VOLUME 3 NUMBER 5 SEPTEMBER/OCTOBER 2007 MICA(P) 099/10/2006 ISBN 1793-0561

AQUA Culture AsiaPacific

Sustainable Shrimp Industry in Indonesia

- Shrimp Club Indonesia
- Linking Food Safety to Feeds

Prospering with Vannamei Shrimp in Vietnam

Taming the Black Tiger Shrimp in Australia

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Volume 3, Number 5 September/October 2007 MICA (P) 099/10/2006

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AQUA Culture AsiaPacific is published bimonthly by **Aqua Research Pte Ltd**
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Annual Subscription by airmail (6 issues a year)
Asia (excluding Japan & Korea): SGD70
Other zones: SGD100

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Letters may be edited prior to publication

From the editor

Root cause is food safety and scarcity

When safety scares ranging from melamine in pet food to Chinese toothpaste made headlines, it opened up a pandora's box in China and elsewhere on quality products and on the politics behind these actions. Aquaculture was included when shrimp, eel and catfish imports from China were banned until the products no longer tested positive for banned chemicals. This added to previous reports of a catfish ban in the US. The usual trade punch was non-tariff barriers and that the playing field is not level. However, it is important to look at some other cause and effect.

Asian producers are big contributors to three major commodity species- tilapia, catfish and marine shrimp. Some 92% of US frozen fillet imports come from China. US tilapia imports are expected to reach 180,000 tonnes in 2007. Vietnam exported 226,000 tonnes of catfish fillets to 85 countries, equivalent to 85% of its fish production of 700,000 tonnes in 2006. With the exception of China where 80% of vannamei shrimp production is consumed locally, most of marine shrimp production in other countries is for foreign exchange earnings. However, controllable market access means that products should adhere to food safety standards of importing countries and these are becoming more exigent. According to the EU Rapid Alert system, Asian products have the most number of notifications in 2006. The weakest link in the supply chain remains to be identified in many cases.

"Most of Asia's production is from small scale farming. This is a unique characteristic of Asian aquaculture; however, much we would like them to consolidate, it will never happen and that it is part of the Asian culture," said Dr Sena de Silva, Director of NACA during a keynote address at Indonesian Aquaculture 2007. "It is crucial that we prepare them for the global challenges, mainly in terms of food safety and environmental issues. This is also to prepare for a sustainable industry in the long term," he added. In Indonesia, government and private sector are coming together to regulate industry. The objective is to assure a clean bill of health for its exports to the EU and USA.

As incomes rise, a more discerning consumer is appearing in China according to an official survey, joining those in Singapore, Hong Kong and Taiwan. Ideally, there should not be a discrepancy in food standards for local and export markets. The alternative for an American, Japanese and European consumer when he or she perceives that the food safety record of Asian producers is not up to the mark, is to buy shrimp products of western hemisphere origin. For the Asian consumer, the alternative is pork or chicken. To keep their share in the domestic markets, it is time that producers adhere to good aquaculture practices and traceability as is practised in Thailand for shrimp. Only then will there be a level playing field between products for the domestic and export markets.

Uncontrollable market access are measures such as proposed by the US Catfish Institute to include in the bill that '*Ictalurus* spp. from China and elsewhere, would need to be certified as being harvested and grown with the same health and safety standards required for US growers'. When large importing countries impose barriers such as antidumping duties on shrimp and catfish, the apparent reason is to safeguard the local industry as there is a large price gap between imports and local production. Imported peeled deveined shrimp costs USD 4- 5/lb while fresh local shrimp has to be in the USD8-10/lb range for local fishermen to make money, according to the North Carolina Division of Marine Fisheries. With catfish, a Chinese producer can grow, harvest, process and ship frozen fish to the US and sell it, profitably, at 15 cents or more per pound less than American growers (Globefish, 2007).

It was reported that 92% of shrimp consumed in the US is imported. Consumers like the convenience while local fishermen worry about the price. Any ban on imports may seem to benefit the US shrimp fisheries, but the market is more than 12 times the size of domestic production. Even if all imports were stopped, domestic production will never be able to meet the shortfall created. The problem is actually scarcity and not the price gap. The real winners will be the Asian producer who can consistently harvest quality products for the US and other markets. Once we have gotten our house in order, then we can begin to discuss on a level playing field.

Zuridah Merican

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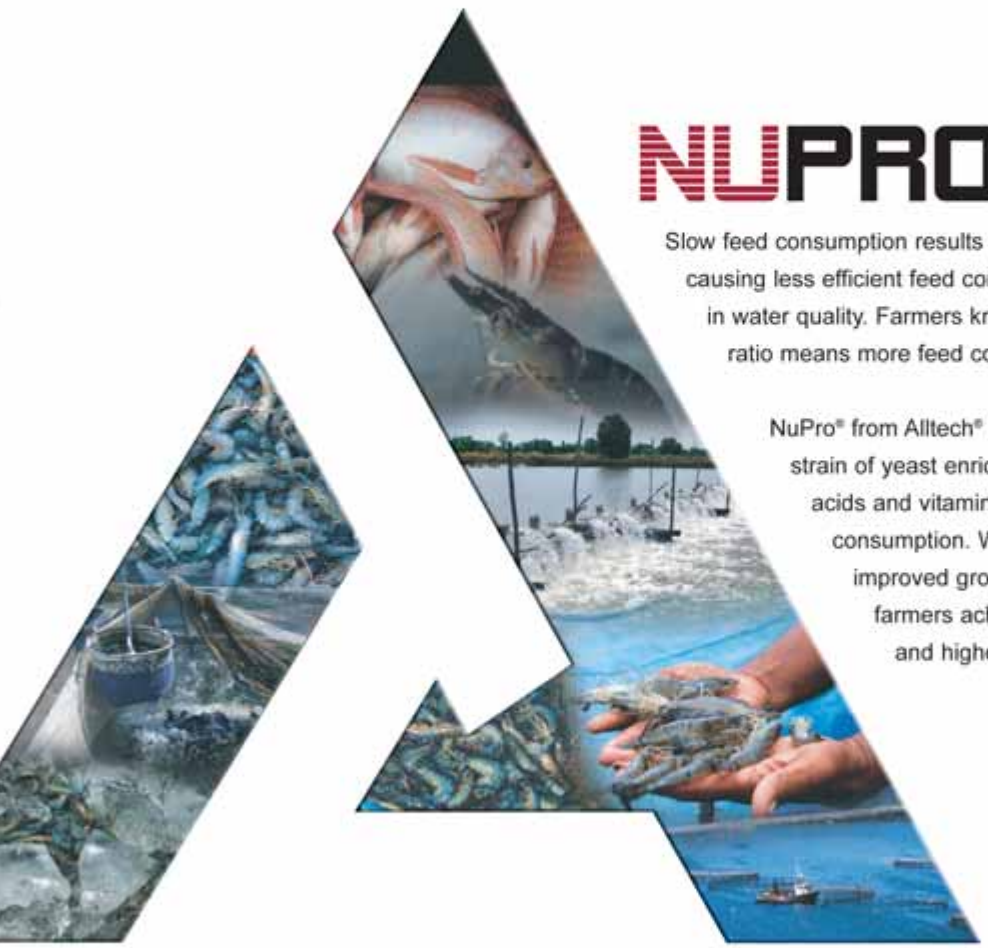

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China/US

China growth on the defensive

As China and the US battle on each other's quality standards, Chinese consumers turn to organic products. China has banned shrimp from Indonesia and Taiwan has suspended shrimp imports from China.

