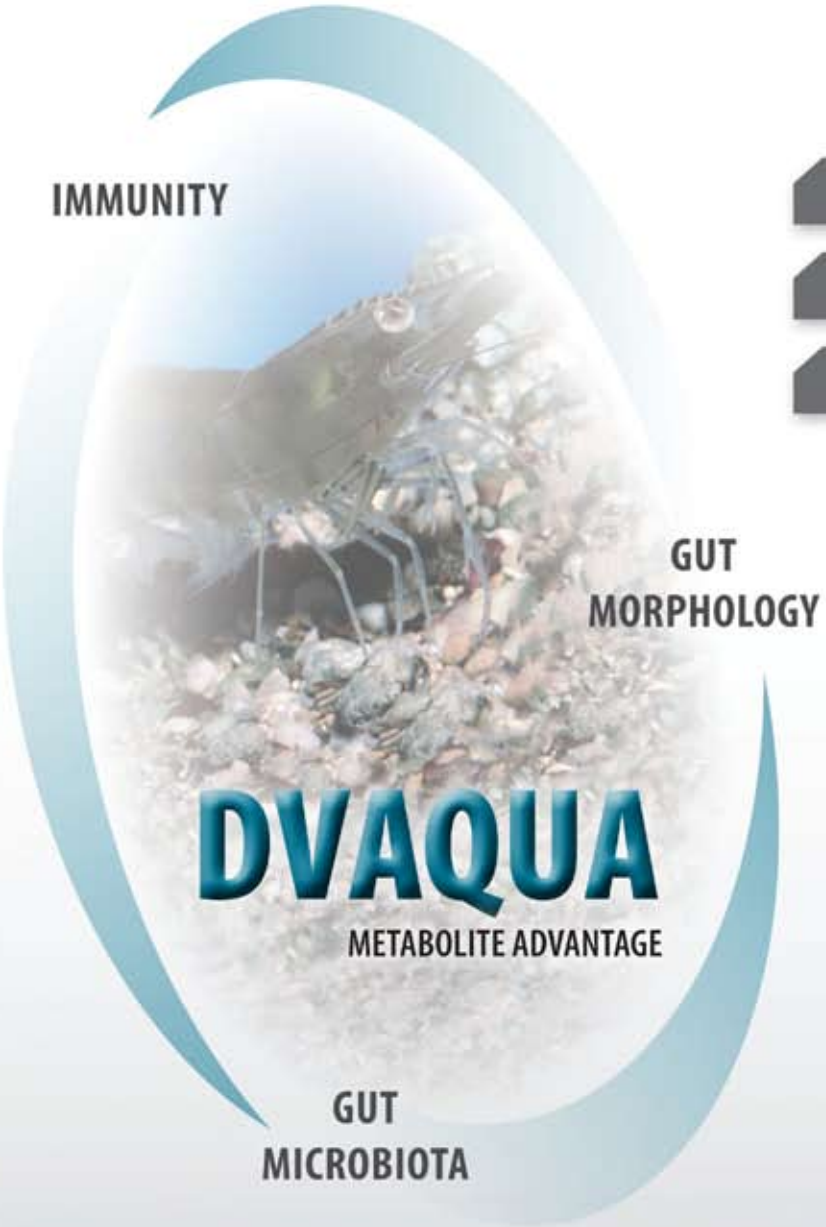

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Improving our understanding of amino acids in aqua nutrition

This was the focus for the half-day seminar organised by Evonik Degussa (SEA), Singapore, held on 19 August, the day after the inaugural TARS-The Aquaculture Roundtable Series 2011 on Aquaculture Feeds and Nutrition. At this seminar, presentations consisted of research work from industry experts on amino acid nutrition in leading fish species in Asia as well as the results from in house research in Vietnam and Thailand.

In his welcome address, Dr Robert Payne, director, nutrition and technical sales, said, "In recent years, we have been very busy with research in amino acid nutrition in the species relevant to industry in Asia. However, a key point for us is not only to provide information for the industry but to be ready for services required by industry."

Updates on amino acid nutrition

Dr Dominique Bureau, UG/OMNR Fish Nutrition Research Laboratory, University of Guelph, Canada looked at the state of the art information on amino acid nutrition and strategies for meeting essential amino acid requirements of fish. This was an extension of his presentation made at TARS 2011 where his main message was that more rational and systematic approaches to fish nutrition research are required (see Issue September/October 2011, p14). According to Bureau, essential amino acid (EAA) nutrition is a dynamic field of research but our knowledge remains quite fragmented and may be not as good as it should be.

An issue often debated among nutritionists is the mode of expression of EAA requirements. Bureau said that different nutritionists follow different schools of thought and express requirements either as % of diets, g/MJ digestible energy, % protein, or in absolute amount (e.g., mg per fish per day).

Few nutritionists appear to realise the practical consequences of these different modes of expression opinions. According to him, "Individual levels of EAA deemed adequate in the diet may vary depending on the mode of expression adopted, composition of diets and amino acid profile of the ingredients. The problem is that these modes of expression are based on opposing assumptions which make them largely incompatible and lead to different results".

Estimates of requirements

Bureau referred to the recent deliberations of the international committee for the preparation of the NRC reference book "Nutrient Requirements of Fish and Shrimp" published in May 2011. Since the last edition of the NRC book in 1993, there have been significant advances in the amino acid nutrition. In preparation for this new edition, the committee looked at 100s of studies. The consensus decisions of the committee resulted in significant increase in estimates of many EAA for different species, notably for salmonids and tilapia, in the new NRC (2011) compared to recommendations in NRC 1993. Reviewing the literature and coming up with reasonable estimates of requirements for the 10 EAA and 2 semi-essential amino acids was difficult due to the potential effects of a wide variety of factors as well as high variability in the results of published studies. The new NRC 2011 estimates of requirements represent a step in the right direction. However, aqua feed manufacturers should view these estimates with some degree of scepticism and work toward developing their own formulation guidelines.

Bureau followed up with a brief presentation of the work of Guillaume Salze, a post-doctoral fellow in his research group, who is compiling and systematically analysing the results from approximately 300 studies in order to determine the effect of different factors on estimates of EAA requirements: experimental conditions, diet composition, growth rate, feed efficiency, response parameters, mathematical and statistical models used for analysis and mode of expression of requirements.

What stood out from the work of Salze is how limited the knowledge base really is when one consider the large number of EAA (10+2), the large number of fish and crustacean species studied and the wide variation in experimental design and methodology. Nevertheless, one factor appears to have a major impact: the different mathematical models used to analyse existing data. In the case of lysine, differences in response fitting models, such as the broken line, exponential, quadratic or nutritional kinetic models, resulted in very different estimates. Analysis of information from recent studies with rainbow trout showed that lysine requirement is estimated at 1.8% of diets when using a broken line model and more than 2.3% of the diet when using a nutritional kinetics model.

Bureau reiterated that accurate information on requirement is critical for feed manufacturers and that there can be a great cost to formulating to levels that are lower than requirement. 'Squeezing out more growth out of the fish' can have a very beneficial economical impact for fish farmers.

Table 1. Essential amino acid requirements of different fish species (NRC 2011).

Amino Acids	Atlantic Salmon	Common Carp	Nile Tilapia	Channel catfish	Rainbow Trout	Asian Seabass	European Seabass	Japanese Flounder	Red Drum	Yellowtail
Arginine	1.8	1.7	1.2	1.2	1.5	1.8	1.8	2.0	1.8	1.6
Histidine	0.8	0.5	1.0	0.6	0.8	NT	NT	NT	NT	NT
Isoleu-cine	1.1	1.0	1.0	0.8	1.1	NT	NT	NT	NT	NT
Leucine	1.5	1.4	1.9	1.3	1.5	NT	NT	NT	NT	NT
Lysine	2.4	2.2	1.6	1.6	2.4	2.1	2.2	2.6	1.7	1.9
Methi-onine	0.7	0.7	0.7	0.6	0.7	0.8	NT	0.9	0.8	0.8
Met+Cys	1.1	1.0	1.0	1.0	1.1	1.2	1.1	NT	1.2	1.2
Phenyla-lanine	0.9	1.3	1.1	0.7	0.9	NT	NT	NT	NT	NT
Phe+Tyr	1.8	2.0	1.6	1.6	1.8	NT	NT	NT	NT	NT
Threonine	1.1	1.5	1.1	0.7	1.1	NT	1.2	NT	0.8	NT
Trypto-phan	0.3	0.3	0.3	0.2	0.3	NT	0.3	NT	NT	NT
Valine	1.2	1.4	1.5	0.8	1.2	NT	NT	NT	NT	NT
Taurine	NR	NR	NT	NR	NR	R	0.2	R	R	R

Factorial EAA requirement models

Nutrient requirements are not static and these are expected to change with species, size and growth rate of the animal and composition of the feed used. Factorial models are increasingly popular to develop dynamic estimates of EAA requirements as a function of these factors. These models predict the amount of the different EAA required on the basis of the amount of EAA retained in the body of the animals and the various losses associated with various metabolic and digestive processes. For the needs of the new NRC 2011, Dr Katheline Hua (Humboldt University, Berlin, Germany) and Bureau joined forces to develop a

novel factorial EAA requirement model for rainbow trout and Atlantic salmon at different life stages. Factorial models are very valuable tools but nutritionists also need to be aware of the limitations.

These models predict an absolute amount of nutrient required by the animal per day. However, this amount of nutrient must be delivered through a certain amount of feed. This amount of feed and/or the adequate dietary concentration of the nutrient are often calculated using simple bioenergetics model which may not have the complexity needed to adequately represent the fluctuating metabolic state and feed intake of the animals.

Supplemental amino acids

Bureau asked, "Why is it that in aquaculture, there are doubts on the supplemental role of amino acids when almost all of the estimates of essential amino acid requirement are derived from studies in which supplemental amino acids are used?

"It is increasingly clear that fish and shrimp can very efficiently use crystalline amino acids" argued Bureau, "but, it is true that some studies have shown that supplemental amino acids are slightly less well utilised than amino acid provided by very high quality intact protein sources. The availability of the supplemental amino acids is nevertheless very high.

"Factors, such as diet composition and feed processing may play a role in how efficiently fish and shrimp utilise supplemental amino acids."

Tilapia feeds

The results of the collaborative work between Evonik with scientists in Thailand were presented by **Suphada Kiriratnikom**, Taksin University. He looked at the effects of DL-methionine supplementation in low fish meal diets on growth performance of the hybrid red tilapia. Parameters studied included feed utilisation, condition factor, hepatosomatic index and histological changes. The randomised design used incremental levels of DL-methionine starting with 0.12 and up to 0.60% in low fish meal diets (3%) containing 32.6 to 33.5% crude protein (as-is basis), mainly from soybean meal. Results were compared to 42% high fish meal diets.

Robert Payne (left) with his team and presenters; from second left: Le Thanh Hung, Dominique Bureau, Orapint Jintasataporn, Suphada Kiriratnikom, Minh Hai Le, technical sales manager and Dhanapong Sangsue, technical sales manager - Asia South, Evonik Degussa.

The supplementation level of DL-methionine raised the total methionine from 0.48 to 1.08% of diet. The recommendation was 0.36 to 0.60% of supplementation with DL methionine for good growth performance of fish with an average initial weight of 1.7 g. Non linear regression analysis showed the dietary methionine and methionine+cysteine requirement for maximum body weight at 1.01%

and 1.50% of diet, respectively. The DL methionine supplementation level was 0.53%. For specific growth rate, the total dietary level at asymptotic response was 0.95% which is equivalent to 1.44% methionine+cysteine or 0.47% supplementation for DL methionine for specific growth rate.

Suphada also said that there was no adverse effect on the gastro intestinal tract of the fish fed these diets.

Methionine in the catfish

Cysteine and cystine requirement can be shared with methionine in semi purified diets, said **Dr Le Thanh Hung**, Nong Lam University, Vietnam in his presentation of the work carried out with Diep To Tam, Nguyen Thi Quyen, and Nguyen Nhu Tri using semi purified diets for the pangasius catfish *Pangasius hypophthalmus*. Consequently, they proceeded to develop practical diets and gathered information on the optimal methionine: cysteine ratio for the catfish in order to obtain the optimal methionine replacement in a total sulphur amino acid requirement (TSAA). Cysteine supply in diets cannot replace methionine but it can partly share methionine requirement in TSAA as has been shown in channel catfish (*Ictalurus punctatus*) (60%: Harding, 1977); blue tilapia (*Oreochromis aureus*) (44%: Liou, 1989) and nile tilapia (*O. niloticus*) (49%: Nguyen, 2007).

In total, 7 diets were tested over a 12-week study. In semi-purified diets, there was 32% crude protein and various levels of TSAA, from 0.31 to 1.36%, accomplished by the addition of incremental amounts (0.15%) of L-methionine. In the practical diets, cystine was kept constant at 0.03% of diet and methionine was increased at 0.06% increment in seven diets. Using the broken line model, Hung reported that methionine requirement was 0.81% diet (2.53% protein) in semi-purified diet and 0.64% diet (2.00% protein) in practical diets. TSAA requirement is 0.84% diet (2.63% protein) in semi-purified diet and 0.97% diet (3.03% protein) in practical diets.

This demonstrated that the tra catfish has higher methionine requirement when compared to channel catfish (2.3% protein) but lower methionine requirement when compared to *clarias* catfish (3.2% protein). The ratio for optimal growth was 46.2:53.8 (methionine:cysteine) using the exponential regression model. Growth was reduced at low methionine and high cysteine levels.

Amino acids in catfish farming

In her presentation on pangasius catfish nutrition, **Dr Orapint Jintasataporn**, Kasetsart University, Thailand also looked at proteins and amino acid composition in feeds in Vietnam. In recent times, fish meal is added at only 3-5%. Several fish meal replacement ingredients are used to replace up to 67%. These include meat and bone meal (added at 16.4% of feed) and several plant meals such as sesame meal.

Crude protein composition differs with the size of fish and can range from 27% when the fish is around 100g or 80 days old to 19.5% in large fish. In a feed survey, feeds with 26% crude protein contain 1.41% lysine and 32% crude protein feeds contain 1.74% lysine. The higher values are for intensive culture conditions.

"If the fish is cultured at high density, there will be a need to increase amino acids to a 10% safety margin as fish lose amino acids in stressful conditions. Furthermore, there may be the need to increase amino acids depending on the ingredients used. During digestion, plant meals tend to lose amino acids before absorption takes place."

Orapint looked at measures to enhance lean meat yield with lysine and methionine. The latter is linked to protein synthesis and is the first amino acid to be the codon for protein synthesis. This was determined in the channel catfish. Accordingly, it may be prudent to supplement diet with lysine and methionine and suggested feeding 24% crude protein diets with 1.59% lysine and 0.6% methionine or 22% crude protein diets with 1.63% lysine and 0.8% methionine. These give fillet yields of 45.55 to 43.96% respectively.

Growth, survival and immune characteristics of white shrimp fed a yeast fermentation metabolite

By Chalor Limsuwan, Chayaporn Tipsemongkol, Watchariya Purivirojkul and Niti Chuchird

Improvements in the growth, survival and non-specific immunity of shrimp were demonstrated with laboratory trials followed by a 90-day commercial culture in ponds in Chantaburi, Thailand.

Many scientists have attempted to solve disease problems by enhancing the non-specific immune response, the main internal defense mechanism in shrimp. The use of immunomodulators is one approach to increase shrimp immunity against diseases (Purivirojkul et al., 2006). Beta-glucans, from the cell wall of yeast was reported to be used as an immunomodulator in aquaculture. It was found to increase survival rate and enhance protection against pathogens in shrimp (Sung et al., 1996; Vargas-Albores et al., 1998; Vargas-Albores et al., 2000; Suphantharika et al., 2003). The use of a fermentation metabolite product from yeast (DV Aqua) in tilapia resulted in enhanced immunity (He et al., 2009). Another study showed that this fermentation metabolite product increased survival in rainbow trout (Barnes et al., 2006).

A similar but less concentrated yeast fermentation metabolite product, DVXP, increased growth and survival, and reduced pathogenic

Sampling for shrimp growth during the pond trials

Commercial ponds used for the trials

Vibrio mortalities in shrimp (Burgents, 2004). However, there has been no published report of on the use DV Aqua in shrimp culture. The objectives of the present study were to examine the optimum concentration of this product to increase growth, survival and immune response in laboratory conditions, and in intensive pond-reared white shrimp *Litopenaeus vannamei* culture.

Laboratory trials

A laboratory trial was conducted at the Faculty of Fisheries, Kasetsart University, Thailand to determine the effect of two levels of the fermentation metabolite on shrimp immunity, survival, Vibrio challenge survival, and growth (with six replicates/treatment). Each replicate consisted of 25 shrimp (8-10g) in 500L tanks. Shrimp were fed four times daily at 3% body weight per day for 50 days with pelleted feed containing graded levels of DV Aqua (0%, 0.125% and 0.25% of the feed).

During the experimental period, water quality parameters were maintained as follows: temperature at 28±1°C, pH at 7.8-8.0 and salinity at 25 ppt. Feeding rates were adjusted according to shrimp weight throughout the 50-day experiment period. Water quality parameters such as pH, dissolved oxygen (DO), ammonia, nitrite were measured weekly throughout the experimental period. The growth and survival rates of all treatment groups were recorded at 20, 35 and 50 days.

Growth and survival

After 50 days, the shrimp group fed with 0.25% of the yeast fermentation metabolite DV Aqua showed an average body weight (16.11±2.14g) which was significantly higher ($P<0.05$) than the control groups (14.98±2.20g) (Table 1). No statistically difference was found between the average body weight of shrimp in the control group and the group fed with 0.125% (15.56±2.64g). Survival rate of shrimp in the two treatment groups ranged from 88.67-95.33% and was significantly higher ($P<0.05$) than for the control group (75.33±5.89%) (Table 2).

Table 1. Average body weight of *L. vannamei* after 50 days of feeding with fermentation metabolites* at 0, 0.125% and 0.25%.

Feeding Period (Days)	Average body weight (g)± SD		
	Treatment diets		
	Control	0.125%	0.25%
0	8.97 ± 0.85^{a}	9.00 ± 0.83^{a}	8.93 ± 0.83^{a}
20	10.87 ± 1.36^{a}	11.47 ± 1.14^{a}	11.53 ± 1.01^{a}
35	12.14 ± 1.38^{b}	13.00 ± 1.34^{ab}	13.47 ± 1.28^{a}
50	14.98 ± 2.20^{b}	15.56 ± 2.64^{ab}	16.11 ± 2.14^{a}

Average values with different letters in the same row are statistically significantly different (P<0.05)
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Harvest day at the farm

Table 2. Percent survival of *L. vannamei* after 50 days of feeding with fermentation metabolites at 0, 0.125% and 0.25%.

Feeding period (day)	Percent survival (%) ± SD		
	Diets		
	Control	0.125% treatment	0.250% treatment
0	100.00 ± 0.00[a]	100.00 ± 0.00[a]	100.00 ± 0.00[a]
20	92.67 ± 3.00[b]	98.67 ± 2.07[a]	99.33 ± 1.63[a]
35	86.67 ± 6.02[b]	95.33 ± 3.01[a]	97.33 ± 2.07[a]
50	75.33 ± 5.89[b]	88.67 ± 7.76[a]	95.33 ± 4.68[a]

Values with different letters in the same row are statistically significantly different (P<0.05)

Immune characteristics

These were analysed every 10 days for 50 days. The study revealed that shrimp fed diets containing 0.25% of the fermentation metabolite product had significantly higher (P<0.05) total haemocyte counts (Table 3), percentage phagocytosis (Table 4) and superoxide dismutase activity (Table 5) compared to the 0.125% treatment and control groups. Shrimp fed with 0.125% and 0.25% of fermentation metabolites had bactericidal activity at the serum dilution of 1:16 while the control group was 1:8 (Table 7).

Table 3. Total haemocyte count (THC) ± SD of *L. vannamei* after 0, 10, 20, 30, 40 and 50 days of feeding with fermentation metabolites at 0, 0.125% and 0.25%.

THC (x 105 cells/ml)	Control	Treatment diets	
		0.125%	0.25%
0 day	15.87 ± 3.18[a]	16.11 ± 2.73[a]	16.23 ± 1.55[a]
10 days	15.75 ± 3.95[a]	19.75 ± 1.32[a]	23.13 ± 2.41[a]
20 days	21.73 ± 3.15[a]	26.13 ± 3.38[a]	38.21 ± 3.49[a]
30 days	27.25 ± 2.55[a]	38.50 ± 4.21[a]	49.00 ± 7.04[a]
40 days	27.54 ± 6.24[b]	33.63 ± 5.74[b]	48.42 ± 2.81[a]
50 days	35.79 ± 10.25[c]	54.71 ± 4.07[b]	57.92 ± 6.07[a]

Values with different letters in the same row are statistically significantly different (P<0.05)

Table 4. Percentage phagocytosis ± SD of *L. vannamei* after 0, 10, 20, 30, 40 and 50 days of feeding with fermentation metabolite at 0, 0.125% and 0.25%.

Percent phagocytosis	Control	Treatment diets	
		0.125%	0.25%
0 day	21.33 + 2.31[a]	20.67 ± 1.15[a]	20.33 ± 0.58[a]
10 days	21.33 + 7.02[a]	23.33 ± 6.43[a]	23.33 ± 6.43[a]
20 days	22.67 + 6.11[a]	24.67 ± 3.06[a]	25.33 ± 3.06[a]
30 days	23.33 + 1.15[b]	26.00 ± 7.21[ab]	28.67 ± 5.03[a]
40 days	23.67 + 3.21[c]	28.00 ± 2.65[b]	33.33 ± 2.08[a]
50 days	23.67 + 3.51[b]	29.33 ± 7.02[b]	36.33 ± 2.08[a]

Average values with different letters in the same row are statistically significantly different (P<0.05)

Table 5. Phenoloxidase activity ± SD of *L. vannamei* after 0, 10, 20, 30, 40 and 50 days of feeding fermentation metabolite at 0, 0.125% and 0.25%.

Phenoloxidase activity (unit/ min/mg. protein)	Control	Treatment diets	
		0.125%	0.25%
0 day	274.20 ± 36.12[a]	295.13 ± 16.61[a]	283.62 ± 15.80[a]
10 days	299.08 ± 34.50[a]	325.73 ± 48.87[a]	335.60 ± 40.47[a]
20 days	289.33 ± 27.75[b]	344.26 ± 27.75[ab]	386.92 ± 15.35[a]
30 days	285.85 ± 24.98[b]	333.47 ± 35.39[ab]	389.14 ± 24.48[a]
40 days	293.17 ± 29.92[b]	351.75 ± 32.07[ab]	381.75 ± 15.87[a]
50 days	304.50 ± 18.86[b]	358.06 ± 29.90[b]	384.20 ± 14.40[a]

Average values with different letters in the same row are statistically significantly different (P<0.05)

Table 6. Superoxide dismutase activity)± SD of shrimp after 0, 10, 20, 30, 40 and 50 days of feeding with fermentation metabolite at 0, 0.125% and 0.25%.

Superoxide dismutase (SOD units/ml)	Control	Treatment diets	
		0.125%	0.25%
0 day	27.30 ± 3.80[a]	30.65 ± 2.99[a]	28.24 ± 4.07[a]
10 days	25.90 ± 2.08[a]	32.60 ± 5.37[a]	30.58 ± 3.95[a]
20 days	28.59 ± 2.11[a]	32.02 ± 2.05[a]	33.65 ± 2.39[a]
30 days	27.62 ± 1.42[b]	33.88 ± 4.71[b]	35.80 ± 1.12[a]
40 days	28.12 ± 1.12[c]	32.49 ± 1.55[b]	38.29 ± 1.32[a]
50 days	31.28 ± 10.52[c]	37.93 ± 4.65[b]	42.27 ± 1.97[a]

Average values with different letters in the same row are statistically significantly different (P<0.05)

A researcher tests water quality at a trial pond

Table 7. Bactericidal activity of *L. vannamei* after 0, 10, 20, 30, 40 and 50 days of feeding with fermentation metabolite at 0, 0.125% and 0.25%.

Bactericidal activity	Control	Treatment diets	
		0.125%	0.25%
0 day	1 : 8	1 : 8	1 : 8
10 days	1 : 8	1 : 8	1 : 8
20 days	1 : 8	1 : 16	1 : 16
30 days	1 : 8	1 : 16	1 : 16
40 days	1 : 8	1 : 16	1 : 16
50 days	1 : 8	1 : 16	1 : 16

Challenge with pathogenic Vibrio harveyi

Shrimp from the feeding experiment (60 shrimp/treatment) were challenged with virulent strain of *Vibrio harveyi* which was cultured in Tryptic Soy Agar (TSA) with 1.5% NaCl (w/v). All shrimp were injected with *V. harveyi* suspension at 8.2×10^6 CFU/ml. Numbers of dead shrimp were recorded for 96 hrs following infection.

Shrimp fed the diet with 0.25% fermentation metabolite product showed higher post-challenge survival compared to control shrimp at all sampling intervals (Table 8). Shrimp fed the 0.125% treatment showed significantly higher survival in comparison to the control shrimp group at the last two post-challenge sampling intervals only.

Table 8. Percent survival of *L. vannamei* after the challenge with *Vibrio harveyi* 8.2×10^6 CFU/ml. 24, 48, 72 and 96 hrs.

Time after challenged	Control	Treatment diets	
		0.125%	0.25%
24 hrs.	76.67 ± 5.77^{b}	93.33 ± 5.77^{ab}	96.67 ± 5.77^{a}
48 hrs.	63.33 ± 5.77^{b}	76.67 ± 5.77^{ab}	83.33 ± 5.77^{a}
72 hrs.	56.67 ± 5.77^{b}	76.67 ± 5.77^{a}	83.33 ± 5.77^{a}
96 hrs.	56.67 ± 5.77^{b}	76.67 ± 5.77^{a}	83.33 ± 5.77^{a}

Average values with different letters in the same row are statistically significantly different (P<0.05)

Commercial farm trials

Effects of DV Aqua on growth, survival and immune response in pond-reared *L. vannamei* were carried out at a commercial shrimp farm in Chantaburi province, Thailand. Eight earthen ponds with an area of 1 ha each (6 rai/pond) were selected for this experiment. Post larvae 10 (PL10) were stocked into each grow-out pond at a density of 1,000,000 PL/pond

Measuring shrimp growth during the pond trial

(104 PL/m^2). Shrimp were fed with commercial pelleted feed during the first 30 days. Salinity during the experimental period ranged from 15 to 18 ppt. Biosecurity was monitored from the time of water preparation to the rest of the culture period.

After 30 days of culture, shrimp from the four treatment ponds were fed with commercially pelleted feed containing 0.25% of the fermentation metabolite product while another four ponds were fed with a regular commercial pelleted feed as the control group. Both groups were fed four times per day and feeding rate was adjusted according to shrimp weight throughout the culture period.

After 90 days of culture, shrimp for both treatment and control groups were sampled for immune parameters studies. Results showed that shrimp fed with 0.25% fermentation metabolite level had significantly higher total haemocyte count, percentage phagocytosis, phenoloxidase, bactericidal activity and superoxide dismutase (P<0.05) than those of control group (Table 8). After shrimp were harvested, the average production and survival rate of the 0.25% treatment group was 2,375 kg/rai (14,850 kg/ha) and 82%, while it was only 2,202 kg/rai (13,763 kg/ha) and 73% in the control group (Table 9).

Table 9. Production, growth and survival of pond-reared *L. vannamei* with fermentation metabolite levels of 0 and 0.25%.

pond	area (rai)*	density (PL/pond)	Culture period (day)	Total production (kg)	production (kg/ rai)	Mean body weight (g/ shrimp)	Growth rate (g/shrimp/day)	FCR	Survival rate (%)
(DV Aqua 0.25%)									
1	6	1,000,000	108	15,015.00	2502.50	17.54	0.27	1.57	85.59
2	6	1,000,000	110	11,443.00	1907.17	17.86	0.12	1.65	64.08
3	6	1,000,000	111	15,419.00	2569.83	17.54	0.18	1.67	87.89
4	6	1,000,000	109	15,126.00	2521.00	16.67	0.24	1.66	90.76
mean± SD	6	1,000,000	109.50	14,250.75 ± 1,879.58[a]	2375.13 ± 313.26[a]	17.40 ± 0.51[a]	0.2 ± 0.07[a]	1.64 ± 0.04[a]	82.08 + 12.18[a]
control (commercial feed)									
1	6	1,000,000	105	12,774.32	2129.05	18.18	0.30	1.64	70.26
2	6	1,000,000	100	12,240.00	2040.00	17.54	0.28	1.72	69.77
3	6	1,000,000	110	12,818.00	2136.33	18.18	0.25	1.86	70.50
4	6	1,000,000	112	15,035.87	2505.98	18.18	0.24	1.61	82.70
mean± SD	6	1,000,000	106.75	13,217.05 ± 1,240.70[a]	2202.84 ± 206.78[a]	18.02 ± 0.32[a]	0.27 ± 0.03[a]	1.75 ± 0.1[a]	73.31 + 6.27[a]

Average values with different letters in the same row are statistically significantly different (P<0.05)
**One rai equals 0.16ha*

Table 10. The immune characteristics of pond-reared *L. vannamei* after 60 days of feeding with fermentation metabolites at 0 and 0.25%.

Immune characteristics	Experimental diets	
	Control	0.25% fermentation metabolite
Total haemocyte count (x 10^7 cells/ml)	24.09 ± 2.73[b]	33.95 ± 3.23[a]
Percentage phagocytosis	41.34 ± 4.36[b]	61.63 ± 5.94[a]
Phenoloxidase activity (unit/min/mg. protein)	356.28 ± 21.91[b]	423.75 ± 32.67[a]
Bactericidal activity	1: 8	1:16
Superoxide dismutase (SOD units/ml)	40.30 ± 9.83[b]	49.62 ± 9.52[a]

Average values with different letter in the same row are statistically significantly different (P<0.05)

Conclusion

The present study indicated that oral administration of 0.25% DV Aqua for at least 30 days could increase the survival, immune response and growth of *L. vannamei*.

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References are available on request.

Chalor Limsuwan

Associate professor Dr Chalor Limsuwan, a leading industry player in Thailand, is directer of Aquaculture Business Research Center, Faculty of Fisheries, Kasetsart University, Thailand.

He is a keynote speaker for most seminars for shrimp farmers in Thailand since 1987 and is on the committee of the National Research Council of Thailand (NRCT) in Agricultural and Biological Sciences, National Center for Genetic Engineering and Biotechnology (BIOTEC), Shrimp Cluster of the National Science and Technology Development Agency and supervisor of Board of Trade of Thailand (Fisheries and Fishery Industry). Limsuwan has a PhD in fish pathology from Auburn University where he also did his post doctoral research. Email: fisscll@ku.ac.th/ ffisntc@ku.ac.th

Assistant professors Dr Niti Chuchird and **Chayaporn Tipsemongkol** are also in the Aquaculture Business Research Center, Faculty of Fisheries, Kasetsart University, Thailand.

Assistant professor Dr Watchariya Purivirojkul is with the Department of Zoology, Faculty of Science, Kasetsart University, Thailand.

Essential amino acids and their variation in tilapia feed ingredients

By Dhanapong Sangsue

The opportunity to reduce ingredient variation in a final feed lies with understanding these variations, in particular the essential amino acids. This is demonstrated with tilapia feed ingredients in Thailand.

Since protein or more precisely amino acids contribute significantly to the final quality of a feed, an understanding of the amino acids requirement of aquaculture species and the variation of amino acids in feed ingredients should not be underestimated.

According to the latest NRC (2011), the amino acid requirements of tilapia (*Oreochromis* spp.) are 1.60, 0.70, 1.00, 1.10, 0.30, and 1.20 % for lysine (Lys), methionine (Met), Methionine + Cystine (M+C), Threonine (Thr), Tryptophan (Trp), and Arginine (Arg), respectively. Thus, a feed would need to contain at least these levels on a dry-matter basis to avoid deficiency and a loss in performance. However, there can be significant variation in the final feed for a number of reasons, including: breed/variety/genetics, fertilizer, processing, handling, weighing, dosing, and mixing at the feed mill operation.

Since many of those factors cannot be avoided, feed producers and nutritionists should measure, understand, and evaluate those that can, especially, the variation in the feed ingredient itself. By doing so, there is opportunity to reduce the variation in a final feed, which can lead to more consistent and improved animal performance.

Since 2008, Evonik has analysed a total of 5,195 fishmeal samples, 11,008 soybean meal samples and 20 broken rice samples from India, Thailand, Vietnam, Malaysia, Indonesia, and the Philippines. However, in this article only an example of Thai tilapia feed will be elaborated. The basic tilapia feed formulation below together with the analyses of ingredients from the country will be used.

Tilapia feeds

The Department of Fisheries in Thailand has recommended that a basic feed formulation for large-sized (3-5 months) sex-reversed tilapia and red hybrid tilapia should contain 28% crude protein and comprise fishmeal (58–60% CP) 24%, soybean meal (48% CP) 30%, broken rice 34%, alpha starch 5%, vegetable oil 5%, vitamin & mineral premixes 0.5 – 1%, and vitamin C at 0.1% (once every other week). Based on this formula, fishmeal, soybean meal and broken rice contribute the protein and amino acids to the feed.

Raw material analysis in Hanau Lab, Evonik Germany.

So, if one wished to minimise the variation of the final feed, then accurate information about the protein and amino acid content of these ingredients would be critical. Tables 1 gives an overview of the average amino acid content of fishmeal, soybean meal, and broken rice samples from Thailand.

If we look closely into the amino acids profiles of those three ingredients, it becomes evident that the variation in these ingredients is quite high, which makes it difficult to simply use an average value for the individual amino acid concentration.

For example, in fishmeal, Lys, Met, and Met + Cys content ranged between 2.64 – 6.57%, 0.98 – 2.42%, and 1.38 – 3.18%, respectively, with coefficients of variation of 16.64, 15.32, and 14.76%, respectively. This variation will ultimately result in significant variation in the growth performance of fish. These results highlight that fishmeal is not simply fishmeal, for example, and that producers should develop quality control measures to routinely analyse their specific ingredients in order to optimise their use.

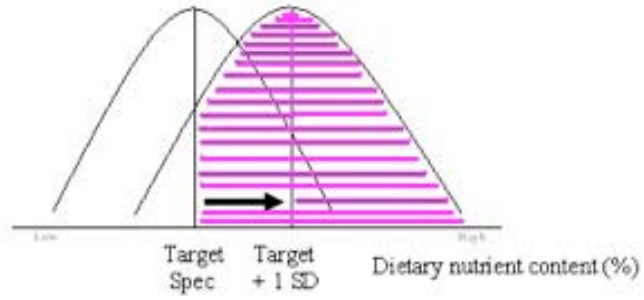
Table 1. Total amino acid concentrations of Thai fishmeal (n = 1186), soybean meal (n = 2512), and broken rice (n = 20) collected and analysed between August 2008 and August 2011 (data reported as % dry-matter basis).