In June, the US FDA (Food and Drug Administration) issued an alert on imports of farmed catfish, eel and shrimp from China contaminated with antibiotics and banned chemicals. This became part of a whole array of doubts on quality of food and non food products from China. In a reaction to the US reports, the Chinese government watch dog on food released a report that 99% of food exported to the US met Chinese quality standards. However, in IHT (24 August), Mike Leavitt, US health and human services secretary said, "You need to meet ours –not theirs".

This and recalls of other food products and toy has sullied the image of Chinese exports. In the midst of the bad press, some consumers in the US changed their shopping habits. In Southern California, unlike grocery shoppers elsewhere, Chinese immigrants view the controversy in terms of politics and economics and were unable to give up eating their native foods. In 2006, nearly 60,000 tonnes of food were shipped into California from China and about 75% was stocked in the area.

However, Beijing shoppers are prepared to pay 10 times more for organic food than regular produce. More than 60% of China's 560 million city dwellers are willing to pay more for produce certified safe or organic, according to research commissioned by the Ministry of Commerce. The national standard for organic food was introduced in 2005, 15 years after green standards were introduced. As wages and food production rise, 'the issue has shifted from total supply to quality of supply' said Huang Jikun, director of the Center for Agricultural Policy at the Chinese Academy of Sciences in Beijing.

In response, regulators in China increased inspections, closed down some 180 food manufacturers and now post the names of violators on their web site. China's aquaculture industry comprises mainly of small scale farms and traceability is difficult. In China, it was reported that rather than face rejections, fish and shrimp processing plants are refusing to process for export and a decrease in supply to export markets is expected. No interruptions in supply are expected from large integrators.

Apparently, as a swift response to the ban on sales and withdrawals from the market of some Chinese made products in Indonesia, China imposed an embargo on shrimp imports. This was a shock for Indonesia as it has always met the stringent health standards imposed by China, said the report in Jakarta Post. In 2006, it exported 2,550 tonnes of shrimp to China. In September, Taiwan suspended the import of Chinese frozen shrimps after detecting residues of nitrofuran in five shipments. It ordered the suspension of further imports until China improved it seafood safety measures. Taiwan imported 2,500 tonnes of frozen shrimps from China in the first half of 2007 (Earthtimes.org).

China has also started recall systems for food on September 1, part of the campaign to alleviate global concerns on the quality of its food products. It has also sought help from WHO (World Health Organisation) in improving food quality. It added that the leaders were 'willing to increase information exchanges and communication in line with its attitude of openness and transparency'. A report published by China (IHT, 24 August) said that as a developing nation, it does suffer from quality problems. Over the years it has endeavoured to improve food quality, ensure food safety and protect consumers around the world.

India

MOU with Norway for finfish mariculture

After the signing of the MOU. From Left, Mr.G.Mohan Kumar Chairman, MPEDA and his team with Ms.Helga Pedersen, Norwegian Minister of Fisheries and Coastal Affairs.

India's long coast line of about 8,121 km, Andaman Nicobar Islands in the east and the Lakshadweep group of islands in the west, offer tremendous potential and scope for development of commercial mariculture. The Marine Products and Export Development Authority (MPEDA) is committed to develop coastal aquaculture in India in a major way for export production. In August during AQUANOR 2007 held in Trondheim, Norway, Mr.G.Mohan Kumar, Chairman of MPEDA signed a Memorandum of Understanding (MOU) with Innovation Norway (IN), a company owned by the Norwegian Government.

The objectives of this new collaboration project will include a detailed survey of potential sites in India, selection of inshore sites and establishment of pilot scale demonstration farms to study the techno-economic feasibility of such projects under Indian conditions. The next step will be the development of off-shore cage culture on a turnkey basis, development of suitable health management packages for cultured species and marketing of value added products in the international market, especially in EU.

This will mark a new beginning for the aquaculture sector in India and further boost seafood production from the country. In its action plan, MPEDA has targeted seafood export earnings of USD 4 billion by 2010 and USD 6 billion by 2015.

WWF

Aquaculture Dialogue on *Pangasius* catfish

In September, the World Wild Life Fund (WWF) will start the process to develop standards for the certification of *Pangasius* aquaculture products. It will be held in Ho Chi Minh City, Vietnam from September 26 to 27. The main purpose of the meeting will be to identify and agree on 6-8 main environmental and social impacts related to the farming of *tra* and *basa* – the two key market species in the *Pangasius* family. A wide range of stakeholders have agreed to participate in the dialogue, including producers, processors, exporters, feed manufacturers, retailers, government agencies and nonprofit organizations working on environmental and social issues related to aquaculture.

The process, called the Pangasius Aquaculture Dialogue, will continue through 2008, when participants will meet to develop credible, measurable and voluntary standards designed to minimize the key impacts they identify in September. Once finalized, the standards will be handed off to a new or existing certification entity to manage the system.

Dr. Flavio Corsin, who will coordinate the dialogue for World Wildlife Fund (WWF), said, " Pangasius farming is one of the fastest growing types of aquaculture in the world. It is critical to minimize Pangasius farming's impact on the environment and society, while also accommodating the market demand for this type of fish."

The first Pangasius dialogue meeting will be held in and focused on Vietnam, where 90% of Pangasius farming occurs. Growth in production has been phenomenal. It is expected to reach 1 million tonnes in 2007. This growth raises concerns about the sustainability of Pangasius aquaculture products, particularly from an environmental and social aspect.

The Pangasius Aquaculture Dialogue is one of six dialogues initiated by the WWF. The others are for developing standards to certify salmon, shrimp and tilapia aquaculture products. Each dialogue group is a network of producers, members of the market chain, researchers, nonprofit organizations, government officials, and investors. They use a transparent, multi-stakeholder process to develop the standards.

WWF has also announced that draft standards for certifying tilapia aquaculture products have been developed and was discussed in conjunction with the INFOFISH organized Tilapia 2007 in Kuala Lumpur, Malaysia from 26-27 August. The standards are a product of the consensus building process used by the Tilapia Aquaculture Dialogue which took two years of meetings with many of the world's top tilapia producers and buyers. These are expected to be finalized by the end of the year, after feedback from the dialogue participants and general public are incorporated.

More information: www.worldwildlife.org/aquadialogues (Related news-page 40)

Philippines

Master plan for growth in tilapia production

The negative effect of the prolonged drought will be on freshwater fish ponds culturing tilapia, mainly in the main tilapia culture areas of Central Luzon. This may bring down production by 45,743 tonnes of freshwater tilapia. However, this can be offset by opening up areas such as saline tilapia in mariculture parks, according to the director of the Bureau of Fisheries and Aquatic Resources (BFAR), Malcolm Sarmiento. He added that the dry spell can be beneficial for the culture of milkfish and saline tilapia, both of which are more suitable in waters with higher temperature and salinity. BFAR will also encourage farmers to recycle water.

Dr Rafael D. Guerrero III and wife (second and third from right) with Philippines participants at Tilapia 2007

The Philippines is a major producer of the tilapia. In 2005, production increased to 163,000 tonnes from 145,900 tonnes in 2004, according to the Bureau of Agricultural Statistics. The main culture systems are ponds and cages, contributing 60% and 30% of production, respectively. Brackish water culture accounts for the balance of 10%.

During the recent conference organized by Infofish, Tilapia 2007 held from 23-25 August, 2007 in Kuala Lumpur, Dr Rafael D. Guerrero III, the Executive Director of the Philippine Council for Aquatic and Marine Research and Development said that the government is now looking at increasing production of tilapia.

"In the master plan for tilapia, we want to use more quality fingerlings. We are producing 2 billion fingerlings and we will increase this to 4 billion by 2010. We will put up more hatcheries to produce the strain Get Excel Tilapia developed by BFAR. At the same time, extension services to the farmers will be increased".