	Fishmeal					SBM					Broken rice				
	Mean	Min	Max	Std.	CV	Mean	Min	Max	Std.	CV	Mean	Min	Max	Std.	CV
DM	93.9	87.8	98.9	1.61	1.71	88.7	87.2	93.3	0.6	0.68	87.5	86.4	88.9	0.66	0.76
CP	66.9	51.5	79.9	6.58	9.83	55.2	42.9	58.2	1.07	1.94	7.51	6.55	8.97	0.56	7.45
MET	1.71	0.98	2.42	0.26	15.3	0.74	0.56	0.77	0.02	2.1	0.19	0.17	0.23	0.02	8.26
CYS	0.58	0.37	0.75	0.08	14	0.81	0.64	0.86	0.01	1.8	0.16	0.14	0.19	0.01	8.04
M+C	2.29	1.38	3.18	0.34	14.8	1.56	1.21	1.64	0.02	1.58	0.35	0.31	0.42	0.03	7.52
LYS	4.67	2.64	6.57	0.78	16.6	3.43	2.74	3.67	0.06	1.7	0.26	0.24	0.3	0.02	6.89
THR	2.57	1.78	3.55	0.3	11.8	2.15	1.71	2.38	0.03	1.41	0.25	0.23	0.29	0.01	5.9
TRP	0.66	0.32	0.94	0.12	18.6	0.74	0.59	0.78	0.01	1.45	0.1	0.1	0.1	0	0
ARG	3.73	2.79	4.82	0.34	9.15	4.11	3.22	4.46	0.08	1.92	0.59	0.51	0.64	0.04	6.19

Safety margin

Without reliable information on their specific feed ingredients, nutritionists often use book values for the nutrient contents in their ingredient matrix. When doing so, nutritionists also employ safety margins as a protection against the actual variation in their ingredients compared with the average book values. In order to make sure that there is 83% chance that the target dietary nutrient content will not fall lower than the target specification, it is common practice to add 1 standard deviation to the mean value (Figure 1). In cases where the variation is lower, it is typical to add ½ standard deviation, which equates to a 69% chance that the target dietary nutrient content will not fall below the target specification.

Figure 1. Safety margin illustrated by adding 1 standard deviation to the mean value.



Considering that a safety margin is simply an insurance plan to protect against ingredient variation and that said safety margin adds cost which may not be needed, a better way to operate is to understand and control the variation via analyses, and then minimise the use of safety margins.

Table 2. The Met+Cys from Thai fishmeal, soybean meal and broken rice, and their contribution to the variation in a complete feed.

Ingredient %	Inclusion rate %	Met+Cys		Contribution to total Met+Cys (%)	
		%	Standard deviation (SD)	Absolute	Relative (X)
Fishmeal	24	2.29	0.34	0.55	48.25
SBM	30	1.56	0.02	0.47	41.23
Broken rice	34	0.35	0.03	0.12	10.52
Others	12	0	0		0.00
Total	100			1.14	100

What to do next with variation?

Pack et al. (2002) suggested that in order to reduce the variation of essential amino acids in feed (table 2), we should focus on reducing the amino acid variation in the high protein feed ingredients. In this context, if the standard deviation of Met+Cys in fishmeal was reduced from 0.34 to 0.17, then the standard deviation of Met+Cys in the feed would be reduced from 0.164 to 0.082 (see Figure 2).

Figure 2. Calculation of standard deviation of total dietary Met + Cys level based on data provided in Table 2.

$$SD_{Met+Cys} = \sqrt{(0.4825 \times 0.34)^2 + (0.4123 \times 0.02)^2 + (0.1052 \times 0.03)^2} = 0.164$$

There are a couple of ways to minimise variation: one is to use less of this fishmeal by replacing it with other lower variation protein sources i.e. soybean meal. The other way is to segregate fish meal in the warehouse according to its nutrient values. Either method helps nutritionists use variable ingredients properly.

Quantitative determination of amino acids and their variation in feed ingredients

Amino acid analysis of feed ingredients and compound feed can be done using regression equations, traditional wet chemistry, or via near-infrared spectroscopy (NIR). In comparison to the use of book values, regression equations should be viewed as the first line of defense with NIR and wet chemistry analyses being the next. Analysis via wet chemistry is the gold standard to which all else is measured, but it is also the most expensive and time-consuming. As such, with its speed and reliability, NIR is the perfect choice for classifying incoming raw materials. Prediction of amino acid content of feed ingredients with NIR allow feed manufacturers to precisely quantify the amino acid contents and the variation of those nutrients resulting in gradual elimination of a safety margin.

In summary, managing ingredient variation via routine analysis and evaluation can provide feed manufacturers several competitive advantages. These are lower feed costs as safety margins are reduced, animal performance is optimised, and increasing of feed efficiency while minimising nutrient waste into the environment.

Reference is available on request.

Dhanapong Sangsue is technical sales manager at Evonik Degussa (SEA) in Singapore.
Email: dhanapong.sangsue@evonik.com

Feed with tuna hydrolysate improves growth of black tiger shrimp

By Vincent Fournier and Victor Suresh

The effect of a tuna hydrolysate concentrate was evaluated in shrimp feeds containing high (27%) and low (16%) levels of Danish fishmeal. Results showed that the inclusion of the concentrate improved growth and feed conversion ratio in both conditions.

The reduction of fishmeal and fish oil levels in aquaculture is a top priority for aqua nutritionists in the last several years. Aquaculture production has been increasing amidst a stagnant supply of fishmeal and fish oil from the wild fisheries of pelagic and small fish such as anchovies, sardines, mackerel, menhaden, herring, and sand eel. Fishmeal and fish oil prices have also nearly tripled within the last decade. This dependence on wild fisheries affects the sustainability of aquaculture development.

Common substitutes of fishmeal and fish oil from wild capture fisheries are proteins and oils from terrestrial plant and animal sources. Complete replacement of fishmeal and fish oil has been successfully executed in omnivorous aquaculture species such as tilapia, catfish and carps. In carnivorous species, a complete replacement of fishmeal and fish oil is still a challenge. Black tiger shrimp, *Penaeus monodon*, is one such species for which reduction in fishmeal levels below 20% results in reduced growth in the species.

Co-products such as head, fins, skin, bones, liver and other gut components from the processing of edible fish constitute a valuable resource for the production of raw materials for aquaculture and animal feed industries. These co-products are traditionally used to produce ingredients such as fishmeal, fish oil and fish solubles. According to an estimate, nearly 25% of the global fish meal production comes from processed fish co-products rather than whole fish from capture fisheries. Another way to convert the co-products into a valuable ingredient is to produce fish hydrolysates. However, freshness of the raw material, selection of appropriate co-products, and process knowledge are critical factors in producing a valuable feed ingredient.

A hydrolysis factory

Fish hydrolysate is produced by the enzymatic digestion of fish processing co-products. The digestion breaks down complex proteins into free amino acids and short-chain peptides and makes the co-products tissues more digestible. Along with other molecules such as nucleotides present in fish muscle tissues, free amino acids and short-chain peptides provide attractant factors in the feed. Derived from fish, the ingredient is also likely to supply whatever unknown growth factors that are provided by whole fishmeal.

SPF Diana is an international French company involved in the production of functional hydrolysates. It has more than 25 years of experience in controlled enzymatic hydrolysis of animal proteins. The hydrolysates are produced using enzymatic hydrolysis of animal by-products or microbial fermentation. SPF Diana builds and operates its facilities in close proximity to those processing meat and fish products for human consumption. This allows the company to source fresh raw materials, and thereby produce high quality end products. In the last five years, SPF Diana, has invested in R&D related to enzymatic hydrolysis of marine origin raw materials, especially fish and shrimp co-products in order to develop a range of functional hydrolysates for its aquaculture division, Aquativ. Among the first products that are offered by Aquativ to aquafeed manufacturers is a tuna hydrolysate concentrate (Table 1).

Table 1. Nutrient profile of the tuna hydrolysate concentrate.

Nutrient	Tuna hydrolysate concentrate
Dry Matter	56%
Crude Protein	28.5%
Crude Fat	6.7%
Ash	6%
Arginine	1.49%
Lysine	1.85%
Methionine	0.60%
Met+Cys	0.80%
Threonine	1.21%

Feed trials

Aquativ's tuna hydrolysate concentrate was evaluated in feeds for black tiger shrimp by testing it in formulas containing high or low levels of fishmeal. Results showed that the tuna hydrolysate concentrate inclusion improved performance of both types of formulas. The test feeds were formulated to contain 42% crude protein, 6.5% crude fat and at least 3500 kcal/kg digestible energy.

The positive control diet (27% FM) contained about 27% of NSM-grade Danish fishmeal from Triple Nine fish protein, one of the top quality fishmeals available in the market. Other ingredients included squid liver meal, wheat flour, soybean meal, wheat gluten, fish oil, soybean lecithin, cholesterol, mono calcium phosphate, and vitamin and mineral premixes.

The formula in Table 2 represented a typical, commercial feed formula for black tiger shrimp. A negative control formula (16% FM) was created by limiting the inclusion of fishmeal to 16%. Crude protein, fat, fatty acids, phospholipids, cholesterol and phosphorus from fish meal were provided by the inclusion of soy protein concentrate and additional amounts of fish oil, soy lecithin, cholesterol, and mono calcium phosphate.

The tuna hydrolysate concentrate (THC) was added at 5% to the negative and positive control formulas to create the two test diets, 16% FM+5% THC; and 27% FM+5% THC, respectively. The formulas were adjusted for nutrients provided by THC. The wheat flour inclusion level was varied to balance each test formula. Table 3 shows the calculated nutrient levels of each experimental diet.

Table 2. Ingredient composition of experimental diets.

Ingredient (%)	Test feeds			
	27% FM	16% FM	16% FM + 5%THC	27% FM + 5%THC
Wheat flour	33.12	29.62	26.77	28.38
Soybean meal, 52%	30.00	30.00	30.00	30.00
Fishmeal, NSM	27.13	16.00	16.00	27.00
Soy protein concentrate	0.00	13.68	11.65	0.00
Tuna hydrolysate concentrated (THC)	0.00	0.00	5.00	5.00
Wheat gluten	3.00	3.00	3.00	3.00
Fish oil, 999	2.39	2.63	2.50	2.26
Squid liver meal	2.00	2.00	2.00	2.00
Lecithin, deoiled	1.66	1.82	1.82	1.66
Mono calcium phosphate	0.39	0.92	0.94	0.39
Rovimix 2050 (vitamin mineral premix)	0.20	0.20	0.20	0.20
Cholesterol	0.12	0.13	0.13	0.12

Table 3. Nutrient profile of test feeds (nutrients, % unless noted otherwise).

Nutrient (%, unless specified otherwise)	Test Feeds			
	27% FM	16% FM	27% FM + 5%THC	27% FM + 5%THC
Crude Protein	42.00	42.00	42.00	42.97
Crude Fat	6.50	6.50	6.50	6.50
Crude Fiber	1.02	1.59	1.53	1.04
Ash	6.40	6.29	6.87	7.07
Arginine	2.38	2.33	2.35	2.45
Lysine	2.48	2.26	2.29	2.56
Methionine	0.93	0.77	0.78	0.94
Met+Cys	1.47	1.32	1.32	1.48
Threonine	1.54	1.43	1.44	1.58
Total n3 Essential Fatty Acids	0.83	0.81	0.81	0.82
Phospholipids	2.00	2.00	2.00	2.00
Cholesterol	0.15	0.15	0.15	0.15
Calcium	1.99	1.38	1.38	1.98
Available Phosphorus	0.45	0.45	0.45	0.45
Vitamin C, ppm	200.00	200.00	200.00	200.00
Digestible Energy, kcal/kg	3773	3812	3702	3673

The feeds were prepared in a lab-scale set up. All ingredients except the vitamin premix, soy lecithin and fish oil were mixed in a vertical mixer for a few minutes. The mixture was then ground through a rotor beater mill (SR 300, Retsch, Germany) which uses a 0.25 mm screen to pass through the ground materials. The ground meal was returned to the vertical mixer and mixed with about 40% water. The wet mash was then autoclaved at 120°C for 5 minutes. The autoclaved mash was cooled and mixed with the vitamin premix, soy lecithin, fish oil and 10-15% water in the vertical mixer.

The resulting dough was extruded through a 2 mm die in a meat grinder to produce noodle-like long strands of feed. The strands were dried in a forced-air draft oven set at 50°C for 3-4 hours. The dried strands were broken into 4-5 mm long feed particles in a food processor and stored in tightly-sealed plastic containers at 20°C until use.

Feeding trial

This was conducted at the Shrimp Nutrition Research Center of the Department of Fisheries, Brunei. Self cleaning microcosm tanks of about 1,800 litres were used. The microcosm tanks are independent, self-circulating units in which all the water movement was driven by airlift and gravity. For each diet, four randomly selected tanks were allocated. Each microcosm tank was randomly stocked with 36 shrimp (20 shrimp/m^2) of 5g individual weight and reared for 56 days. Ten shrimp were sampled once every seven days for weight. The feeding rate was based on a standard, shrimp size-based feeding chart as shown in Table 4. The daily ration was divided into two portions: 40% for feeding in the morning (08:00 H); and the remainder (60%) for feeding in the evening (16:30 H). The feed was placed on a belt-feeder and delivered in a continuous manner. Water quality conditions were maintained within the following ranges: temperature, 28 - 33°C; salinity, 24 - 30‰; pH, 7- 8.2; dissolved oxygen, > 4mg/l.

Table 4. Feeding table used in the trial.

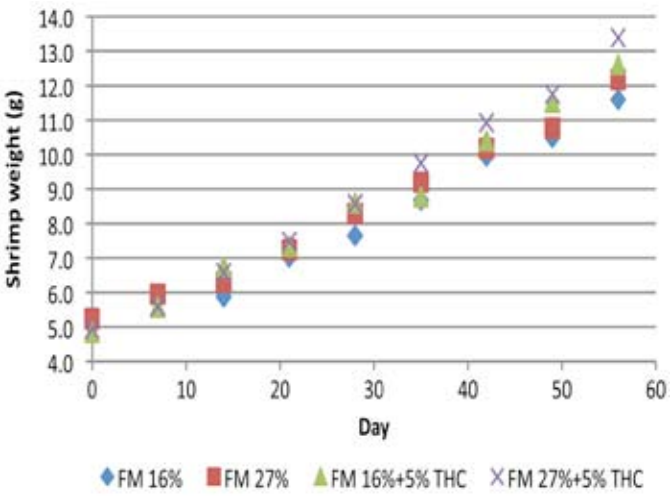
Body weight	Feed (% body weight/day)
1-3 g	6
3-5 g	5.5
5-7 g	5
7-9 g	4.5
9-11 g	4.3
11-13 g	4
13-15 g	3.6
15-17 g	3.4

Shrimp performance

The body weight of shrimp in all dietary treatments doubled from 5g to more than 10g after 56 days of feeding (Figure 1). Shrimp fed the negative control diet (FM 16%) reached an average body weight of 11.6g while shrimp fed the positive control diet (FM 27%), reached an average body weight of 12.2g. The shrimp group fed the tuna hydrolysate concentrate showed a higher body weight in comparison to those fed the control feeds. Shrimp fed 16%FM + 5%THC reached 12.6g, while shrimp fed 27%FM + 5%THC reached 13.4g. The increased weight gain due to the addition of the tuna hydrolysate concentrate was 18.2 and 21.7%, respectively.

Survival of shrimp in all dietary treatments exceeded 90% (Table 5). On a weekly basis, the weight gain was 0.9, 0.8, 1.0, and 1.1 g/shrimp/week, respectively (Figure 2). Other performance parameters followed the trend of weight gain (Table 5).

Figure 1. Growth of shrimp fed experimental diets for 56 days.



Tuna hydrolysate concentrate

The series of microcosm tanks used for feed trials

One-way analysis of variance showed no significant differences among treatments in terms of weight gain or any other performance parameter. However, some apparent differences among treatments cannot be overlooked. From the third week onwards, shrimp fed diets containing the tuna hydrolysate concentrate consistently sustained superior growth when compared to those fed control diets (Figure 1). It was speculated that the high variability among replicate tanks in the trial led to the lack statistical significance. Similar or higher variability is common in practical shrimp farming, and one needs to see beyond standard statistical tools to arrive at a reasonable conclusion on whether or not a product provides performance improvement.

In the present trial, nearly 40% of fish meal used in the positive control feed formula was replaced by soy protein concentrate. Except for essential amino acids, especially methionine, all other major nutrients contributed by fish meal were provided for by higher levels of other ingredients. As a result, the difference in performance between the positive and negative control diets was minimal. Yet, when the tuna hydrolysate concentrate was added, performance improved noticeably. Surprisingly, shrimp performance improved not only in the low fishmeal feed, but also in the high fishmeal feed.

Figure 2. Average weekly weight gain of shrimp fed experimental feeds.