He added, "Attending this conference are some processors who will be learning more on the processing and marketing of tilapia. Some have been more involved in tuna marketing and are looking to diversify to other species. Tilapia is an alternative choice as we have been farming it for several decades. BFAR will put up a processing plant in Mindanao, where there are no problems with typhoons etc. Instead, our problem will be how to produce quality fish of 600-800g with high fillet yield. We are also looking for sites to set up integrated farms".

"Relative to other countries, such as China, our cost of production is high. We have identified two major items where we can reduce costs. Cost of energy is cheaper in Mindanao with hydro electric power. To reduce feed costs, we are looking to substitute fish meal with earthworms, similar to some feeds produced in Europe using polychaete worms".

Rafael said, "The potential will be in brackish water ponds using saline tolerant tilapia. There are about 200,000ha of brackish water areas with low productivity. Previously they were used for the production of milkfish which is now cultured in cages. We have two strains of saline tilapia, *Oreochromis mossambicus* and a hybrid of *O. niloticus x O. spirulus*".

"We still think that the local market will continue to be a major one. However, we have to bring down prices to affordable levels. If we can produce at the right time, we can compete with imports of *Pangasius* catfish".

Brief news

No anti dumping duties for Ecuador's shrimp

In a reaction to the World Trade Organization (WTO) conclusion that it had acted inconsistently in 'determinations of sales at less than fair value (dumping) with respect to certain frozen warm water shrimp from Ecuador', the US Department of Commerce (DoC) has revoked the shrimp anti-dumping duties for Ecuador from August 15, 2007. With this decision, shrimp imports from Ecuador into the US will not be subjected to the 2.48 to 4.42% duties. These were imposed in December 2004, together with Brazil, China, Vietnam, Thailand and India. In July 2006, Ecuador resubmitted its complaint to WTO. Other complainants to the WTO include India and Thailand. The verdict for India is expected in September. The online WSJ quoted A.J. Tharakan, national president of Seafood Exporters Association of India, that a favourable WTO verdict in the bond issue, coupled with applying the Ecuador ruling for other countries, could brighten the prospects for Indian shrimp exporters.

Asean versus Australia at WTO on shrimp imports

Thailand, the largest exporter of shrimp to Australia, will join nine other countries and take Australia to WTO over its tough new restrictions on shrimp imports. The group, which includes China, Vietnam, Taiwan, Indonesia, Malaysia and the Philippines claimed that the new quarantine requirements specified by Australian regulator Biosecurity Australia on raw shrimp imports are a non-tariff barrier to trade, aimed at protecting the USD 51 million local industry from the USD 2 billion import industry.

The revised interim quarantine measures specified that imports should be sourced from a country or zone recognised by Australia to be free of WSSV, infectious hypodermal and haematopoietic necrosis virus (IHHNV), yellowhead virus (YHV) and Taura syndrome virus (TSV) and if not from a disease free source, have each batch tested on arrival with negative results for WSSV, IHHNV and YHV; or be cooked.

Thai officials at a meeting in Australia said that the requirements are unnecessary, onerous and scientifically unsound, according to fishsite.com. Bangkok-based shrimp disease expert Tim Flegel from Mahidol University, who accompanied the Thai officials, said that it was "very likely" that Australia would lose the case, especially as the World Animal Health Organisation is revising its guidelines on transferable diseases to specifically exclude shrimp sold for human consumption from the so-called "disease-risk pathway".

Hygiene compliant exports increased 13%

Bangladesh's shrimp exports increased 13% in 2006-07 fiscal year, according to the Daily Star. This was because "Bangladeshi producers are ensuring hygiene compliance, making the country more competitive in the global shrimp market," said Ehsanul Matin Panni, an exporter. Demand for Bangladeshi shrimp is increasing in European and US markets. Bangladeshi shrimp received an additional price of about US 37 cents for each pound unit in 2006-07 compared to 2005-06, thanks to the growing demand and reputation, according to Export Promotion Bureau statistics. Producers have spent a huge amount of money on ensuring hygienic compliance at every step from farming to processing.

Shrimp farmers dispute Wal-Mart

Thai shrimp farmers said that their exports are getting a poor image in the US and world markets, because of misinformation provided by American retail giant Wal-Mart. In the Nation, Bunjonk Nissapawanich, president of the Thai Eastern Shrimp Farmers' Association said that the Department of Fisheries should refute the article and inform the world that the Thai shrimp industry has continued to upgrade standards, with or without Wal-Mart. Thai shrimp is well known and well received by world consumers for its high quality, food safety and traceability. This is due to the sustainable standard implemented by the department and practices by all shrimp farmers through the Code of Conduct and Good Aquaculture Practice, Bunjonk said.

In July, an article in the WSJ, The New Wal-Mart Effect: Cleaner Thai Shrimp Farms said that Rubicon Resources, a US-based supplier of farmed shrimp to Wal-Mart, had bought and upgraded some 150 small shrimp farms in Thailand out of concern for environmental and social standards. It added that 80% of small independent Thai shrimp farms "lack the resources to make the necessary upgrades.