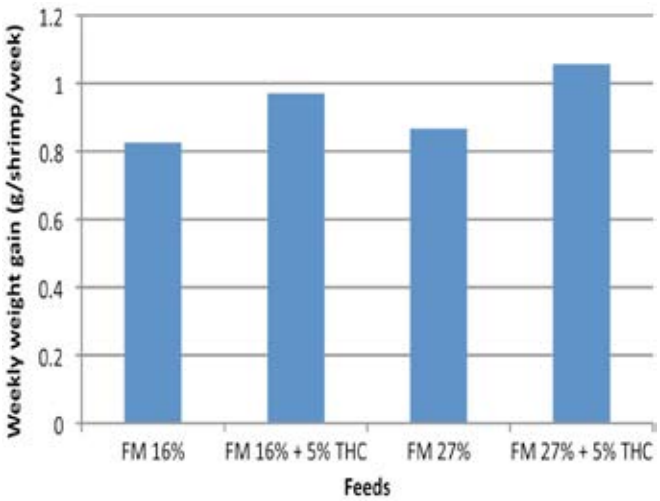


TABLE 5. Performance of shrimp fed experimental feeds for 56 days.

	27% FM		16% FM		16% FM + 5%THC		27% FM + 5%THC	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Initial body weight (g/shrimp)	5.3	0.2	5.0	0.2	4.8	0.2	4.9	0.2
Initial biomass (g/tank)	189.0	8.0	180.0	5.9	174.5	7.3	178.0	5.9
Final body weight (g/shrimp)	12.2	1.8	11.6	1.9	12.6	1.2	13.4	2.1
Final biomass (g/tank)	415.3	76.0	402.8	66.2	429.5	54.4	443.3	86.9
Survival (%)	94.4	4.5	96.5	2.7	94.4	5.1	91.7	8.2
Weight gain (g/shrimp/8 weeks)	6.9	1.6	6.6	1.8	7.8	1.3	8.4	2.1
Weekly weight gain (g/shrimp/week)	0.9	0.2	0.8	0.2	1.0	0.2	1.1	0.3
Biomass gain (g/tank/8 weeks)	226.3	68.7	222.8	61.8	255.0	61.4	265.3	83.3
Feed conversion ratio	3.3	0.6	3.2	0.6	2.9	0.6	2.9	0.9

Conclusions

The following conclusions were made:

- It is possible to replace about 40% of fishmeal in black tiger shrimp feed formulas containing 27% fishmeal provided that a highly digestible, high protein source such as soy protein concentrate is used and the formula is balanced to provide most of the missing nutrients arising from the reduction of fishmeal .
- The tuna hydrolysate concentrate at 5% inclusion had successfully replaced 11% of top-premium fishmeal and even outperformed the positive control (27% FM) by 10%. Performance of the high fishmeal feeds also improved with the inclusion of the hydrolysate, thus demonstrating the beneficial effect of aquafeeds peptide enrichment at all dietary fish meal levels.

Dr. Vincent Fournier

Dr. Vincent Fournier is R&D manager of Aquativ since 2003 and is responsible for the development of functional hydrolysates for the aquaculture market. With a strong expertise in protein hydrolysis processes, he heads studies on product performance evaluation in fish and shrimp and product characterization in collaboration with several universities. He is a fish nutrition researcher with 15 years of experience. Email: vfournier@diana-aqua.com

Dr Victor Suresh

Dr Victor Suresh is director of nutrition & feeds at Integrated Aquaculture International (IAI), based in Brunei and is involved in nutritional services for aqua feed manufacturers and ingredient suppliers, and R&D. From 2001 to 2007, Suresh was an independent consultant for the aqua feed industry and his work included the shrimp feed business in India; technical services for the start-up of a feed additive business in Asia and research leading to product and applications development in aquaculture. Email: victors@integratedaquaculture.com

Current status of freshwater fish feeds in Asia: A gap analysis

By Pedro Encarnação

A detailed look at freshwater fish feeds in Asia shows a gap in composition of nutrients and recently published information on requirements. There are many ways to produce a kilogram of fish but farmers must see the benefits of using feeds targeting performance and not only costs.

Fresh water aquaculture production contributes about 60% of the world aquaculture production, with about 28.8 million tonnes (FAO, 2008). Freshwater fish production is dominated by the production of carps (*Cyprinidae*) at 71.1 %. Other important fresh water fish species are the tilapia. The recent dramatic growth in the production of Pangasius catfish in Viet Nam has made it a very important species. China is by far the biggest fresh water fish producer (mainly carps) with a production close to 20 million tonnes a year. India is the second biggest fish producer with 3.5 million tonnes of fish produced every year with major focus on the rohu *Labeo rohita*. The fast development of the pangasius industry in Vietnam made this country the third largest producer of fresh water fish in the world with a production close to 2 million tonnes.

This growth in fresh water fish production was triggered by the intensification of the farming process, successful farming of new species, but most of all, by the improvements in feed technology and the rapid increase on the use of extruded feeds. These improved floating feeds, with better water stability, nutrient availability and control of feed intake, allowed farmers to move to higher production densities and resulted in improved fish performance and better revenues, prompting rapid growth in the sector.

Pedro Encarnação with Jarin Sawanboonchun (left), Technology Deployment Manager (Aquaculture, Asia) and Chantana Thuwadaratrakool, Assistant Technology Deployment for Thailand, Cargill Siam Ltd at TARS 2011

Balancing nutrients

However, frequently the development of these commercial feeds has been done without major knowledge on nutritional requirements and nutrient utilisation of the different target fish species. In many cases, the feed formulations do not reflect the nutrient requirement of the fish, but are mainly based on assumptions from other species, or follow ingredient availability and cost constrains. In addition, this fast growth in feed production has led to more pressure on raw material availability, which made access to quality feed ingredients a major constraint for the development of the industry. Feed formulations, feed quality and feeding practices used for the production of fresh water species around Asia, many times reflect the use low cost ingredients (rice bran, rice polish, cassava flour, etc) with poor nutrient profiles which result in sub-optimal performance by the fish.

It is important for the industry to realise that growth performance and biomass gain by a fish depends firstly on the composition of the feed used. Feed must provide all required nutrients in a balanced way to maximise biomass gain. The role of feed manufacturers is to select a combination of ingredients to produce a formula that will contain sufficient levels of essential nutrients needed for the targeted animal species. This selection is done on the basis of chemical composition, nutritional value and cost of the different feed ingredients. At the end, a compromise between the cost of the feed and its nutritional value for the animal must be achieved.

Understanding the limitations

Variable quality, inconsistent nutritional content and possible contamination or adulteration of the raw material is a huge challenge for the development of consistent nutritional feeds. Strong efforts must go in understanding characteristics and limitations of feed ingredients. Digestibility of protein and amino acids is variable and can dictate the level that each ingredient can be used. Maximum levels of inclusion of certain ingredients in the formulation should be defined to prevent harmful levels of antinutritional factors that can affect fish performance.

With the increase reliance on less costly protein sources and low nutrient dense diets, we are most likely increasing the levels of raw materials with lower protein digestibility and higher amino acid imbalance, higher carbohydrate and fiber content. This will lead to an inefficient utilisation of the nutrients in the feed resulting in an increase in feed usage and poor animal performance and increase in costs to produce 1 kg of lean fish. This way we will not only be feeding the fish but also feeding the pond, which can be beneficial in terms of increasing natural food production in the pond, but still resulting in a less efficient process.

Gap in requirements

A closer look at nutritional composition of fresh water feeds across Asia and the reported nutrient requirements published in the latest NRC book on requirements of fish and shrimp (NRC 2011), often shows a gap between available information on fish requirements and the levels present in the feeds (Table 1 and 2).

It is true that there is still a need to better establish the nutrient requirements for some of the more relevant species farmed in the Asia region, and to fully characterize and evaluate available feed ingredients for application in aqua feeds.

Table 1. Recommended crude protein (CP) levels in commercial feeds according to fish size (NRC, 2011).

Species	<20 g	20-200 g	200-600 g	600-1500 g
Channel catfish	44	36	32	32
Common carp	45	38	32	28
Nile tilapia	40	34	30	28

Table 2. Current observed crude protein (CP) levels in commercial feeds according to fish size.

Species	<20 g	20-200 g	200-600 g	600-1500 g
Pangasius	38-32	32-28	28-26	26-20
Nile tilapia	36-32	30-26	26-22	22-18

Effective feeds

A better understanding of nutrient and energy utilisation may allow fish nutritionists, feed manufacturers to produce more cost effective feeds. Priority should be given to the establishment of fundamental nutritional information such as energy, protein and essential amino acids requirements, and protein: energy ratio for major farmed species. In addition, studies on nutritional profile and digestibility values for most feed ingredients will make it possible to do more accurate feed formulations. Focus should be given to the complete characterisation of available local feed ingredients for optimising their utilisation and make full use of local resources.

When presented with accurate nutrient and energy utilisation data, the aquaculture industry in Asia may reconsider, for example, the use of low nutrient and energy density feeds (low cost feeds but not necessarily cost-effective feed) for the rearing of warm water omnivorous fish (catfish, tilapia, carp). Ultimately, the development of nutritional models will allow the adjustment of feed formulas to different production conditions and different production stages in fresh water species.

Based on current knowledge on nutrient requirement and nutrient utilisation, it appears that the use of deficient diets with low nutrient and energy density feeds are the main reason for the very poor feed conversion ratio (feed/gain, between 1.5 and 3) seen in most aquaculture operations. Production cost with such feeds may not be advantageous as often touted when one accounts for manufacturing (e.g. extrusion), transport costs and a poor FCR often observed.

The potential negative impact on the productive capacity of the rearing environment which should be considered is the high organic waste output associated with feeding low digestible nutrient density feed. Improving cost-effectiveness is more than just a least-cost formulation. A complicated cost-benefit analysis based on ingredient characteristics (composition, limitation, and cost), manufacturing cost, fish performance (growth rate, FCR) and production constraints is necessary.

Feeding practices

Farmer education regarding feed and feeding practices is also a major point for the success of establish improved feed formulas in the industry. Farmers need to understand that there are many ways to produce 1 kg of fish, and that the amount of feed required by a fish to achieve 1 kg weight depends primarily on the composition of the feed used. In general, a greater amount of a lower nutrient density feed (Table 3) will be required when compared to a higher nutrient density feed (Table 4) to achieve the same performance level, assuming that the two feeds are similarly balanced.

Cost of fish produced

The cost of the feed ($/kg feed) will definitely be lower with lower digestible nutrients compare to a higher nutrient density feed because grains and other carbohydrate-rich feedstuffs are often cheaper than higher protein and fat feedstuffs. However, total feed cost ($/kg fish produced) may be greater with the cheaper feed since a greater amount of that feed will be needed to achieve the same level of performance. Thus, it is important that farmers understand the benefits of using feed targeting performance and not costs.

The use of suitable diets in aquaculture operations can significantly increase profitability by reducing feed costs, improving animal performance, maintaining water quality, and minimizing nutrient loads to the environment. The manufacture and use of feeds based on high quality and digestible feedstuffs, is highly recommended for the aquaculture industry as long as the use of such feeds is profitable and compatible with the environment.

Table 3. Economic formula.

Ingredient	Formula
Fish meal	11.00%
Meat & Bone meal	10.00%
Soybean meal	30.00%
Dried rice bran	12.25%
Wet rice bran	18.50%
Cassava	18.00%
Fish oil	0.00%
Premix	0.25%
	100.00%
DP	23.40%
DE	10 MJ/kg
Feed cost ($/tonne feed)	**$ 417.4**
Feeding cost ($/tonne fish)	**$ 684.5**

Table 4. Performance formula.

Ingredient	Formula
Fish meal	17.00%
Meat & Bone meal	11.00%
Soya bean meal	32.00%
Dried rice bran	10.00%
Wet rice bran	7.75%
Cassava	18.00%
Fish oil	4.00%
Premix	0.25%
	100.00%
DP	27%
DE	14 MJ/kg
Feed cost ($/tonne feed)	**$486.8**
Feeding costs($/tonne fish)	**$569.6**

The article in based on a presentation at the Roundtable on Aquaculture Series (TARS2011), Aquaculture Feeds and Nutrition held from 17-18 August 2011, Singapore.

Pedro Encarnação, PhD is aquaculture technical director at Biomin Singapore and director of the Applied Centre of Aquaculture Nutrition (ACAN), Biomin's aquaculture research centre in Bangkok. In Asia, since 2006, Pedro has an extensive background in aquaculture and nutrition in Asia. He has conducted several research projects focusing on the improvement of feed formulations for aquaculture species and improving animal performance. He has a MSc in Aquaculture from the University of Algarve (Portugal), and PhD in Animal Nutrition from the University of Guelph, Canada. Email: pedro.encarnacao@biomin.net

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Cobia aquaculture in offshore cage systems in China

By Xinxuan Li and Zufu Li

Currently, more than 20,000 marine cages in China are devoted to cobia culture, yielding more than 7,000 tonnes per year.

Cobia culture in offshore submerged cage systems in Zhanjiang

Cobia, *Rachycentron canadum*, is a carnivorous marine fish suitable for warm, open-water aquaculture mainly distributed in the South Sea, East Sea, Yellow Sea and the Bohai Sea in China. Known for its firm texture and excellent flavour, the cobia flesh is ideal served as sashimi and fillet.

Cobia can be easily domesticated to adapt to commercially available formulated feeds, reaching 6-8kg in size in a year. With their rapid growth rate, nutrition value and high flesh quality, cobia now commands a high price and is a popular aquaculture product, both for the domestic market and for export.

In the late 1980s, researchers in Taiwan recognised the rapid growth and potential market of the fish, leading to the fast development of cobia cage aquaculture in Taiwan. Mainland China producers have been obtaining cobia fry from Taiwan since the mid-90s. Now cobia has become one of the most important marine fish to be cultured in offshore cages off the coast of south China. Cobia is considered one of the most important marine fish for future aquaculture production.

The Ocean Cage made by Sun Yat-sen University and Santeh Feeds Corp. in Subic Bay, Philippines

In recent years, the scale of production has been expanding rapidly in South China, including in Guangdong, Hainan, Zhejiang and Fujian provinces. Significant progress has been achieved in research on the cobia, including studies on its basic biology, artificial breeding technology, nutrition demand, disease and genetics. This paper is a brief review of the current status and developments focusing on aquaculture of cobia in offshore submerged cage systems.

Breeding technology

In recent years, cobia breeding and mass production have been achieved in Taiwan, which helped to address the problem of fry supply for the cobia. Following the success of cobia aquaculture in Taiwan, emerging technology is being used to demonstrate the viability of raising cobia in collaboration with academic institutions in mainland China. Guangdong Ocean University has been working on cobia artificial breeding studies since 2000 and successfully produced 70,000 cobia with 7-8 cm in length. In 2002 they produced 360,000 cobia of around 7 cm in length.

Aquaculture technology

With greater depths, stronger currents and distance from shore to reduce environmental impacts, offshore cage systems contribute to the rapid development of cobia aquaculture technology. Patented low-cost, current-resistant submerged cage systems have been successfully developed in China. More than 6,000 have been in use in Guangdong, Hainan, Zhejiang and Fujian provinces.

Aquaculture farm bases

In Zhanjiang, Guangdong, a collaboration between government and the industry to develop an offshore cage system industrial park is being established. Covering an area of 56 ha, it has the capacity for 200 submerged cages with an average production rate of 23.6 tonnes/

Bioeconomic analysis of cobia cage culture in Taiwan

Based on related studies on the production economy of cobia cage culture, Huang Cheng-Ting and Miao Sha, Department of Aquaculture, National Taiwan Ocean University, Keelung, Taiwan investigated the operational outcomes of the industry and reviewed various factors that influence the profits of the industry in order to compare the advantages and disadvantages.

Data covered the period from 2002 to 2007 and came from fishery economic surveys. It looked at whether different years and culture areas affected production input and output during the culture of cobia in cages.

Results showed that different regions and years have had significant effects on both the input and output of cobia aquaculture as unit production input costs of cobia tended to increase on an annual basis. In Taiwan, production costs in Penhu were higher than those in Pingdong. In terms of cost structure, the main production costs were dominated by feed costs in Penhu, and by feed, labour and maintenance costs in Pingdong.

In terms of profit, the overall cobia aquaculture achieved excellent productivity in 2003, with a benefit-cost ratio of 0.41 in Penhu and of 1.77 in Pingdong, which was one of the reasons for the yearly increase in production scale. As a whole, greater profits were obtained in Pingdong than in Penhu, and this is related to the scale of operations. The benefit cost ratio was highest in 2007 at 1.97, while productivity reached 1.9 indicating that excellent management performance was achieved (both fish breeding and survival rate effect management performance).

Huang Cheng-Ting and Miao Sha, Department of Aquaculture, National Taiwan Ocean University, Keelung, Taiwan, abstract presented at the 9th Asian Fisheries and Aquaculture Forum, April 21-25, Shanghai, China.

Cobia fry

Cobia

cage/year. It is estimated to produce more than 2,000 tonnes of cobia when the construction project is finished next year.

In Shantou, Guangdong, the farm base is located on Nanao Island. There are 60 submerged cages producing 300 tonnes of cobia per year.

Feeds

Sun Yat-sen University and other institutions have been conducting research on the apparent digestion rate for cobia in response to different protein sources, as well as studies on replacing fishmeal with plant protein sources, including peanut meal, extruded soybean meal and rapeseed meal. According to results, 45% protein and 25% starch are the optimal requirements in formulations for cobia aquaculture.

Studies on diseases

The research team conducted pilot scale research on vaccine candidates from genetic engineering of Iridovirus, including studies on candidate gene coding protein expression. Vaccinated cobia have 97% survival rate after three months.

Processing and marketing

Guangdong Hengxing Group is a large scale enterprise with expertise on feed production and aquaculture product processing. With 160,000 m^2 of facilities, they have an annual production of more than 100,000 tonnes and a cold storage capacity of approximately 30,000 tonnes. The company generates over CNY 2 billion in annual revenue and cobia is one of their main products.