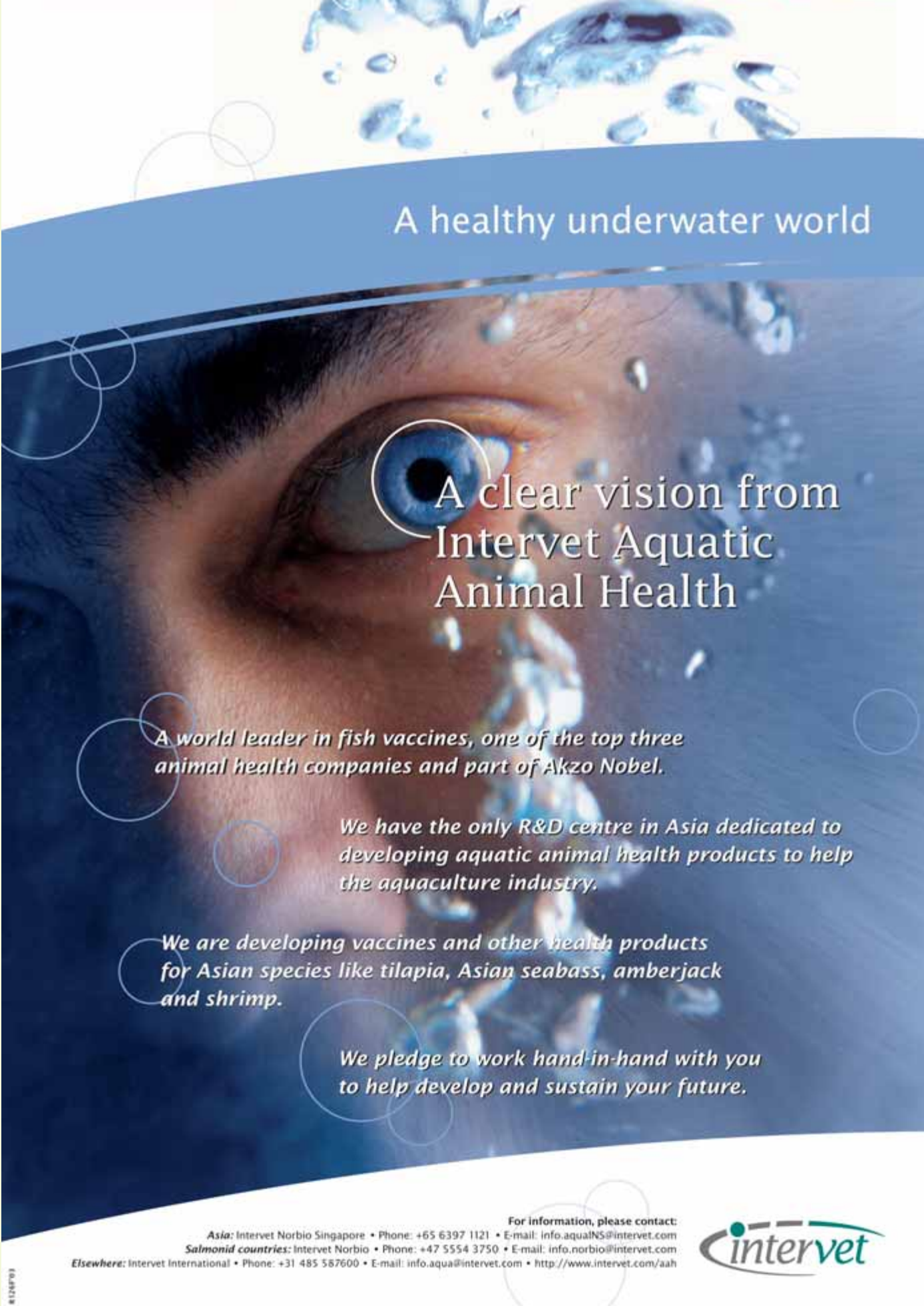
NZ to be major player in mussel farming

A Rabobank report said that New Zealand will emerge as a niche player in the global aquaculture market as it has abundant clean coastal waters, an unmatched clean and green global image and strong focus on product quality and integrity. Growth in production from key commercial sectors grew from 23,000 tonnes in 1990 to over 107,000 tonnes in 2006. The three major commercial aquaculture activities in New Zealand as long line Greenshell™ mussel farming, cage farming of king salmon and inter-tidal farming of pacific oysters. Of these the mussel industry showed the most dynamic growth, increasing by 470% since 1990 to nearly 100,000 tonnes. The growth of New Zealand aquaculture is closely linked to success in export markets, given New Zealand's relatively small population of around 4 million. Thus the strength of the world economy and the ability of New Zealand to access markets and to tap into higher value segments of these markets are key, according to the report.

First open sea cages in India

The first open sea cage has been launched by the Central Marine Fisheries Research Institute (CMFRI) in 10 m deep waters off Visakhapatnam on the east coast of India. This experimental project is for the culture of seabass. Cages with a diameter of 15 m were designed and fabricated locally and made of high density polyethylene (HDPE) pipes. It has two circular nets- an outer predator net and an inner fish net. The cage is anchored well and can withstand rough sea conditions.

Some 6,000 seabass have been stocked in the nets. In addition to this, there is a bird net. A production of nearly 2 tonnes can be harvested from the cage after a period of about 5 months, according to Dr Mohan Joseph, Director, CMFRI, the principal investigator of the project. CMFRI has plans to launch similar projects in three more centres, namely Ratnagiri, Diu, on the east coast and Mandapam in the south.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INDONESIAN AQUACULTURE2007

Sustainable aquaculture and food safety

Indonesia, one of the global leaders in aquaculture has the opportunity to expand aquaculture production from 3.08 million tonnes in 2006 to 3.6 million tonnes in 2007 and onwards to 4.3 million tonnes in 2009. In the national aquaculture policy, the catch phrases are *Propekan*-to increase export-oriented aquaculture production; *Proksimas*-to increase aquaculture production for in-country consumption and *Prolinda*- to ensure the protection of natural fisheries resources. Currently, the focus is on the development of prime commodities such as shrimp, seaweed, grouper, tilapia, pearl oysters, crabs, ornamental fish, milkfish, pangasius, carp, guorami, and shellfish.

The objective of Indonesian Aquaculture, held from 30 July to 2 August 2007, was to convene an industry forum and seek a common vision amongst central government, local governments, the private sector, farmers and other stakeholders involved in the development of aquaculture. It was also a venue for industry to network. More than 600 participants, mainly from Indonesia's marine shrimp industry attended the meeting and trade show. It was organised by the Directorate of Aquaculture, Ministry of Marine Affairs and was supported by the several producer associations including Shrimp Club Indonesia (SCI), and Indonesian Feed mill Association (GPMT).

Dr Chalor Limsuwan, Thailand (right, pictured with Dr Dean Akiyama, PT Central Proteinprima), presented "Recent developments in Shrimp disease management in Thailand". He provided information on current diseases affecting vannamei as well as some methods on prevention. He summarized that the key factors are good post larvae. These should reach 10g in 60-65 days in stocking density of 90 PL/m². The shrimp should reach 20g in 3 months. Next is maintaining the best conditions in the pond environment. Amongst these is dissolved oxygen which should be maintained at above 4 mg/l and in certain areas. Chalor added, "Unfortunately, most farms can buy lots of postlarvae but will not invest in an oxygen meter, the cost of which is equivalent to 20kg of shrimp".

Dr Endhay Kusnendar (left) and Dr David Drahos, Novozymes, USA. "This was a very successful event according to Dr Endhay Kusnendar , Chairman of organizing committee. The government is looking at having such gatherings annually".

At the plenary and shrimp farmer session, David spoke on the microbes that can help the farmer solve specific problems and ensure optimal growth of shrimp. A successful farmer can reap the benefits of biotechnology instead of using chemical means.

Although opportunities for increasing exports of farmed shrimp and fish are bright, progress has been dampened by frequent reports of contamination with chemicals, bacteria and antibiotic residues in fish and shrimp from Indonesia. The number of notifications through EU's Rapid Alert Systems for Feed and Food (RASFF) declined in 2006, but only marginally as compared to 2005. During routine inspections, the Food and Veterinary Office of the European Commission said that more needs to be done to ensure that specific food safety parameters are met.

How the farmed marine shrimp industry should act on this, was the main topic at the 3-day conference. At the plenary session, Dr Made L. Nurdjana, Director of Aquaculture called on industry to look into new

Participants, From left, Dr Andi Tamsil, Makasaar Muslim University, Safwin, Shrimp Club North Sumatra, Malik Masry, Adviser to SCI and farm owner in Makassar, Arianto, PT Suri Tani Pemuka and Hasan Widjaya, Advisor, Shrimp Club Medan.

In the audience, from left Park See Woo (PT Aquarium Shrimp Pontianak), Choi Jong Sun (President Director of CJ feed Indonesia) and Lee Jun (PT Aquarium Shrimp Pontianak)

technologies in marine shrimp farming. Technology in aqua engineering, biotechnology, aeration technology etc. has changed in leaps and bounds. He added that by refraining from using banned chemicals and antibiotics, farmers can see the benefits of these technological advances. At the special shrimp producer session, sponsored by CJ Feed Indonesia, international speakers discussed several aspects in marine shrimp farming technology.

The current threats to industry sustainability are food safety and the environment. A dialog session on "Indonesia shrimp industry and the international market challenge' followed. Dr Made, Iwan Sutanto, Shrimp Club Indonesia (SCI, see p10), Aris Utama, Indonesia Frozen Seafood Association (APCI) and Yani Surya (Indonesia Shrimp Hatchery Association) urged stakeholders to follow codes of practices and focus on food safety to gain market access.

During the opening ceremony, the Minister of Marine Affairs and Fisheries, Freddy Numberi emphasised on the role of aquaculture in Indonesia's economy as a source of employment and revenue. To maintain its position as top exporter, his plea to producers was to run the business in accordance with all the standards, rules and regulations.

"I also make the same plea to all involved in grow-out, feed production and aquaculture inputs including chemicals and pharmaceuticals. This is vital so that we can guarantee the safety of food produced, both for all consumers, domestic and overseas".

Puspita Dewi Prijadi, President Director, with her team.

Launch of marine fish feeds

At its booth, Puspita Dewi Prijadi, President Director of PT Matahari Sakti, introduced the new Megami range of feeds for *Plectomus leopardus* (Sunu grouper), *Cromileptes altivelis* (humpback grouper), *Epinephelus fuscoguttatus* (brown grouper), *Lates calcarifer* and *Lutjanus sp* (snappers). For the grouper, the 47-50% crude protein and 13% crude fat feeds are sinking whereas both floating and sinking pellets containing 44-48% crude protein and 13% fat are produced for the seabass and snapper. The word 'Megami' is derived from the Japanese word which means 'Sea Goddess'. The company started its aquafeed business in 1988.

SCI on food safety and traceability: Go for it

Amidst threats to the farmed shrimp industry on imports into Indonesia from China, in particular, there was a move to form an association of farm owners to protect the interest of the industry. Thus Shrimp Club Indonesia (SCI) was formed in 2005.

Iwan Sutanto, President and protagonist of Shrimp Club Indonesia said, "We had a sudden introduction to global issues such as antidumping, sustainable aquaculture, traceability and food safety. It was difficult for farm owners in remote areas to keep up to date with issues. We realized that we needed to act together. We also need to have information exchange regularly."

SCI is an association of owners of shrimp farms only. There are 360 members from 13 districts in Indonesia stretching from Medan, Lampung, Sukabumi, West Kalimantan, South Sulawesi, Malang, Surabaya, Situbondo, Tuban, Banyuwangi, Lombok, Sumbawa and Bali. These are mainly owners of intensive ponds with a total yearly production of 120,000 tonnes.

"We believe that among us in Indonesia, we are not in competition. We are all together. No one should allow prices to decline and if one person fails, we all will fail. Our misson is to increase productivity with the transfer of technology. Our motto is "Bersama kita bisa" (translated as "Together we can")

There is already the awareness in the industry on food safety, traceability and environmental issues. The next step is how to incorporate these into current culture practices.

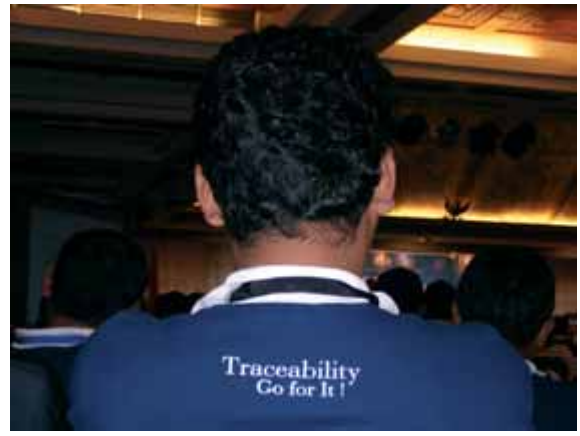
"Many members know how to farm shrimp well and that antibiotics should not be used. However, there is little attention on environmental impact. We know that we must learn how to manage effluents, water intake etc. Most farms are about 10-20 years old and modifications are required as pond design and construction may not fit into the current norms for shrimp farming. However, industry is under pressure to demonstrate that measures are in place to ensure that exports can meet the requirements of markets in the EU, USA and Japan".

"It was only recently in 2007 that the government introduced three regulations on good aquaculture practices for immediate implementation. These are in GAP and on the distribution and trade of pond chemical and drugs".

"I believe that we are ready. In one year we have taken action. In 2006, a technical team from SCI had a road show to every production area across the vast archipelago. Each farm must exercise good hygiene practice. There is data to indicate that use of antibiotics is decreasing. In August, we will have an inspection team from the USFDA (US Food and Drug Agency) and in November, the EU commission's inspection team. I have asked the EU team to please give us more time as we have only recently implemented these regulations. I am confident that the team will be satisfied with our efforts. I can assure you that the numbers of reports on antibiotics residues will go down".

The new regulations cover grow-out farms and hatcheries and all have to be certified. SCI also works together with the Indonesian association of hatchery owners (APPUI) and cooperate with the association of processors (APCI) and feed producers.

"In our objective to achieve food safety and traceability in the industry and produce consistent quality shrimp, we have reached out to all in the supply chain. We have emphasized that if the hatcheries continue to use antibiotics, producers will be implicated and the whole industry will collapse. This will have country wide ramifications", added Iwan.



Shrimp club member at the dialog session with the latest catch phrase "Traceability – Go for it"

Iwan is optimistic that Indonesia will maintain its competiveness and prices will improve. Indonesia's problems with the increasing costs of production are also shared by the other countries in the region such as India and Vietnam. The cost of production is very similar and he does not see this as a threat. In the case of Indonesian producers, profits per kg are only IDR 2,000 if they can produce 10 tonnes/ha, FCR of 1.6 and sizes 60 pcs/kg. If the production is only 8 tonnes/ha, the farmer makes a loss.

"Failures in the culture of black tiger shrimp in 2001 forced us to switch to P. vannamei in 2002. Immediately, we faced the challenge of a globalised market when prices fell and exports to the EU were restricted.. But one day, when we have SPF monodon I am confident that black tiger shrimp culture will resume. It is after all our native species".

Iwan Sutanto started a farm in Surabaya on graduating from Malang University of Fisheries in 1989. The farm was run using culture technology from Taiwan. In 1994, due to crop failures from white spot virus syndrome with *P.monodon* at the farm, he moved to Lampung, his home town. He then changed to the heterotrophic culture system. In 1997, a group of farm owners in Lampung decided to form a shrimp club (SC) to work together to advance shrimp culture. Iwan became its first president. The group organized visits to several countries in the region to learn farming practices. The period around 1998 was the golden years for shrimp culture as prices rose from IDR 20,000/kg to IDR 100,000/kg. SC Lampung became the predecessor to the SCI.

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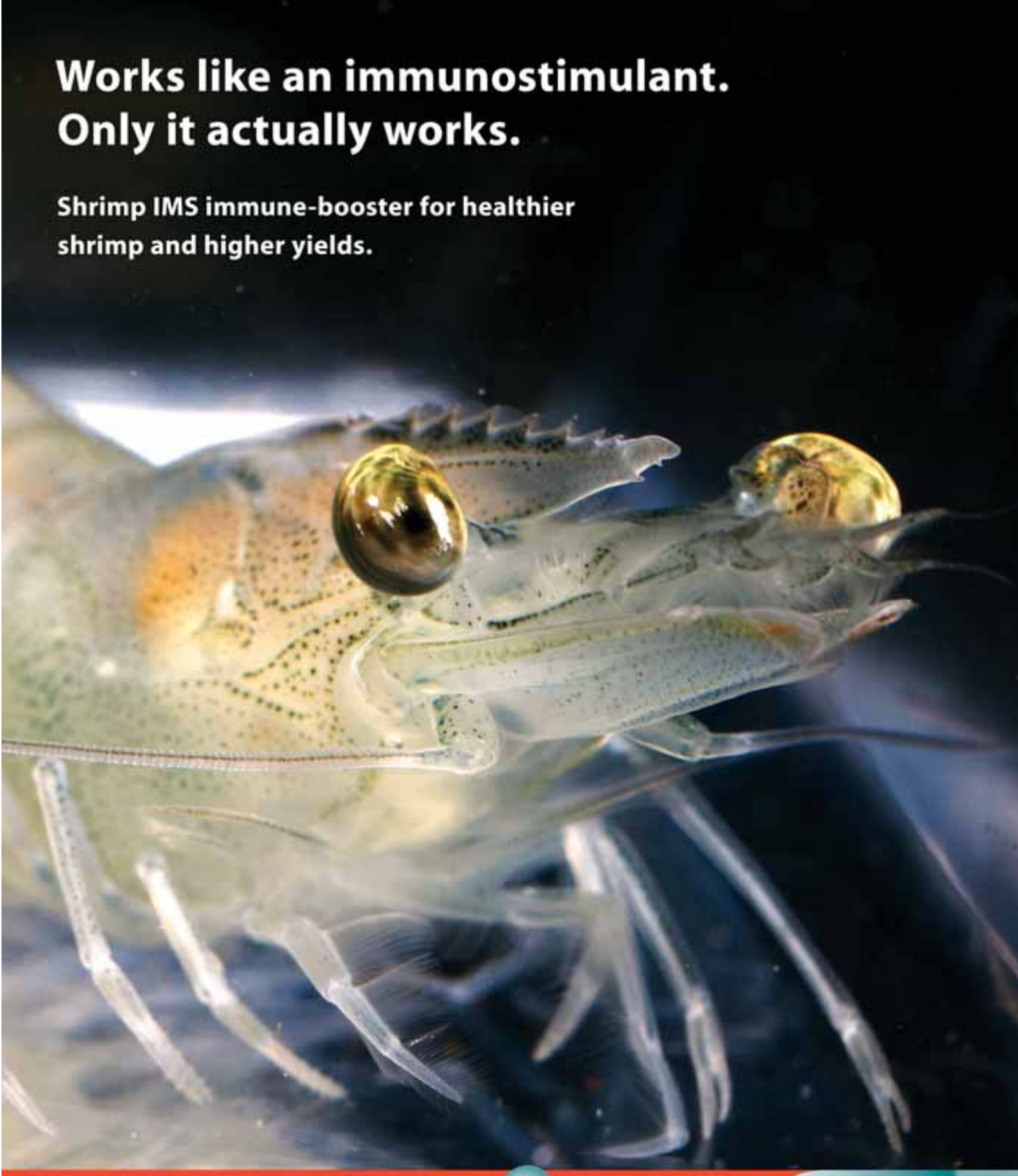