Cobia products sold in supermarkets

Xinxuan Li

Xinxuan Li is a research assistant at Sun Yat-sen University, Guangzhou, China. His main interest is marine science & marine biology. Email: 120379200@qq.com

Zufu Li is also a researcher at Sun Yat-sen University and is working on fishery sciences.

Selected families of white shrimp *Litopenaeus vannamei* from a Panama breeding program show important resistance to WSSV

By Jorge Cuéllar-Anjel, Brenda White-Noble, Paul Schofield, Roberto Chamorro and Donald V. Lightner

The future with WSSV resistance in vannamei shrimp is demonstrated in challenge tests with no histological signs of WSSV infection nor any detectable level of WSSV by qPCR in surviving shrimp.

Three F8, F9 and F12 generation families of white shrimp *L. vannamei* were challenged per os with white spot syndrome virus (WSSV) at the University of Arizona's Aquaculture Pathology Laboratory (UAZ). These families were developed by the Panama shrimp company Camaronera de Coclé, S.A. (CAMACO) from founder stocks which were survivors of the white spot disease a decade ago.

Shrimp families

All three groups were obtained by selective breeding of offspring, that were survivors of experimental infections with WSSV since 2001, generation after generation. The family identified as 'LP-1' was F9 generation and was produced by artificial insemination from one female and one male. The second family identified as 'LP-2' was obtained by crossing females from a mass selected F11 population with F8 generation males from the 'LP-1' family using natural copulation. The third family of this study was identified as 'LP-3,' and it is in the F12 generation. It was obtained by crossing shrimp previously produced by mass selection and natural copulation from a mixture of all individually selected and WSSV challenged families.

Challenge tests

The *L. vannamei* stock (average weight 1.5g) utilised in these studies were shipped to the UAZ from Camaco in Panama. On arrival, shrimp were acclimated and stocked at 50 to 96 animals per tank into nine 1000L fiberglass tanks containing artificial seawater at 30 ppt salinity and 26°C. Shrimp were allowed to recover from shipping stress for 3 days prior to being used in the WSSV challenge studies. The experimental challenge consisted of three 1000L negative environmental control tanks, each containing representatives from one of the families, which were challenged separately with WSSV.

A total of six 1000L tanks were utilised for challenging the three families with WSSV and included two replicates for each family. A positive control consisting of 20 'Kona' SPF reference line *L. vannamei* (average weight 1.5g) was included and challenged with WSSV in a 90L glass aquarium. The Kona stock was fed the same batch of WSSV tissue as the three Panama families to ensure that the tissue used was infectious and to provide a basis with which to measure and compare survival. All tanks were equipped with air diffusers to provide sufficient aeration and an acclimated oyster shell internal recirculating biological filter. Each tank was covered with a plastic sheet to contain aerosols and minimise water temperature fluctuations.

WSSV isolate

A China WSSV isolate (WSSV-CN95) was chosen for this challenge study because it is the reference isolate of WSSV most often used by UAZ laboratory and because of the consistency in virulence that the isolate has shown since it was obtained by UAZ in 1995. On day 0 of the study, the six challenge tanks and the positive control tank, were given one feeding of WSSV infected minced frozen animals at a rate of 5% of their average body weight. Beginning on day 1 (post-feeding) of the challenge study, the challenge animals and the Kona stock were fed a commercially available pelleted shrimp diet.

Dead and moribund animals were recorded and removed from the tanks daily. Dead shrimp were frozen at -70°C. Moribund animals when observed and some of the survivors at termination on day 17, were preserved in Davidson's AFA fixative and processed using routine H&E histology to confirm WSSV infection as the cause of morbidity during the study, and to determine their WSSV status at day 17. Additionally, five WSSV survivors from each tank were frozen and individually tested using real-time PCR test (qPCR) to determine their WSSV status and viral load. The WSSV challenge study was run until mortalities ceased at day 17 post-challenge.

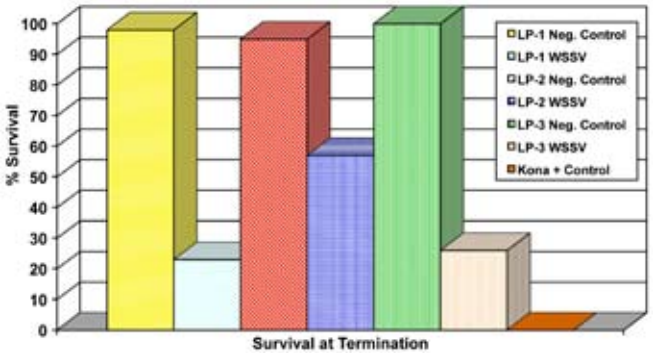
Tanks in the infection room

Extraction of dead shrimp after infection

Table 1. The experimental design in the WSSV challenge study.

Tank Number	Family Code	Treatment and controls	Survival shrimp (%)
1A	LP-1	Negative control	49 of 50 (98%)
1B	LP-2	Negative control	91 of 96 (95%)
1C	LP-3	Negative control	68 of 68 (100%)
90L	Kona	WSSV Positive Control	0 of 20 (0%)
B1 & B2	LP-1	WSSV Challenge	24 of 104 (23%)
B3 & B4	LP-2	WSSV Challenge	74 of 129 (57%)
B7 & B8	LP-3	WSSV Challenge	37 of 130 (28%)

Figure 1. Survival by family in a WSSV challenge study of CAMACO stocks.



Survival rates

Survival of three families at termination in the Camaco negative controls was 95%, 98% and 100%, respectively. Survival in the Kona line WSSV positive control was 0% as all the Kona line shrimp had died by day 6 post-infection. At termination, survival in the Camaco WSSV challenged groups was 23%, 57% and 28% for families LP-1, LP-2 and LP-3, respectively (Figure 1; Table 1).

WSSV challenges performed at UAZ using *L. vannamei* during the period of 1996 to 2010 resulted in an overall survival rate of ~5% with a low of 0% and a high of 25%. A total of 176 families were challenged during this period with most WSSV challenges resulting in no survival. Occasionally, 1-5 survivors were noted within a single family. The total number of surviving animals in the highest survival noted (25%) was a total of 5 animals from a single family.

The results of the 2011 challenge are unusual in the fact that survival rates were 23%, 28% and 57% and the number of total survivors was 24, 37 and 74 animals, respectively. These survivors were in the same tank with shrimp with severe WSSV infections and chronic mortalities that did not cease until ~2 days prior to termination of the study on day 17 post-challenge.

Histological evidence

Histological examination of the day 0 specimens collected prior to the start of this study showed no sign of infection by WSSV, Taura syndrome virus (TSV) or other significant shrimp disease agents. The severity of white spot disease pathology was high in all of the moribund specimens collected on day 4 post challenge or later in the study, but prior to termination.

The high severity grade of WSSV infection in most of the moribund specimens was due to the very high number of cells in target tissues presenting fully developed basophilic intranuclear inclusion bodies. WSSV has an anti-apoptosis gene, which has been suggested to be the reason why species such as the Australian redclaw crayfish, *Cherax quadricarinatus*, can show severe WSSV infections while not suffering high mortalities.

Perhaps, selection for WSSV resistance in the three families tested in this study is related to the up-regulation of the anti-apoptosis gene of WSSV, or up-regulation of a shrimp apoptosis gene. It could be due to a combination of these and other possible explanations, consistent with high levels of WSSV replication but reduced or delayed mortality as was observed in this study. However, not consistent with the hypothesis of the up-regulation of the anti-apoptosis gene(s) of the virus or shrimp host, was the finding that the shrimp that survived to termination on day 17, presented neither histological signs of WSSV infection nor did they contain a detectable levels of WSSV by qPCR.

With a detection limit of 1 WSSV genome copy by qPCR test, this findings suggest that survivors from all three families in this study either were never infected with WSSV (while others from the same family in the same tank died from WSSV) or that they were sufficiently resistant to the virus to clear it to levels below the detection limit of the qPCR test.

It is the first time in the known scientific literature that under controlled conditions for a severe WSSV challenge, resistance is shown, as is demonstrated by Camaco L. vannamei genetics.

The original article was first published in Global Aquaculture Advocate, Jul/Aug 2011. Vol.14, Issue 4, pages 65-66.

Camaronera de Coclé S.A. (CAMACO)

This is the largest integrated shrimp farm operation in Republic of Panama, Central America, dedicated exclusively to white shrimp *Litopenaeus vannamei* farming. It was established in 1990 and is part of the Agro-Industrial Group CALESA, the largest agriculture company in Panama. With a harvest cycle from July to February, the company produces around 3,500 tonnes of processed and packed shrimp from its own farm (1,200 ha) and from other related farms (clients of feed and post larvae). The market share composition is 50% Europe (Spain, Italy, Denmark, France, England and Belgium), 35% USA (East and West Coast) and 15% Taiwan.

The company is a regional leader in the development of top technologies in the shrimp aquaculture, with its own pathology, molecular & biotechnology laboratories, two centres of larval production (20 million nauplii per day and 120 million post larvae per month) and development of its own disease resistant genetic lines of white shrimp, based on its own professional team experience and also external consultants, leaders in correspondent specialities. (Web:www.camaco.com.pa)

Jorge Cuéllar-Anjel

Roberto Chamorro

Brenda White-Noble

Paul Schofield

Dr Donald Lightner

Jorge Cuéllar-Anjel and **Roberto Chamorro**, managers are with Camaronera de Coclé S.A., Natá (Coclé), República de Panamá. Email: roberto.chamorro@grupocalesa.com; camaco@cwpanama.net

Brenda White-Noble, **Paul Schofield** and **Dr Donald Lightner** are at the Department of Veterinary Science and Microbiology, University of Arizona, USA.

A microbial consortium based fermented Single Cell Detritus as marine larval feed

By S. Felix and P. Pradeepa

Innovative aquaculture products for biomass enhancement and bioremediation to attain biosecurity are increasingly being produced all over the world. The nutrition requirement for marine larval development is one area that has evaded solutions for many years now. Attempts are being made to replace phyto- and zooplankton cultures and Artemia which, to date, form the single source of nutrition to sustain marine larval production. Phytoplankton cultures, however, could not be depended upon, as production is highly unreliable.

Many technologies have been developed as a substitute for algae and Artemia, including microencapsulated diets, microbound diets, bioencapsulated diets, etc. However, none of them could satisfactorily replace algae. The marine single cell detritus (MSCD) production is presently gaining the attention of aquaculture scientists as a replacement or substitute for algae and Artemia in marine hatcheries.

What is Marine Single Cell Detritus (MSCD)?

MSCD is a seaweed based product produced through a combination of enzymatic and fermentative techniques. It can be prepared at a particle size of 5 to 12 µm, making it ideal for marine hatchery feeding, in addition to its bioremediatory and probiotic roles.

Role of SCD

Fermentation is one of the oldest biotechnological achievements which can be exploited for larval feed preparation. In Japan, Motoharu Uchida (2003) was the initiator of the formulation and production of MSCD for marine hatcheries. For maximum utilisation of the dietary potential of macroalgae, it is advantageous to perform thalli degradation under conditions regulating the catabolic losses. Mechanical or enzymatic fragmentation is effective for this purpose. Conversely, a method using viable bacteria for degradation is advantageous.

Another interesting characteristic of the detritus diet is the attachment of bacteria to the surface of the detritus. It is also possible to supply the SCD particles with different bacteria attached to its surface by incubating the bacterium for several hours with axenically prepared SCD particles. This optional method of attaching bacterium has some useful functions such as anti-pathogenic activity or a vitamin-producing ability and is expected to be useful in the development of a functional hatchery diet for suspension feeder animals. The combination of lactic acid bacteria and yeast might have a synergetic effect for reducing the risk of the prevalence of pathogenic microbes in the production process. Furthermore, some studies also suggest the possible probiotic effect of lactic acid bacteria and yeast on aquatic organisms.

Production of MSCD

MSCD production usually takes place over two phases: the first phase is cellulolytic enzymatic treatment of seaweed which leads to single cell units. The enzymatic digest is further treated with bacteria and yeast in the second phase which is known as the fermentative phase. These two phases can be performed simultaneously or one after another.

Cellulolytic enzymatic phase

Algae have cellulose in their cell wall which keeps the cells intact. When cellulose is digested, the individual cells are released and become single cell units. The enzyme 'cellulase' is used for this purpose and the end product of cellulolytic digestion is sugar. This phase has two roles, one is to produce single cell units and the other is to produce sugars for the fermentative phase.

Fermentative phase

Two organisms are used in this phase to produce MSCD and they are lactic acid bacteria (LAB) and yeast. These organisms can be isolated from the natural fermented seaweed or from other sources. Uchita (2004) used *Lactobacillus brevis* (LAB), *Debaryomyces hanseii var hanseii* (yeast) and *Condida zeylanoides* (yeast) that are isolated from fermented Ulva. Bacteria like *Lactobacillus plantarum* and *L. casei* can also be used for this purpose. In the case of yeast, any suitable source of yeast can be used for fermenting the seaweed. In our studies we have been using *L. plantarum* (source: IMTEC, Chandighar, India) and *Saccharomyces cereciseae* in the consortium of bacteria and yeast combination.

Lactic acid bacteria and yeast utilise the sugar produced by cellulolytic digestion and produce lactic acid. This would prevent other organisms from growing and thus preserving the MSCD. MSCD can be filtered with appropriate sieves to obtain the required size suitable for feeding. It can be stored for a year at room temperature. LAB also acts as a probiotic and helps to increase the survival rate and maintain the water quality. Yeast predominately acts as a bioremediation agent and enables us to maintain the culture system without water or limited water exchange.

Large scale production

MSCD can be produced in large quantities in airtight containers or in 'fermentors' or 'bioreactors' under controlled conditions. The difference between the two is that air tight container production takes nearly 2 weeks for the fermenting process, compared to 2 to 3 days for the fermentor. Furthermore, for purity and production quality of MSCD, fermentors are recommended.

Application of MSCD

MSCD can be used to feed larvae of both finfish and shellfish. The use of MSCD as feed has been tried in oysters and Artemia by Uchida (2004) in Japan. At present, our laboratory is working towards the formulation and production of MSCD for shrimp larvae (*Penaeus monodon*), as a replacement for unicellular algae and Artemia. Our trials so far have been successful. This work should pave the way for a major turnaround

Figure 1. pH changes during microbial fermentation.

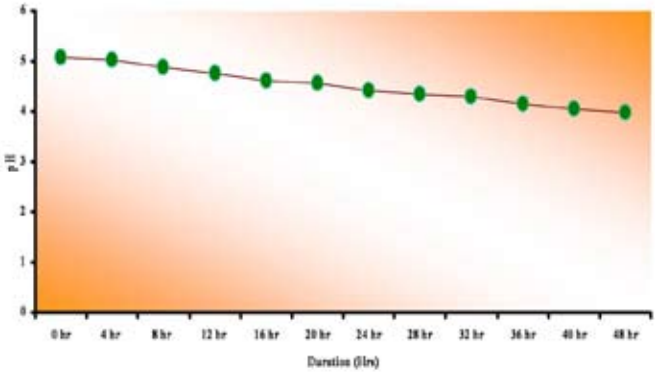
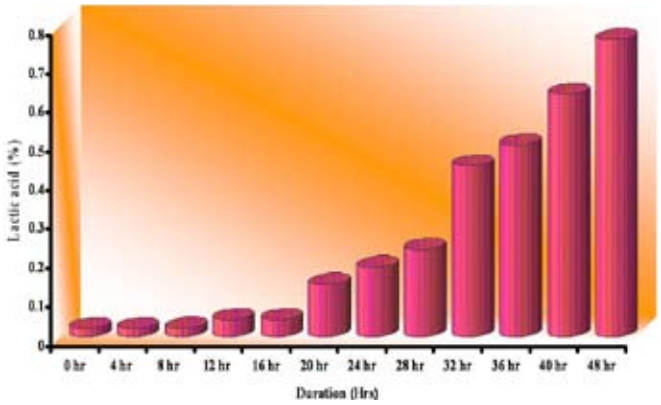


Figure 2. Lactic acid production during microbial fermentation.



in the shrimp hatchery feeding technology, making shrimp hatchery nutrition management simpler and cost effective.

Advantages of MSCD

Some advantages of MSCD are listed below:

- Relatively nutritious (crude protein levels up to 35% have been achieved).
- It could effectively replace (partially or fully) microalgae and Artemia as a feed in hatcheries.
- Particles of required size can be produced, as per the needs and requirements of the cultured species and producers.
- It can be stored for up to a year at room temperature.
- MSCD can act as a bioremediation agent.
- The probiotic effect also has been proven.
- The high cell concentration of MSCD is comparable with algal concentrates.
- MSCD production facilitates promotes better utilisation of seaweed resources.
- Mass preparation of MSCD is relatively easy in comparison to the production of microalgal culture and its maintenance.
- Production and use of MSCD is an economically viable technology.

In the near future, MSCD technology is poised to change the way aquatic organisms are fed, particularly in marine hatcheries. The technology integrates nutrition, probiotic and bioremediation aspects towards a better management of nutrition in hatcheries. Hence it is an innovative, multifaceted and integrated technology that would throw more light on seaweed resource utilisation and also will pave the way for simplifying marine larval rearing technology.

References are available on request.

Professor Suga Felix

Dr P. Pradeepa

Professor Suga Felix is with the Fisheries Research and Extension Centre, Tamil Nadu Veterinary and Animal Sciences University, Madhavaram Milk Colony, Chennai, India. Email: sugafelix@yahoo.com

Dr P. Pradeepa is Senior Research Fellow (SRF) at the same centre. Email: pradeepa_21@yahoo.com

Guolian expands

Zhanjiang Guolian Aquatic Products Co Ltd based in Guangdong province, is expanding, not only in terms of its shrimp and tilapia production but also the feed milling operations. It exports 20,000 tonnes of marine shrimp annually.

Guolian is the largest shrimp exporting and processing enterprise in China. It was established in 2001 and is now a complete industry chain from hatchery to processing and marketing. The *Penaeus vannamei* post larvae production business was started in 2007 and at present there are 6 hatcheries in Xunwen, Donghai, Zhuhai and Beihai and farming areas in Nansan Islands of Zhanjiang City. Post larvae production uses Specific Pathogen Free (SPF) brood stock from Shrimp Improvement Systems and Oceanic Institute, USA. Annual production is 5 billion post larvae. There is also collaboration with the Guangdong Ocean University, Ministry of Agriculture, to form the Guangdong Vannamei White Shrimp Genetic and Breeding Centre.

"The location in coastal Zhangjiang, the heart of shrimp farming in China is ideal and we are not limited by space. As such, the company does not have to move to other areas in China," said Dennis Wang, in charge of sales, at the Asian Seafood Exposition in Hong Kong in September.

The farming area comprises 140ha of 46 lined ponds, complete with independent water treatment, waste treatment and a central drainage system. Both hatchery and grow out farm are BAP (Best Aquaculture Practices) certified by the Aquaculture Certification Council (ACC) accreditation. According to Wang, in general the yield is 2 tonnes/5mu/crop (6 tonnes/ha/crop), usually of 100 pcs/kg size shrimp. In addition, production from farms following culture standards of the company, supplies Guolian with its raw material needs for the exports of processed shrimp.

Expansion in feed production

A wholly owned subsidiary, Zhanjiang Guolian Feed Co Ltd, produces 60,000 tonnes of feed annually for the marine shrimp and fish, freshwater fish and eel. The company is also involved in tilapia production but is a small player compared to producers in Miaoming City, also in Guangdong province. In a news report (aquafeed.com) it was announced that Guolian will invest in the production of floating feeds for tilapia. The investment will be CNY 90 million (USD 14 million) for two production facilities for floating fish feed to supply feed to Guolian Aquatic's planned integrated tilapia production. Completion is expected in September 2012.

Leading with shrimp exports

Guolian's shrimp processing plant is the largest in China with 100,000m^2 of processing and cold storage facilities. Annual processing capacity is more than 60,000 tonnes and cold storage is 10,000 tonnes. Shrimp products ranged from CPTO, breaded shrimp, EZP, HLSO, shrimp rings and shrimp skewer and butterfly shrimp. The plant is ACC certified.

Dennis Wang

The company is one of the first batch of enterprises with the 'CIQ 2211' electronic visual monitoring system from the Guangdong Inspection and Quarantine organisation. This system includes electronic remote surveillance of all the facilities from larval tanks/ponds to the receipt of raw materials, processing and packing. In the case of any violation in the production regulations, a report will be raised to site management staff. In addition, clients can be authorised to access the surveillance system and the company can also authorise the surveillance of the relevant production lines based on orders. Associated with the processing plant is the Guolian Testing Centre established in 2005 with LC/MS/MS, equipment for immunofluorescence analysis and enzyme linked immuno assays. These detect a range of antibiotic residues, metabolites and bacteria as required in the finished product.

China's shrimp exports to US have been subjected to antidumping tariffs since 2004 and the country wide rate varies from 26 to 40%. However, this does not affect Guolian which has an almost zero antidumping duty (0.0676%) since 2004. It exports to US, Russia, Middle East and Europe. In 2007, the US imposed an alert for imports of catfish, shrimp, dace and eel from China following detections of chemical residues in some imports. Guolian's facilities were inspected by the US Department of Health and Human Services and FDA which then exempted the company from the 100% inspection. In 2009, Guolian achieved a milestone for an enterprise from China when it was certified to supply the live shrimp market of Hong Kong after officials from the Food and Environment Hygiene Department visited the Nansan production bases.

At present, local demand for shrimp is increasing and the company will be increasing domestic sales. However, it will still need to maintain export volumes to the US. "The US is still an attractive market with shrimp consumption at 2.4kg/year/capita. In comparison China's marine shrimp consumption is only 0.6kg/year/capita."

Shrimp products at Guolian's booth at the China Seafood and Fisheries Exhibition, November 2011, Qingdao.

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

TARS 2012
The Aquaculture Roundtable Series
15-16 August 2012

THE AQUACULTURE ROUNDTABLE SERIES 2012

A shared vision for aquaculture in Asia

SHRIMP AQUACULTURE – SHAPING THE VALUE CHAIN

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

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

An unprecedented opportunity for Multiple Stakeholders!

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

Dialogue with Experts!

Plenary Session – Where Are We Today?

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

Breakout Session – Where Do We Want To Be Tomorrow?

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

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

Organisers:

AQUA CULTURE Asia Pacific

corporatemedia
The Total Communications Company

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

15 – 17 February 2012, BITEC, Bangkok, Thailand

Everything for production of safe and cost effective feeds

There will be TWO feed shows held together in one exhibition venue. They are FIAAP ASIA & VICTAM ASIA 2012. FIAAP is a specialist show for companies from all over the world who will be displaying the latest innovations for specialist ingredients and additives that are used in the formulation and preparation of feeds for animals, petfoods and aquafeeds.

VICTAM complements FIAAP as it is famously known as the world's foremost event for animal feed processing technology. Once again international companies will be displaying the latest technology, equipment and systems that are used in the manufacture of animal feeds, petfood and aquafeed. Mill managers, CEOs, nutritionists, formulators, etc., will be able to see, touch and discuss the very latest appropriate technology that is available to the market. Industry executives will also see a wide and varied range of ancillary equipment and systems.

VICTAM exhibitors will also be displaying the latest technology for biomass pelleting. Biomass pellets are becoming increasingly important as an alternative, safe and green energy source. Pellets are made from organic waste and are used within household stoves, municipal and industrial power plants. Visitors will see at the show what will probably be the largest number of companies specialising in pelleting technology ever assembled in Asia.

There is more as these two trade shows are co-located with a third – GRAPAS ASIA 2012. GRAPAS is another specialist trade show, but it is about grain processing. Therefore visitors will see technology and equipment that is used in all forms of grain storage, preservation and transportation, as well as, rice and flour milling and also the manufacture and processing of noodles, breakfast cereals and extruded savoury snacks.

There will be five conferences and of interest to aquafeed producers will be the Thai Feed Conference and Aquafeed Horizons Asia 2012 (see box). Details for the other conferences can be found at the conference websites.

Industry wishing to visit both FIAAP & VICTAM ASIA can register online free of charge at www.fiaap.com or www.victam.com

Aquafeed Horizons Asia 2012

This 6th international Aquafeed Horizons Conference will be presented by the aquaculture feed industry's information specialist, Aquafeed.com. It will take place will take place February 15, 2012 and comprise two sessions:

Morning session: Nutrition and ingredients

This will be devoted to formulation solutions for aquaculture: traditional and novel protein sources, functional ingredients, nutritional advances:

- Is algae the future for aquafeeds?
- What's new with poultry by-product meal in aquatic feed formulations?
- How can we reduce feed cost by optimizing nutrient utilization and gut health?
- Can a revolutionary array of non-GMO soybeans really replace fishmeal in aquafeeds?

Afternoon session: Extrusion workshop - in association with E.N. Hutchinson Ltd., Auckland, New Zealand

In a break away from previous conferences, Aquafeed Horizons Asia 2012 will devote a half day to a practical extrusion workshop. Led by international extrusion consultant, Peter Hutchinson, the workshop will comprise two sessions: Practical Extrusion and Diet Development for Extrusion Processing.

Practical extrusion will focus on feed extrusion principles, incorporating screw designs, screw profiles; die design, extruder trouble shooting, drying and cooling. Practical nutrition will look at diet development for extrusion processing: sourcing locally available material, matching extruder profile to formulation, die design in relation to species and high retention (water stable) diets, optimizing the pellet through extruder settings (cook, minimising nutritional damage, stability and density), basic quality control, post coating and density control (through coating and dryer design).

Expert Panel

Peter will be joined by an international panel of extrusion experts to help find solutions to your extrusion problems - so come armed with your questions. (More information: www.feedconferences.com)

Highlights at Victam 2012

Wenger, the original producer of industrial extrusion cooking equipment, will have a machine at the show and will provide details on production of aquatic feeds, pet foods and land animal feeds all by advanced extrusion cooking technology. The balance of the process can also be discussed with emphasis on drying technology and how this can improve your profits if you are not using the latest in drying developments. Extrusion is the process of choice, come by and learn how to increase your earnings per ton of product produced by proper selection of the most advanced equipment in the industry.

Wenger Manufacturing, Inc, USA www.wenger.com
Show contacts: Joe Kearns, jkearns@wenger.com; Rock Chen, RockChen@wenger.com; Paul Chen, pchen@wenger.com and Doug Baldwin, DougB@wenger.com
Booth A031

Van Aarsen International specialises in feed milling technology, and has globally gained over 60 years of experience. Being exclusively involved in feed milling, Van Aarsen International has built-up a broad knowledge and wide experience in every area of the compound feed industry and has developed into one of the world's leading companies in design, construction and manufacturing of high quality feed milling equipment and installations. The GD hammer mill was introduced to the market in 2006 and was rapidly adopted by lots of feed millers all over the world due to its high efficiency and ease of operation. Together with the optional automatic sieve changing system it offers a big step in increasing the flexibility of production of a modern feed mill.

The hammer mill with optional automatic screen exchange has the following benefits: very flexible production, minimal production stops, ergonomic working conditions, excellent feed structure and pre-determined structure for each recipe.

Van Aarsen International, the Netherlands
www.aarsen.com
Show contact: Jos van de Berg
jos.van.de.berg@aarsen.com
Booth C115

Hammer Mill GD 1400 Auto Screen Exchange from Van Aarsen

ANDRITZ FEED & BIOFUEL is launching a new and improved unique extrusion programme for the production of all kinds of fish feed, shellfish feed and pet-food. The new improved extruders are based on the experience gained from the popular Andritz Feed & Biofuel Ex620, Ex920, Ex617, and Ex917 extruders, which all have proved their process versatility, controllability, and energy efficient extrusion performance, leading to very uniform and high nutrient value feeds for aquaculture and pets for many years. The new extruders are designed to meet the special demands from the aquatic feed and pet-food industries, as well as feed ingredient processing plants. The overall targets of the development have been to secure further improved:

The new extruder EX1021 from Andritz Feed & Biofuel

- Capacity
- Energy efficiency
- Long lifetime
- Easy operation
- Hygienic standards and easy cleaning
- Controllability
- Low wear parts costs
- Low maintenance costs
- No unnecessary down time

This is consolidating Andritz Feed & Biofuel's position inside the high quality extrusion segment.

Andritz Feed & Biofuel, Denmark
www.andritz.com,
andritz-fb@andritz.com
Booth A111

Highlights at FIAAP

Kemira is the leading global producer of high quality organic acids-based products for the food and feed industry. The company will showcase the latest product developments for Feed Safety (Kemira Mould Control, Kemira Bacteria Control) and Animal Performance Enhancement (Kemira Pro GIT). Kemira, connected through safe solutions.

Kemira Asia Pacific Pte Ltd Singapore
www.kemira.com
Show contact: Han van der Broek Manager Sales & Marketing Food & Feed, Asia Pacific,
han.van_der_broek@kemira.com
Booth B151

Uniponint AG will have the Klinofeed-2000 Heulandite/ Clinoptilolite mineral, as feed additive. This is a mulit functional additive with a high ammonium binding capacity.

Unipoint AG, Switzerland www.unipoint.ch
Show contact: Tan Meng Kiang
kiang26@singnet.com.sg
Booth D121

GePro Gefluegel-Protein Vertriebsgesellschaft mbH & Co. KG will present the GoldMehl (R) FM /Low temperature feather meal. These are processed using a low temperature production technology with fluid bed drying and which are close to LT fish meal. As a non-aquaculture source, it lends itself well for aqua feeds and trials with vannamei shrimp and tilapia show that it can replace fish meal in diets effectively. Details of trials are available on the website.

GePro Gefluegel-Protein Vertriebsgesellschaft mbH & Co. KG, Germany www.ge-pro.de
Show contacts: Dr Franz-Peter Rebafka, franz-peter.rebafka@ge-pro.de
Booth C051

Dr. Eckel GmbH is a leading German company in the field of innovative animal nutrition with a product portfolio comprising concepts for optimised and sustainable farm animal production and aquaculture. In September 2011, Dr. Eckel established a representative office in Bangkok to serve their partners and rapidly expanding customer base in Asia.

Latibon®Plus ME, the multifunctional 100% active acidifier approach for improved animal health and performance provides for better feed intake through better taste, effective antimicrobial activity throughout the GIT and heat stability with easy and safe handling. This is a German quality product distributed in Asia under the Bayer brand, now under registration for shrimp in Thailand.

The company will soon launch a new phytogenic product line. Anta®Phyt will allow multi-purpose applications for aquaculture and monogastric animals. Anta®Phyt is the result of years of intensive research on synbiotic approaches, combining anti-microbial, anti-inflammatory and anti-oxidative properties for improved animal health and increased performance.

DR. ECKEL creative solutions

Dr. Eckel GmbH, Germany
www.dr-eckel.de
Show contact: Dr. Andreas Lewke, Director Asia, a.lewke@dr-eckel.de
Booth D025

Bayer HealthCare, one of the world's leading pharmaceutical company provides highly innovative product solutions for the aquaculture and aqua-feed industry. In Asia the Bayer Healthcare umbrella additionally incorporates cutting edge technology developed from partnering companies as Dr Eckel GmbH, AgraQuest, Clariant and Novozymes Biologicals.

Apart from well-known brands such as the trusted disease vector eradicating Dipterex®, the pond-water quality conditioner Remedor®Aquatic, there is the pond-water conditioner PondPlus® and the pond-water remedy for toxic hydrogen sulphide, PondDtox® both from Novozymes Biologicals, the myctoxin adsorbing additive TOXISORB® Premium from Clariant, the company will showcase numerous other additive specialties and products for the aquaculture industry.

TOXISORB® Premium, the multifunctional 100% natural activated toxin binder approach for improved animal health and performance provides effective unspecific mycotoxin binding activity throughout the GIT and extended claims of endotoxin binding. This product from Clariant is distributed by Bayer in Asia. Another product is PondDtox®, a unique microbial application and natural approach for improved pond water quality and aquatic animal performance. It assists in the management of hydrogen sulphide accumulation in the pond water.

Bayer will soon launch a new pond biocide product, Aquabosso, to control parasitic mollusk contaminations. For pond aquaculture Aquabosso is an application of Bayer HealthCare's core competence, developing sustainable biocide applications.

Bayer HealthCare

Bayer HealthCare
www.viva.vita.bayerhealthcare.com
Show contact: Dr. Jan Koesling, Business Development Manager, jan.koesling@bayer.com
Booth D023

Salmon feed benefits in hatchery and during on-growing

Tassal, Australia's largest producer of Atlantic salmon, found that dedicated recirculation diets keep the water in its new hatchery far cleaner and also demonstrated sustainability benefits in Skretting MicroBalance® grower feeds with low fishmeal contents.

The AUD20 million Tassal freshwater hatchery in southern Tasmania was completed in 2010. It is the most advanced smolt rearing facility in Tasmania and has the capacity to produce 4 million smolt to support its annual production of more than 24,000 tonnes of salmon. The hatchery has three distinct production areas; egg and larval incubation, start-feeding and smolt-rearing tanks. Completing the hatchery is an advanced particle and bio-filtration system that takes up 30% of the floor space. Diets for all stages of the production cycle are supplied by Skretting Australia.

Recently the Tassal hatchery began using Skretting's recirculation-specific diet, Nutra RC. Rhys Hauler, nutritionist and product manager for Skretting in Australia, explained, "RC stands for recirculation. We supply Tassal with Nutra RC in 1.2, 1.5, 2 and 3mm sizes. The smaller grades are manufactured in our plant In Norway and imported, whilst 3mm Nutra RC is made locally in our Tasmanian factory.

"A diet with specific benefits for recirculation is critical for Tassal's hatchery, where 98–99% of the water is reused. Water is exchanged hourly in each tank and to accomplish such high rates of recirculation the system includes denitrification and processes to remove phosphorus, and final 'polishing' of the water with ozonation and UV treatment."

Doug Paveley, hatchery manager, said, "Until recently we were not using recirculation specific diets. We found that while we had good growth, the water was turbid making it difficult to view fish behaviour and feeding response. As submerged lights are also used to help in the smoltification process, it was possible that the dark water was preventing the lights having their full effect.

"Once we moved to the new Nutra RC, we noticed profound differences. The most obvious change has been the colour of the recirculated water. Previously, you could not see the bottom of the tanks, but now the water is quite clear. You can see smolt swimming at the very bottom of 3-meter deep tanks. Other benefits include a noticeable lessening of the demand on the filtration system. Since using these diets, less ozone is needed to maintain water quality and there are fewer organics getting into the biofilters."

According to Hauler, the benefits of the feed come from the fact that it contains patented, functional ingredients that help faeces bind together. It also improves the elasticity and structural stability of the faeces. Basically you end up with a larger faecal 'pellet' that is quite durable even with water turbulence, allowing it to be easily stripped out by physical filtration.