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Indonesia Aquaculture 2007

Food safety starts with quality feeds

PT Gold Coin Indonesia, a veteran shrimp feed producer will continue to expand production to support shrimp culture activities. The flagship mill in Bekasi is ready with feed that meets international food safety standards. The industry in Indonesia has to focus on food safety in the production chain to meet global standards according to JC Filippi, Gold Coin Group CEO.

JC Filippi (right) and Sam Soh at the GC booth. "The Gold Coin culture is the belief that we do our business professionally with very high standards in a sincere and caring manner. Our motto is "Grow with Gold Coin" and by working hand in hand with shrimp farmers in improving their farming skills, they can grow together with us".

In Indonesia, the company was one of the early promoters of commercial culture of *udang windu* or black tiger shrimp *Penaeus monodon*. Its shrimp feed business was started in the 1980s by first importing feed from Malaysia before a mill was ready in 1989 in Bekasi and later in 1993 with another mill in Medan. Today, it has a large presence in all the key marine shrimp culture areas in Indonesia- from North Sumatra, Lampung, East and West Java to Bali where the *P. vannamei* shrimp is now the main culture species and in Sumbawa and Kalimantan where black tiger shrimp dominate. In the last 7 years, the company reported impressive feed sales with volumes increasing almost three times. Since 2007, production capacity has doubled in the mill at Bekasi.

During Indonesia Aquaculture 2007, held in Bali from 27 July to 2 August, JC Filippi (JC) and Sam Soh (SS), Regional Director in charge of the aquaculture and livestock business for Indonesia, Thailand and India spoke on various issues unique to the industry in Indonesia such as food safety, the independent feed market amidst the trend to package feeds with post larvae and how it plans to optimize on opportunities and mitigate threats.

Success in Indonesia

JC - We are reputed to be the largest independent feed miller for shrimp and livestock feeds. In Indonesia our focus is on the free market. Our customers are farmers practising intensive culture who demand feed that can perform under exigent culture conditions. Our success is measured by the demand of our feeds. With demand outpacing capacities, we increased our shrimp feed capacity for the Bekasi mill this year, and we are now working on expanding and upgrading the mill in Medan.

How GC optimizes opportunities and mitigates risks in Indonesia

JC: Indonesia remains a very important market for GC. This is an emerging country with very strong expansion growth potential. It is one of the top shrimp exporters to Japan and the USA and with the strong governmental emphasis on the industry, there is plenty of scope for growth in shrimp culture. Within the country, shrimp consumption is relatively small. More domestic consumption can be encouraged to mitigate the effects of declining prices. This is possible as we see that the economy of the country is growing and purchasing power is increasing.

As part of the Group's direction to play a leading role in the food safety system in the countries where we are operating in, GC Bekasi Livestock became the first feedmill within Indonesia to receive the ISO22000 certification. The main advantage for the customer is that Gold Coin products meet the strictest requirements for food safety. Together with Gold Coin's high quality, the farmers can be assured that feeds given to their animals enjoy good performance with least problems. Within the next 2 years, we aim to have all our Indonesia operations certified.

Diversification opportunities are present in the extruded fish feed markets to extend our revenue stream while softening seasonality effects of shrimp business. Our shrimp business has been enjoying compound growth; we see further expansion opportunities in this business by expanding capacities through acquisition or putting up additional production lines. We are also now keenly looking at investing in some projects that secures vital raw materials for production.

Regionally, we have operations in Malaysia, China, Thailand, Vietnam, India, and Sri Lanka. While we intend to replicate our Indonesian success in our new JV setup in India, there are also many best practices within the Group that are consistently applied across all mills, thus making the GC group of companies fairly consistent in its approaches towards the market and customers.

The PT Gold Coin Specialties from the Bekasi Feed mill in West Java. From left: Yudie Wirawan, Djoko Subono, A. Faridi, Budi Rasdiono and M. Fitri.. The feedmill produces 3 grades of feeds for both vannamei and monodon shrimp. Majority of farmers culturing vannamei shrimp usually use the Supreme brand of monodon feed for early stages of culture and then shift to the lower (36%) crude protein Forte brand of vannamei feeds from 100 days to harvest. Some 10% of their customers in East Java and Sumbawa culture only black tiger shrimp and these are for the large shrimp (40g) market.

SS: In Indonesia, we sell through a combination of distributors and directly to farms. Our farmers have been using our feed for many years. Our success is that they remain satisfied with our feed and that their priority is consistent quality over price. When vannamei shrimp farming came on board, we developed and launched a dedicated feed, Gold Forte, for this species based on research of appropriate nutrients and feedback from the market. Over the years, these experiences were exported to other GC mills within the region and the name Gold Forte is now synonymous with vannamei farming around South East Asia.

A look at some challenges unique to Indonesia

.....on food safety

SS: Similar to other stakeholders, I see that food safety and product traceability are fast becoming mandatory requirements by importing countries. As a major shrimp exporting country, adherence to international standards is extremely important for Indonesia and is the responsibility of all stakeholders. Doing so will not only comply with standards but also raise quality of products. The impact of the antibiotic cases detected on Indonesia shrimp shipped to Japan did bring down confidence and credibility of the industry along with delays in payments by cold storage to farmers.

JC: We foresee that the industry here will need to adjust itself for standards indicating compliance to international norms on quality. This means that it is necessary for the industry to organize itself in the same direction with a focus on GMP, HACCP and testing of raw materials and final shrimp products.

...on production efficiency

SS: Declines in shrimp prices amidst rising operating costs will remain a constant challenge for the industry, just like what happened two years back when farmers had to look at increasing production efficiency amidst skyrocketing fuel costs and when overall production cost increased by 16%.

With shrinking margins, farmers in certain areas may start to look for lower grade feed to keep their production costs low. The industry must remember though that such low cost shrimp feeds may not be in line with the nutritional requirements of shrimp but may pose a threat to the sustainability of the industry.