Paveley said, "After just two years of operation and in concert with these diet developments, it is giving significant payback on Tassal's investment in the form of high quality, healthy smolt."

Higher sustainability with fish meal grower diets

Tassal also ran extended trials to compare Optiline grower feeds with low levels of fishmeal and conventional feeds. Their results showed no difference between Skretting's conventional 22% fishmeal Apollo feed and a 15% fishmeal feed made using the MicroBalance® concept. An 8% fishmeal feed also performed well enough for Tassal to consider this as a commercial option for grower feeds in 2011.

Tassal has a strong interest in sustainability. It appointed Linda Sams, Chief Sustainability Officer to the executive management team and a sustainability team reporting to her. "When we explained the MicroBalance concept to Tassal, they were keen to test it in their own farming conditions," said Hauler. "We prepared two Optiline grower feeds for the trials. Using the MicroBalance® concept, we could make these feeds where fishmeal levels are much lower than usual by providing alternative proteins with a range of micronutrients conventionally derived from fishmeal. One feed had 15% fishmeal and the other only 8%. They were compared with an Apollo formulation with 22% fishmeal over a 74-day feeding period for the 15% fish meal diet and 56 days for the 8% fishmeal diet."

The indicators monitored included relative feed index and relative growth index (RGI), using Tassal's own models, biological and economic feed conversion ratios and mortality. Growth rates of fish in both trials significantly exceeded growth of all previous seasons at Tassal. "With the 15% fishmeal diets, there were no statistically significant differences in any of these indicators apart from growth. This favoured the Optiline feed, which showed an RGI of 1.54 versus 1.45 for the Apollo formulation," said Hauler. "Similarly there were no statistical differences in any indicators comparing the 8% fishmeal diet, with some observations that favoured the Optiline diet."

Linda Sams adds, "Fishmeal is a limited resource and a key sustainability focus for Tassal and the Optiline diet means we can reduce fishmeal content without affecting the performance of our fish. This in turn supports Tassal's objective of meeting world best practice with regard to marine resource use."

Clean water in tanks

New name for its animal health division

The animal health division of Merck (NYSE: MRK), formerly known as Intervet/Schering-Plough Animal Health, has announced it has begun using the new name, Merck Animal Health. It will be known as MSD Animal Health outside the United States and Canada.

"The name change reflects Merck's commitment to animal health and its complementary role to the overall business," said Richard R. DeLuca Jr., who has recently succeeded Raul Kohan as president of Merck Animal Health. "We are unwavering in our commitment to veterinarians, producers, pet owners and society as a whole. We aim to generate additional value and sustained growth by continuing to provide integrated solutions with innovative animal health products and services to meet the evolving needs of our customers. With the scientific and business backing of parent company Merck, Merck Animal Health possesses the necessary mix of resources to enhance its position as an industry leader."

Merck Animal Health is a global leader in the research, development, manufacturing and sale of veterinary medicines and vaccines, with a strong presence in biologics and pharmaceuticals. The division generated global sales of USD 2.9 billion in 2010. Merck values the diversification that Merck Animal Health brings to its portfolio, and sees growth opportunities in the business that can be leveraged across both animal and human health. The company intends to capitalize on Merck Animal Health's broad and innovative portfolio going forward, and to develop the unit into a best-in-class global animal health leader.

Aquatic Animals Business Unit

This business unit specialises in the R&D, manufacture, marketing and technical support of veterinary medicines for the rapidly expanding aquaculture industry worldwide. Currently it supplies medicines for the treatment and prevention of diseases in several species of fish. This includes a range of antibacterial products including the broad spectrum antibiotic AQUAFLOR® (florfenicol). Merck's Aquatic Animals Business Unit also markets SLICE® (emamectin benzoate), one of the major tools for the control of sea lice in the salmon farming industry.

The focus is on developing, manufacturing and marketing health solutions for three key segments of the aquaculture industry; namely salmonids, marine and warm water fish. The AQUAVAC® and NORVAX® range of vaccines were developed for the prevention of disease throughout the lifecycle of farmed fish. The vaccines are administered by immersion, orally in feed or by injection depending upon formulation and life cycle stage of fish to be vaccinated. The range of vaccines and administration for the salmonids cover the majority of the most damaging diseases present in the different life stages: Pancreas disease (PD), Infectious pancreatic necrosis virus (IPNv), Vibriosis, Furunculosis, Yersiniosis and Winter sores.

The company has one of the leading ranges of vaccines for the mariculture industry, covering several species of marine fish farmed in the Mediterranean and Japan to the warm water varieties. To meet the challenges of a rapidly expanding industry, there is an existing range of proven and trusted vaccines for the most common diseases including; Vibriosis, Pasteurellosis, Streptococcosis and Lactococcosis. As part of its ongoing commitment to this segment, new vaccines are being developed to provide solutions to emerging diseases such as Iridovirus infection and Tenacibaculosis.

The company recently introduced AQUAVAC® STREP SA, the first fully registered vaccine for tilapia protecting against *Streptococcus agalactiae*. This joins the range of live attenuated vaccines for the control of columnaris disease and edwardsiellosis caused by *Edwardsiella ictaluri*.

The R&D team in Singapore, from left, Neil Wendover, technical manager, Asia), R&D project leaders, Saro Poobalane and Miyata Masato and Chang Siow Foong (R&D site lead)

A focused R&D

As fish farms operate in a variety of environments, the challenges in disease management differ. The company has two fully dedicated R&D centres. The one in Bergen is dedicated to the development of vaccines for the salmonid industry whilst the facility in Singapore is dedicated to vaccine development for marine and warm water fish species. In addition, there are resources in the USA, UK, Netherlands and Japan working on development of the pharmaceutical and biological veterinary medicines for aquaculture.

A strong technical service team

The responsible use of veterinary products has been often highlighted and is closely scrutinised by consumers and non-governmental organisations (NGO's) worldwide. The Aquatic Animals team works closely with both producers and veterinary professionals to ensure that medicines are used within veterinary health plans to ensure best results. Close collaboration ensures the safe and effective implementation of these programs and responds rapidly to changing needs and farming practices. The role of the strong technical service team is to maximise performance of veterinary medicines and ensure the best possible return on producer investment.

The exceptional level of quality required for the vaccines and pharmaceutical products is met through production in specialised production plants compliant with the highest standards of GMP (good manufacturing practices) and environmental requirements. Products are produced with quality control meeting or exceeding government standards and are produced with the highest quality ingredients for optimum performance.

All in all, the responsible use of veterinary medicines in aquaculture has been highlighted in many sectors as a critical factor in successful development of environmentally and economically sustainable aquaculture. Expanding the availability of these medicines is one of Merck Animal Health's primary objectives. The company assures that it will continue to contribute to the aquaculture industry's objectives of profitable, efficient and environmentally sustainable fish farming.

More information: Web: aqua.merck-animal-health.com Email: aqua@merck.com

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GlobalGAP Certification in Vietnam

OCIALIS Vietnam compound feed factories received GlobalGAP certification in September this year, allowing the company to forge ahead in its strategy to help seafood professionals develop specific traced and secured networks, especially for tropical fish such as pangasius.

A member of GlobalGAP since 2009, Ocialis has actively participated in the development of pangasius standards. It has built specific private standards with European buyers that require more demanding specifications. For example with Davigel (from the Nestlé group), Ocialis utilised a unique technical tool called "The Fish House" to help the fish producer respond better to the buyer's needs. This technical centre is placed in the heart of the Mekong Delta and provides its expertise to both farmers and processors in terms of nutrition, health, farming, product quality, etc. This localisation combined with the expertise and the power of the INVIVO NSA research team worldwide gives a unique differentiation to seafood buyers, as well as complete transparency on the farming and processing process.

Alongside Ocialis, which is a major player in the tropical aquaculture network, the aquaculture brand of EVIALIS manufactures and sells feeds for shrimp and fish in Vietnam, Brazil, Mexico, France and Indonesia. Evialis is the feed division of INVIVO NSA, one of the world's premier specialists in animal nutrition and health. INVIVO NSA has 75 manufacturing sites in more than 18 countries around the world. Its annual turnover is Euro 1.4 billion.

Evialis also manufactures and sells aquaculture premix and additives in France, China, India and South Africa. The company has a leading position in its main market and ranks third, behind Cargill (USA) and Chareon Pokphand (Thailand) in the global tropical aquaculture feed market. Ocialis works with the main producers and processors in both production and in research in the countries where it is present.

More information: Web: www.ocialis.com/www.invivo-nsa.com email: ocialis@ocialis.evls.net (Stephane Ralite)

New in Vietnam

AQUATIV, part of the DIANA Group and a specialist of functional hydrolysates for the aqua feed industry announced that it has opened a representative office in Ho Chi Minh City in November 2011. Nguyen Anh Ngoc, chief representative of this new structure, is proud of this important step. Ngoc has been part of the pioneering team since 2007.

"I am very happy that we are now opening this office in Ho Chi Minh. I spent a significant period of time in our research centre based in France to learn the fundamentals of our product and few years between Vietnam, France and Thailand to start and develop our sales network in the country. The opening of our production facility in Thailand with our partner TC Union Agrotech in 2010 helped us to offer a very good range of functional hydrolysates for the fish and shrimp feed industry. As we have planned, sales have taken off very well in Vietnam where we supply both shrimp feed and fish feed manufacturers." Ngoc said.

Aquativ offers two product ranges in the Vietnamese aquafeed market:

- NUTRIPAL© range of quality marine raw materials (tuna soluble extract, tuna crude oil, tuna liver powder) essentially used for its high nutritional value in the formulations (protein, omega 3, DHA etc
- ACTIPAL© range, which is a new generation of functional hydrolysates designed to improve the feed performance and ultimately the farm productivity. Performance is due to the high concentration of low molecular weights compounds such as peptides, free amino-acids and nucleotides generated by the hydrolysis bioprocess.

Vincent Percier, general manager of Aquativ Thailand, said, "This new office, in addition to our factory in Thailand, demonstrates our commitment to serve better our Vietnamese customers and is aligned with our company's tagline 'the closer - the better'. We are proud the industry has been rewarding us beyond the product performance by considering our capability to deliver consistent, reliable and fully traceable products. These results have been achieved thanks to our industrial standards such as GMP and HACCP, as well as our strict supply chain control. This industry is driven by the high standards imposed by the overseas markets such as EU & US and our product's full traceability has been a major asset for our customers exporting to these markets. That makes us very unique and very confident on the development of our sales in the South East Asia region."

Nguyen Anh Ngoc

More information: Web: www.aquativ-diana.com
Email: nanhngoc@diana-aqua.com

New corporate branding

This highlights the strength and value of the Diamond V portfolio of products and services

In October, Diamond V unveiled a new corporate brand strategy that supports the unique portfolio of trusted products and services. The new brand focus, 'The Trusted Experts in Nutrition & Health,' reflects today's Diamond V: a customer-centered company focused on developing innovative technologies, cutting-edge products and value-added services that meet customer needs and wants.

During the past seven decades, the company has become synonymous with 'the trusted experts in nutrition and health," according to recent research. "During these decades, Diamond V has gained an enviable reputation for supplying producers with effective products, technical expertise, quality and innovation," said John C. Bloomhall, CEO.

Research shows that delivering predictable results is one of five that it brings value to producers and their nutritionists. Other ways are technology innovation, quality commitment, technical expertise and industry commitment. To guarantee predictable results, the company validates its all-natural products through peer-reviewed research studies prior to their commercialization. The studies confirm product efficacy, build producer confidence, and assure results.

Technology innovation stems from Diamond V's proprietary fermentation process which delivers unique products, according to Bloomhall. "Each of these product innovations offers stability and repeatability, the assurance producers and nutritionists want and need."

The commitment to quality extends to both its products and services. The proprietary manufacturing processes use only high-quality, reliable and traceable ingredients. The company's technical expertise ranks among the best in the industry. Each member of the technical staff is hand-picked as a respected expert in his or her field. These knowledgeable professionals excel at building relationships and transferring knowledge to the benefit of producers and their nutritionists.

Diamond V with its headquarters in in Cedar Rapids, Iowa, USA, is the world's leading supplier of nutritional fermentation products used to optimize digestive function and nutrition key to animal and aqua health, productivity, efficiency and profitability. For more information: Web: www.diamondv.com

Thai aquaculture maintains high shrimp productivity despite challenges

Brian Hunter

This is a forthcoming presentation on "Shrimp aquaculture in Thailand – History and Current Status" which Dr Brian Hunter, Diamond V Asia will be presenting at the 2011 Nicovita Symposium in Tegucigalpa, Honduras.

The objective of the presentation is to explain how the Thai shrimp industry has remained productive over the years, despite challenges in techniques and disease epidemics. Hunter will explain the history and current status of modern Thai shrimp aquaculture, focusing on developing the proper infrastructure for feed, post-larvae quality testing, technical diseases, water quality management support and post-larvae handling. He will explain how current practices and lessons learned in the Thai aquaculture industry can be applied to increase shrimp productivity in Latin America.

This year marks the fifth annual Nicovita Symposium, which will take place from 22-24 November, 2011. The purpose of the symposium is to provide the opportunity for aquaculture producers and industry experts to discuss experiences, new techniques and to explore opportunities to contribute to the development, competitiveness and sustainability of the shrimp industry.

With the support of Alicorp and more than 20 years of experience in the aquaculture industry, Nicovita focuses on advising clients on how to improve profitability. It offers cost-effective personalized solutions and a highly specialized technical consultancy program that seeks to maximize its productive yields. R&D is devoted to developing innovative and optimized diets that expand the options for raw materials, especially to those with limited resources.

First breakthrough in the CO_2 debate

Biomin's commitment to environmental management gains international recognition

This comes with the award of the internationally recognised ISO 14040 certification for its environmental sustainability measures that will contribute to a deeper understanding of the environment debate.

The climate change and greenhouse gases debate urgently needs solid, scientific data and Biomin is proud to be able to play its part said the company's director for Innovation Management, Franz Waxenecker. "Biomin is totally committed to fully understanding the life cycle assessment of its individual business processes in the area of environmental sustainability."

Interest in CO_2 emissions continues to grow, and all stages of the production chain, from feed manufacture and animal husbandry to slaughter, processing and retail, are now under increasing pressure. To foster a deeper and more accurate understanding of livestock production's contribution, Biomin has scrutinised its own processes, so gaining ISO accreditation.

As a starting point, Biomin looked at 'global warming potential', particularly CO_2 equivalents. Taking into account the climate relevant gases CO_2, CH_4 and N_2O, Biomin identified how much a product group, or particular animal group, contributed to the greenhouse effect.

Adopting a "cradle to grave" approach, the company focused on two main areas. Cradle to gate analysis looked at CO_2 emissions at all stages, from the technical and biotechnological processes during raw material production through to completion and delivery of its products. Thorough assessment revealed that some 70% of CO_2 equivalent emissions came from the raw material production itself. In addition, core indicators for water efficiency, energy efficiency, waste and land use were monitored.

The gate to grave assessment evaluated the performance enhancing effects of Biomin products in animals and associated reductions in CO_2 equivalent emissions. By optimizing feed use and improving animal performance, it is possible to reduce emissions from livestock operations. For example, studies have shown that 1to of CO_2 invested in a Biomin product reduced CO_2 equivalent emissions in broiler production by up to 128to.

More information: www.biomin.net

Revolutionary net cleaner gives excellent results in Chile

A Hughes Pumps aquaculture net cleaning unit recently supplied to Rovscan in Puerto Montt, Chile has proved to be so effective during recent commissioning that the company has immediately ordered a second, identical unit. Hughes Pumps' managing director Phil Cranford said, "This will replicate the success enjoyed by farms in Norway and Scotland in net cleaning operations."

Gary McNicol, general manager of Rovscan, one of the leading suppliers of remotely operated vehicles (ROVs) to the Chilean aquaculture industry which earlier this year was appointed exclusive agents for Hughes Pumps in Chile, had seen the industry struggling to clean nets with low powered, unreliable equipment and identified the Hughes range of aquaculture net cleaning units as a perfect fit with their business.

The HPS2200 DS canopy unit supplied to Rovscan is already the unit of choice with most fish farmers and net cleaning contractors in Norway and Scotland. Its powerful performance of 228lpm at 320 bar the HPS2200 unit powers a Terminator 9 net cleaner to produce a 2.7m cleaning path, stripping the most stubborn marine growth in a single pass, leaving the net 100% clean.

There are two versions of the Hughes HPS2200 package available; a conventional standalone pump set fitted with an acoustic canopy that is generally used from a workboat deck and a marine engine driven version designed to be installed below deck that uses seawater to cool the engine, making for a very compact installation.

More information: Email: sales@hughes-netclean.co.uk; Web: www.hughes-netclean.co.uk

The Hughes HPS2200 power unit

Operators monitoring the Terminator 9 net cleaner in use.

Guaranteed quality

The world's largest producer of krill-base products for animal feeds can guarantee every step of the way from ship to mill, offering complete traceability and product quality for its meal and oil.

QRILL™ products are processed through Aker Bio Marine's vertically integrated value chain which controls all aspects: from the harvesting of krill in cold, clean Antarctic waters with its own fleet of ships, to the finished Qrill™ product.

As an integrated biotechnology company established in 2006, Aker BioMarine can guarantee to feed producers, the highest level of quality throughout the value chain for its krill meal and oil. These products are an outstanding and fresh source of phospholipids, omega-3 fatty acids, astaxanthin, amino acids, and other components that act as feeding attractants and enhance palatability.