JC: As a feed producer, our role is to look out for ways to increase production efficiency. We look at using alternative raw material sources to keep costs of feed low relative to overall costs of production. As a group, we continuously look at the strategic supply of key raw materials at competitive prices. We realise that any feed changes that we introduce must be appropriate to the culture system and that it must contribute to the sustainability of the industry.

..on bundling of feeds with postlarvae supply

JC: In Indonesia, farmers easily enter into partnership with feed mills which provide a total "package" ranging from fry, feed, to collection of harvest. While it may be argued that logistics and convenience follow, one must remember that if this came about as a result of lack of choice amongst farmers. Then does this really help or bind the farmers?

In the case of Gold Coin, we remain committed to the core business of shrimp feed manufacturing. The choice of postlarvae, feed and production should be in the hands of the farmers. Our aim is for independent farmers to have alternative choices not only in feed supply but also in PL supply. At the moment, choices are limited and confine independent farmers to integration. Monopolistic arrangements can negatively pull down an industry in the long term. We know that our strong bond with farmers- our partners- has enabled us to achieve our strong position in the feed market for shrimp. We will continue to focus on selling feed only and will remain committed to give our best to customers in terms of quality and services. We have a simple yet effective system where the Group keeps in touch with the market not only through sales and technical staff visits to the farmer but where local and regional management actively seeks the feedback to meet the needs of farmers".

Immunostimulation in aquaculture: What's the news?

By Klaus Hoffmann

The use of pro- and prebiotics on one hand, or nucleotides on the other hand, to enhance general animal health and performance are claimed not to be restricted to species or applications. However, we are much closer to understanding the role of these feed additives in fish than in crustaceans.

Although there has been considerable improvement in the management of farms in aquaculture during the last decades, there is still the risk of financial losses due to diseases, either through mortality or reduced meat quality. Often the animals are kept under stressful conditions, such as overstocking, poorly adjusted feed levels or bad feed quality as well as variation in water temperature or water quality such as pH-values and salinity. As shown in land animals, stress reduces productivity and promotes the outbreak of diseases. There is a direct negative effect of stress on the immunity and general constitution of the animals.

With stress the primary line of defence against bacterial, viral or parasitic infections is weakened, increasing the susceptibility to infections. In this stage any health challenge taxes the organism's resources thus affecting productivity and performance and finally reducing the profit for the producer. The economic losses can be huge.

In the last few years, many shrimp farms around the world have been particularly badly hit by epidemics of various viruses, generating losses of thousands of millions of USD worldwide. Good husbandry practices help at least to some degree to reduce the risk of outbreak of diseases, but additional protective activities are essential to minimise the risk of epidemics. The use of antibiotics or other chemical substances in culture ponds is expensive and undesirable with respect to consumers and environment. Hence, comparable approaches to disease control in livestock industry as well as in humans shift the interest on compounds that confer protection and/or enhancement of immune reactivity to likely pathogens.

Immunostimulation as a key to enhanced health and performance

Probiotics, prebiotics and other additives supporting the immune system claim to support general health and, as a consequence, improve productivity and performance in livestock industry as well as in aquaculture. The differences in the setup of the immune system between animals and aquatic species, in the past have lead to controversial discussions on the efficacy of immunostimulants. The immune system of fish is closer to the mammalian immunity than of the crustacean.

In fish unspecific or innate mechanisms contributes significantly more to immune response than the specific or acquired defense. Innate immunity includes various phagocytic cells as well as different kinds defence proteins. Acquired immune response comprises memory-based reactions of specific cells in the organism which are assembled during or after the initial contact of the animal with an antigen (bacterial, viral or parasitic). In crustaceans, a very basic non-specific immunity consisting of various agglutinating proteins involved in inflammatory-type of reactions is found. These differences allow for the transfer of any immunostimulatory effect from land animals to fish which is easier than the transfer to crustaceans.

Prebiotics and Probiotics – a breakthrough in fish?

Dietary supplements of live organisms are classified as probiotics. By affecting the intestinal microbial balance, probiotics may influence fish immunity, disease resistance and performance indices. In fish this group includes several bacterial strains (*Bacillus, Lactobacillus, Enterococcus* and *Carnobacterium*) as well as yeast strains (*Saccharomyces* and *Candida*). Probiotics may be added to the diets as well as directly to the aquatic medium claiming to reduce the presence of potential pathogenic bacteria by competitive exclusion.

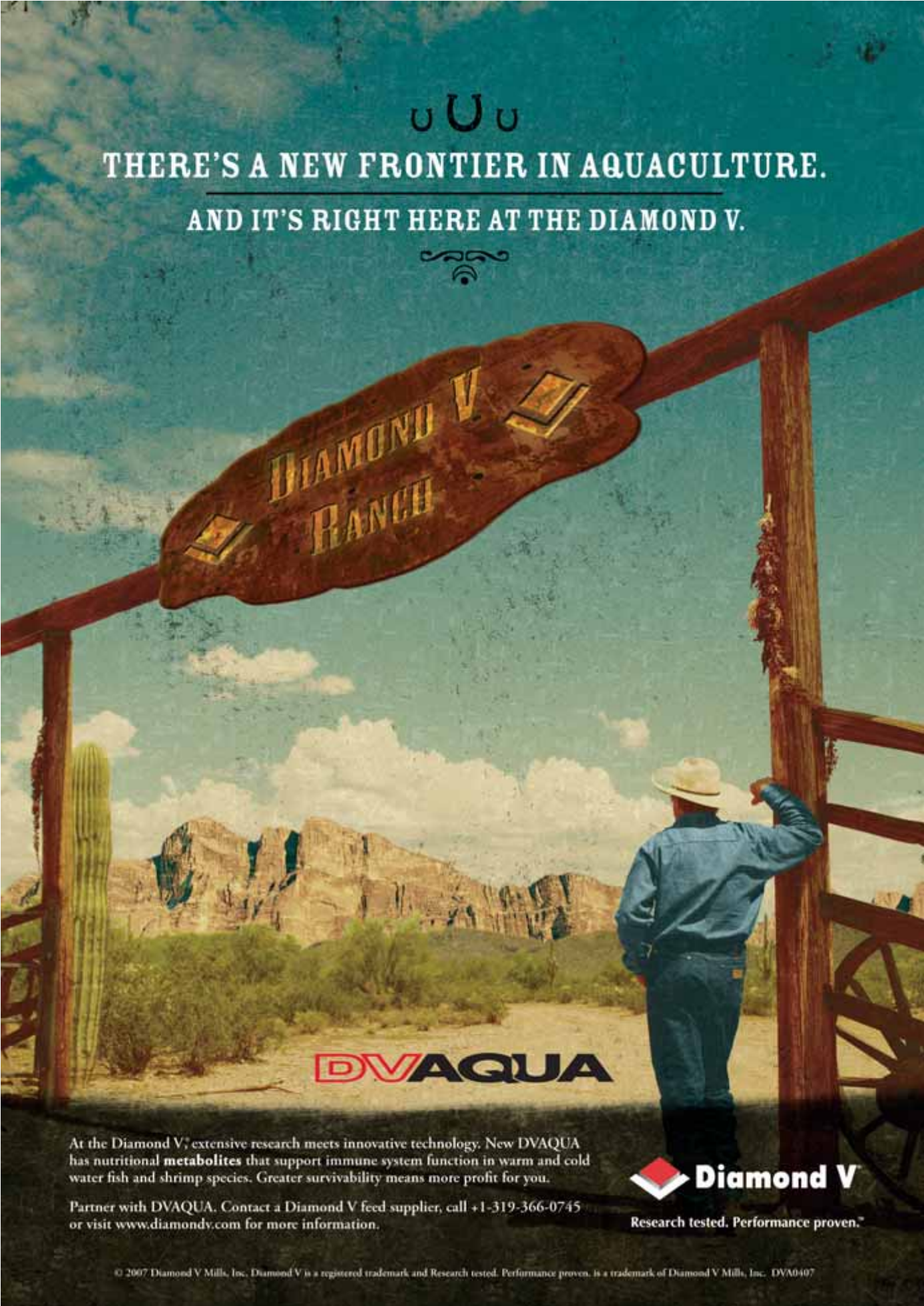
The current restrictions on application of probiotics in aquaculture include cost as well as insufficient evaluation of the biological consequences on natural microbial biodiversity. This has to be addressed more carefully in basic as well as field research. Moreover the supplementation of feed with probiotics raises the question of their stability during feed manufacturing and storage. Potential losses in efficacy have to be considered when defining doses or inclusion rates. Moreover, it remains unclear to what extent dietary probiotics survive the process of digestion in the intestinal tract.