By controlling the entire supply chain, from harvesting krill, processing raw materials, logistics, final processing, product specifications and internal and external audits, Aker BioMarine is able to offer a unique nutritional supplement to feeds for fish and animals. Continuous monitoring of the fishing operations means reliable traceability.

Aker BioMarine's invention of the Eco-Harvesting™ technique - and the fact that only a small portion of the total krill biomass is harvested - ensures sustainability. Eco-Harvesting™ also protects fish, marine mammals and diving sea birds. This patented harvesting method ensures no by-catch, which regular fishmeal producers cannot claim.

Qrill™ krill is manufactured according to agreed specifications, quality standards and in accordance with national and international food regulations and legislations. Certified by MSC and cooperating with World Wide Fund for Nature (WWF Norway), Aker BioMarine offers long term sustainable ingredients for healthy aquaculture feed and pet food. All harvesting can be traced back to its coordinates and offers full traceability.

Marine biotechnology company, Aker BioMarine ASA, listed on the Oslo Stock Exchange delivers high-value marine ingredients and products. Its integrated value chain, ranges from harvesting marine resources and onboard processing of raw material to the finished customer product. The company holds two krill-licenses from the Norwegian Directorate of Fisheries allowing the company to fish krill in the Southern Sea within the limits defined by the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). Since October, the company operates two krill trawlers and one freighter vessel in the Antarctic. This is in accordance with the company's previously stated long term strategic plan based on increasing demand for both Qrill™ and Superba™ krill, as well as stricter requirements for redundant harvesting and production capacity.

To protect the future of krill CCAMLR restricts annual krill fishing to about 1% of the total population in the Antarctic. This makes krill one of the most sustainable sources of nutrients and protein for fish feed, pet food and humans. More information: www.qrill.com

AQUA 2012

Global and regional food security
Aquaculture trade
Economic sustainability
Resources management
Aquaculture image

A full scientific programme with many sessions for abstract submission
An international trade event and associated forums and workshops

Global Aquaculture

SECURING OUR FUTURE

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worldaqua@aol.com

AQUA 2012 is the combined meeting of the European and World Aquaculture Societies, incorporating the "Aquaculture Europe" and the "World Aquaculture" events

Organised in partnership with the University of South Bohemia - Faculty of Fisheries and Protection of Waters

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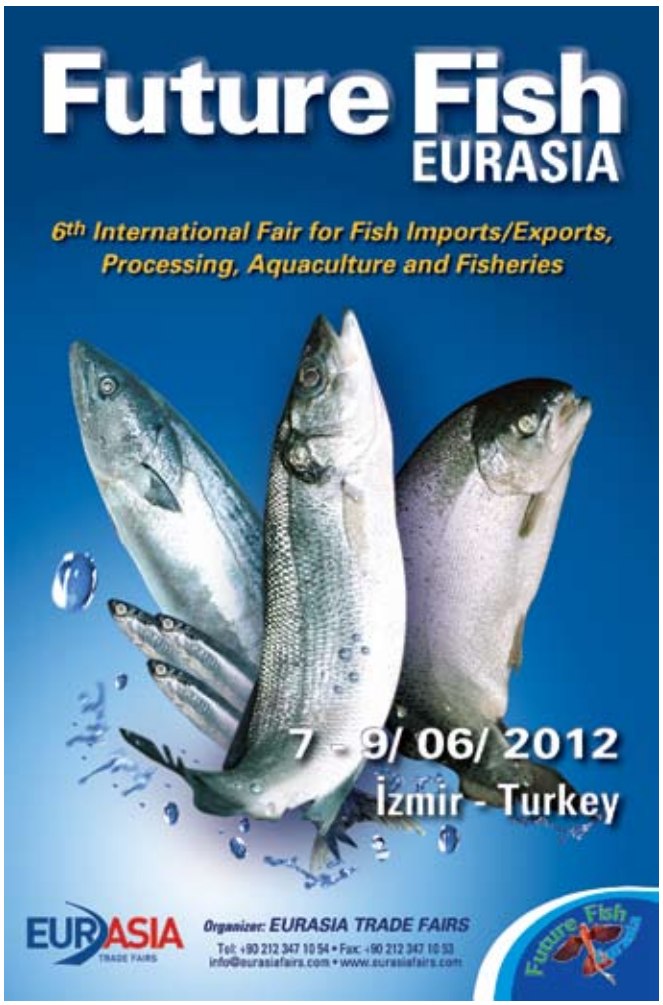

Fish vaccination to start in Vietnam


Kjersti Gravningen

PHARMAQ announced that the vaccine ALPHA JECT® Panga 1 received an observation license from the Department of Animal Health, under Ministry of Agriculture and Rural Development (MARD) in Vietnam, on October 12, 2011. The term observation means that the vaccinated fish will be followed closely by the authorities and PHARMAQ.

"This is the first ever fish vaccine commercially available in Vietnam and represents a breakthrough to both the Vietnamese seafood industry and to PHARMAQ", said Kjersti Gravningen, general director, PHARMAQ Vietnam Ltd.

ALPHA JECT® Panga 1 is a vaccine administered by injection that provides protection against the bacteria *Edwardsiella ictaluri* causing disease in pangasius. In Vietnam, the company is entering into a new phase with the exciting challenge of establishing the best practice for fish vaccination in Vietnam. Activities will include vaccination training and close collaboration with the farmers during and after vaccination.

"Our team is prepared and ready for these challenges. The implementation of vaccination will make difference for the farmers in Vietnam."

"By the introduction of ALPHA JECT® Panga 1 we have reached a great milestone in the history of Pharmaq and taken another step to strengthen our presence in the global fish health market. Our activities in Vietnam are an essential part of our strategy in exploring the potential of the Asian aquaculture industry", says Morten Nordstad, CEO.

More information: Email: kjersti.gravningen@pharmaq.no

An exclusive distribution partnership for Vietnam

Swiss market expansion group DKSH and Scotland's Xyrex have signed a deal that will see Xyrex distributed its entire product range in Vietnam.

Scotland-based Xyrex, part of the EFH Group, manufactures products for the fishing, seafood processing and aquaculture industries. In a press release, DKSH says that it has a dedicated sales and marketing organization in Vietnam which offers 'first-class market expansion services with the capability to effectively distribute Xyrex across the industry'.

The Xyrex product range is designed to slow down bacterial spoilage in finfish and melanotic blackening in crustaceans, ensuring seafood that is fresher and has a longer shelf life. It has been fully approved by a number of leading regulatory authorities.

Xyrex director John Davis said, "The products can significantly increase the value of harvested fish and shellfish. The collaboration with DKSH marks a significant point in our strategy for growth in aquaculture, and we look forward to a mutually successful relationship with DKSH and growing our market share in Vietnam,"

With 610 business locations in 35 countries, 590 of them in Asia and more than 23,000 staff, DKSH is one of the top 20 Swiss companies ranked by sales and employees. In 2010, the group generated a transaction value of nearly CHF 10 billion (USD 12.6 billion).

More information: www.xyrex.com; Email: john@xyrex.com; Related article: Preventing 'blackspot' in shrimp and prawns, Aqua Culture Asia Pacific, Volume 6 number 3, May/June 2010 pp36-37.

Incorporation in Singapore

Norel Animal Nutrition has announced the recent incorporation of Norel Animal Nutrition Asia Pacific Private Limited. Since the opening of the Singapore representative office in 2008, the company has strengthened its position in the region and the opening of the private limited company confirms the aim to be closer to the customers and understand their needs, identify the market trends quickly, and the commitment to expand activities in Asia and Pacific.

Norel Animal Nutrition is active in 17 countries, namely Australia, Bangladesh, China, India, Indonesia, Japan, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, and Vietnam because of the distributor network. Being based in Singapore, a city which is the hub of the Asia-Pacific region, and well-connected to the rest of the globe, offers the company many opportunities and the plan is to continue to grow and set up a R&D centre specialized in aquaculture.

More infromation: Email: mcortyl@norel.es (Mathieu Cortyl)

New appointments

Yongjiu Jerry Cai

Chief technical officer

Diamond V® has announced the appointment of **Dr. Yongjiu Jerry Cai** as chief technical officer of Diamond V China. As CTO-China, Cai will lead DV China's technical services with a focus on swine, poultry and aquaculture marketing efforts. Cai reports to Michael Goble, vice-president of Diamond V, is also called upon to perform other services in the assistance of the executive officers of the Company as determined.

Prior to joining Diamond V, Cai served as a director of Animal Nutrition - Asia at ADM Specialty Feed Ingredients Division where he directed technical service supports to ADM specialty feed products sales, ADM Alliance Nutrition premix business conduction and ADM-JV feed products marketing in China as well as Asia.

Cai earned his Ph.D. in Animal Nutrition from Iowa State University, and then received his post-doc research training in animal nutrition and feeds from the University of Georgia. Prior to these, Cai had received his M.S. degree in Fish Physiology from University of Minnesota and a college degree from the Central China Agricultural University, China.

Kultheera Theerakul

Resource Coordinator in Asia

Diamond V Asia has added **Kultheera Theerakul** to its team. Theerakul will be responsible for coordinating marketing and sales support for the Diamond V Asia office. Previously she was with the Betagro Group where she worked in marketing, sales support and export coordination. She has a Master of Management, International Programs degree from Mahidol University in Thailand.

Member of Standards Oversight Committee

Dr. Alejandro Buschmann

The Global Aquaculture Allaince has announced that **Dr. Alejandro Buschmann**, head of i-mar Research Center and former director of research and graduate school at the Universidad de Los Lagos in Puerto Montt, Chile, has been appointed to the Standards Oversight Committee (SOC) that oversees the development of the Global Aquaculture Alliance Best Aquaculture Practices (BAP) certification program.

As a researcher at the i-mar Research and Development Center of Coastal Resources and Environments, Buschmann has written extensively on coastal ecology, as well as sustainable coastal and aquaculture management strategies. Much of this work focused on seaweed cultivation, while his more recent efforts have dealt with integrated multi-trophic aquaculture and kelp ecology.

Buschmann has served on scientific panels of the Chilean Science Agency. As a scientific consultant, he has promoted sustainable environmental technologies for the salmon industry in Chile and the use of seaweeds for biofuel production. Buschmann was recognised by the International Foundation for Science with the Silver Jubillee Award for his scientific achievements.

"I hope to introduce a conceptual framework toward the development of sustainable aquaculture practices based on the Chilean experience," Buschmann said.

Buschmann holds a degree in marine biology from the Universidad de Concepción and received his doctorate degree from the Pontificia Universidad Católica de Chile.

Aquaculture at Livestock Asia 2011

LIVESTOCK ASIA 2011 was held in October in Kuala Lumpur, Malaysia. As a premier event for Asia's livestock industry, it was a 'must attend' event for companies as well as veterinarians, formulators and nutritionists. In addition, there were forums on animal health and advances in the feed and production aspects for the poultry, swine and ruminant industry. Aquaculture was a very small component and two Malaysian companies are featured below.

Promoting tilapia production

Star Feed Mills, part of Thailand's Charoen Pokphand's (CP) feed business in Malaysia, is a regular exhibitor at Livestock Asia's biennial trade show. This year, the focus is on the tilapia fish business. Tilapia fish production is increasing in Malaysia. The leading producer is a large cage culture project in Temenggor Lake in the northern state of Perak, led by Norwegian company, Genomar. The project involves 20 cage modules with an annual production capacity of 20,000 tonnes. Other producers are smaller farms scattered all over the country.

Star Feed Mills is one of four major feed production companies producing and marketing feeds for the tilapia. It has a range of tilapia feeds for the various culture systems; pond culture where stocking density is 5 pcs/m^2; cage culture with stocking density of 30-50 pcs/m^2 and polyculture system (together with vannamei shrimp) with tilapia in cages within the pond at stocking density of 15 pcs/m^2.

The company is a major player in the aquaculture industry in Malaysia and is leading in the sales of marine shrimp feeds and vannamei shrimp fry. In Malaysia, it began trading in CP monodon shrimp feed in 1992 (imported from Thailand), followed by CP tilapia fish feed in 1994 (imported from Indonesia). A shrimp hatchery was started in 2001, followed by a farm in 2004. Local feed production began in 2006. Currently, it operates two processing plant, one out sourced processing plant and several marine shrimp hatcheries and farms in West and East Malaysia.

New aqua feed equipment

The new product for the aqua feed industry is from Malaysian equipment manufacturer, **SHT Engineering Sdn Bhd**. The aqua feed line comprises a small extruder with a capacity of 500kg/hour which is fully imported from China. It has been designed for the production of pet food, shrimp and fish feeds. In general the pellet size will be from one mm to 10 mm. SHT also has other equipment such as high speed rotary grinders, post pellet conditioning etc to complete the setup of a feed plant. This feed line was recently installed in a grow-out facility for Clarias catfish farming in 50 tanks and 20 concrete ponds. The company will also begin tilapia farming soon.

Alvin Ng at his booth

SHT Engineering was started in 1987 and is well known as a manufacturer and exporter of food industrial machinery and equipment including food processing machinery, commercial kitchen equipment and industrial stainless steel projects for local and international markets, through its trading company Hui Trading.

According to Alvin Ng, director, "We entered the aqua feed production business because we see the potential of aquaculture. Demand for fish is increasing and we understand the limitations of capture fisheries. Some of the producers in Malaysia came to us as they were seeking innovative yet cheaper equipment for feed production at small volumes. Usually an investment of MYR 10 million will be required for a medium size feed plant but we can provide units with smaller capacity to match their needs at MYR 2 million. We have a joint venture with a company in China for parts. Our advantage is that we can offer either gas, diesel or electricity to operate the equipment, depending on the requirements of the customer."

More information: www.hui.com.my Email:wei23@hotmail.com

Skretting Australasian Aquaculture 2012

'The Next Ten Years'

This is the biennial event of the National Aquaculture Council of Australia and Asia-Pacific Chapter of the World Aquaculture Society. It will be held from 1-4 May, 2012 at the Melbourne Convention and Exhibition Centre, Melbourne Australia. In the latest press release, the Program Committee of Australasian Aquaculture 2012 has extended the Call for Papers deadline until **30 November 2011**. Abstracts can be submitted on line at https://www.was.org/AA12/Abstracts/Default.aspx -

More information: www.aquaculture.org.au email: sarah-jane.day@aquaculture.org.au (Sarah-Jane Day)

2012 Hinter Symposium on Nutrition & Feed Technology of Fish & Shellfish

This annual series of symposia for industry in China will be from 24 February to 18 March. The Hinter team will hold these in the following cities:

- 24-25 February in Chengdou (Sichuan Province)
- 2-3 March in Changsha (Hunan Province)
- 9-10 March in Suzhou (Jiangsu Province)
- 16-17 March in Tianjin

The objective of the annual symposium is to communicate research findings and update industry on the latest information and technology in the feed industry. Similarly, as in 2011, the topics will cover business aspects such as feed enterprise operations, aquatic animal nutrition and feed technology, feed ingredient quality control and extruded production technology. The symposia is organised by Guangzhou Hinter Biotechnology Co., Ltd, and Guangdong Haid Animal Husbandry and Fisheries Research Center. Co- organisers are American National Renderers Association (NRA), Evonik Degussa (China) Co., Ltd and several others.

More information: Web: www.hinter.com.cn Email: hintermeeting@gmail.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 – Shrimp Aquaculture** August 15-16, Phuket, Thailand **AQUA 2012**, September 1-5, Prague, Czech Republic	**17th China Seafood & Fisheries Exposition 2012**, 6-8 November, Dalian, China	

Practical short course on Feeds & Pet Food Extrusion

29 January – 3 February, 2012, Texas A&M University, USA

A one week practical short course on Feeds & Pet Food Extrusion will be at conducted by the staff, industry representatives, and consultants. The program will cover information on designing new feed mills and selecting conveying, drying, grinding, conditioning and feed mixing equipment. Current practices for production of pet foods, preparing full-fat soy meal; recycling fisheries by-products, raw animal products, and secondary resources; extrusion of floating, sinking, and high fat feeds; spraying and coating fats, digests and preservatives; use of encapsulated ingredients and preparation of premixes, and least cost formulation are reviewed. Practical demonstration of pet food, vacuum coating, and several others are demonstrated on four major types of extruders - (dry, interrupted flights, single and twin screw), using various shaping dies.

Reservations are accepted on a first-come basis. For more information, programs and application forms, contact: Dr. Mian N. Riaz, Food Protein R&D Center; 2476 TAMU, Texas A&M University; College Station, Texas 77843-2476. Tel/Fax: +1 979 845 2774; Email: mnriaz@tamu.edu; Web: www.tamu.edu/extrusion

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

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

November 17-20
Malaysian International Seafood Exhibition
Kuala Lumpur, Malaysia
Email: www.mise.com.my

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

January 29-February 3
Practical Short Course on Feeds & Pet Food Extrusion
Texas A&M, USA
Web : www.tamu.edu/extrusion
Email: mnriaz@tamu.edu;

February 8-9
Ildex Bangkok
Thailand
Email: info@ildex.com
Web:www.ildex.com

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

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

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

February 29 - March 2
India International Seafood Show
Chennai, India
Email: mpeda@mpeda.nic.in/seaihq@eth.net Web: www.indianseafoodexpo.com

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

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

May 9-11
8th Philippines Shrimp Congress
City (TBA), Philippines

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

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

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

August 24-26, 2012
The Ninth International Conference on Recirculating Aquaculture
Email: aquaconf@gmail.com
Web: www.recircaqua.com

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

FIAAP Asia 2012

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VICTAM Asia 2012

AQUAFEED PROCESSING TECHNOLOGY

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

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