Nevertheless, some probiotics have been shown to be growth-stimulated by various so-called prebiotics. These substances including e.g. FOS, LPS and glucans have been extensively studied in terrestrial animals. The microorganisms supported by these prebiotics play integral roles in growth, digestion, immunity and disease resistance in livestock and humans. The current research on prebiotics with fish is limited.

Although there are some recent studies available, the effect on the general health status of the animals remains questionable. Assuming that probiotics and prebiotics support the intestinal tract by balancing intestinal flora and the immune system, and thereby strengthening the general health status of the animals, this will consequently affect performance and productivity. Even if there is considerable potential of probiotics in aquaculture, the effective application will require intense characterisation and understanding of the microflora in fish.

Prebiotics and probiotics – what about crustaceans?

The differences in immunity hamper the direct assumption that pro- or prebiotics may be similarly beneficial in crustaceans. The lack of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specific or adaptive immunity prevents, as first approximation, analog supplements being likewise effective in crustaceans. Although the strengthening of the intestinal flora in shrimp to boost general health and performance might be as crucial, knowledge on intestinal microbes in shrimp is limited and needs to be studied more intensively .

Immunostimulation in crustaceans, to prevent outbreak of viral, bacterial or parasitic infections, has to target innate immunological pathways. The cellular effects on specific gene expression or posttranslational modifications of factors involved in phagocytosis or haemocyte encapsulation therefore needs to be examined upon usage of pro- or prebiotics.

There are several recent reports dealing with effects of biotic additives on a molecular level but the results seem to be inconsistent and it is too early to draw a conclusion on their efficacy on boosting unspecific immunity in crustaceans. The lack of profound scientific work on their efficacy, combined with limited knowledge on species specific differences in reactivity to pro- and prebiotics leads to an urgent need for proper large-scale and long-term evaluation of these additives.

For aquaculture a balanced application of synbiotics, which is a synonym for a combination of pro- and prebiotics, might be successful. But these combinations need to be studied in detail.

Is there an alternative to pro- and prebiotics for fish and shrimp?

For years, nucleic acids and nucleotides were not considered essential nutrients for use in any dietary programmes. It was thought that all organisms can supply sufficient amounts of nucleotides to meet their physiological demands via *de novo* synthesis or a so called "Salvage Pathway", a recycling of nucleotides from dead cells.

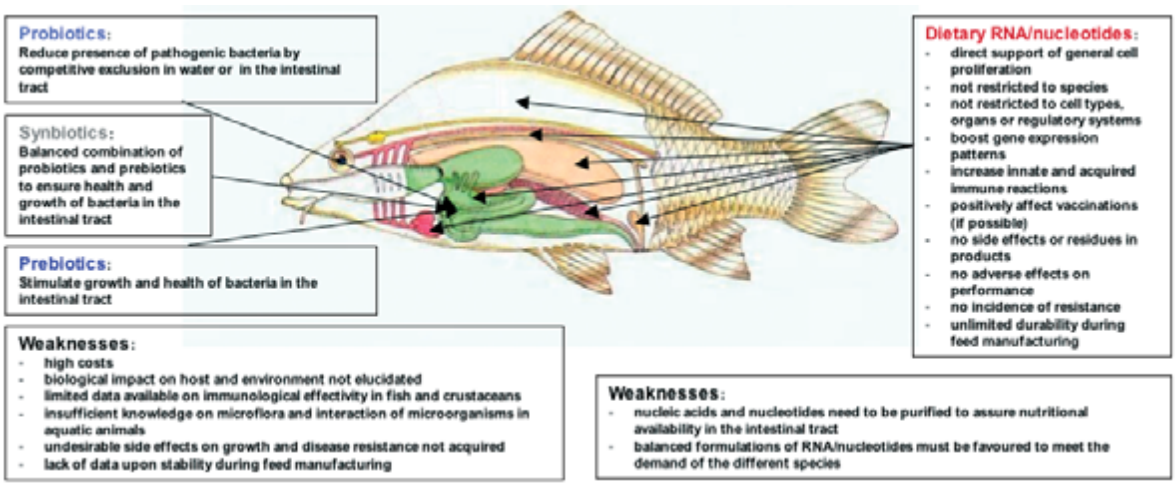
However, under certain conditions, including rapid growth, limited food supply, stress, immunological challenges and some others, dietary nucleotides become conditionally essential nutrients. They may spare the energetic and materialistic costs of the *de novo* synthesis as well as the poor efficiency of the salvaging and significantly speed up their availability for the organism. Balanced formulations of purified dietary nucleotides modulate innate and adaptive immune response as reported in numerous scientific publications .

Fish fed nucleotide-supplemented diets generally have shown enhanced resistance to viral, bacterial and parasitic infections. The reasons for the immunofacilitating properties of RNA/nucleotides include dietary provision of physiologically required levels of nucleotides due to limited synthetic capacity of certain tissues, inadequate energetic expenditure for *de novo* synthesis or salvage, immunoendocrine interactions and modulation of gene expression patterns.

Nucleotides are chemical compounds that consist of three portions: a heterocyclic base, a sugar, and one or more phosphate groups. In the most common nucleotides the base is a derivative of purine or pyrimidine, and the sugar is a five-carbon sugar (pentose). Nucleotides have universally valid essential physiological and biochemical functions including encoding and deciphering genetic information, mediating energy metabolism and cell signalling as well as serving as components of coenzymes, allosteric effectors and cellular agonists. RNA and nucleotides provide basic building blocks for cell proliferation in fauna and flora. Unhindered cell proliferation is a prerequisite for growth, repair, development and functionality of organs and regulatory systems (e.g. the immune system).

To date, with an increasing number of publications, rather consistent and encouraging trial results are reported favouring balanced formulations of free and isolated nucleotides for fish health management. Nucleic acids found in many feed and food ingredients are protected by specific binding proteins only allowing just around 30% to be nutritionally available for the organism. By isolating and purifying RNA/nucleotides, thereby eliminating the protective proteins, it is possible to formulate feed additives with a nucleotide availability of over 95%.

Dietary nucleotides have been shown to have multiple effects on the gastrointestinal tract in animal models, including physiological, morphological and microbiological influences. In Atlantic salmon the first morphological effect was observed when the fish were fed a nucleotide enriched diet by comparing the intestinal tract with control animals. Proximal, mid and distal intestinal villi were significantly longer, thereby simultaneously increasing the total gut surface area, compared to control animals. Similar results are available for sea bream. In higher vertebrates the positive effect of RNA/nucleotides on the composition of the intestinal microflora was reported. Although the



microbial ecology of fish still needs further research, possible positive effects of dietary nucleotides may be predictable as RNA/nucleotides are ubiquitously used in every animal species and microbes .

In terrestrial animals and humans, dietary nucleotides can influence macrophage and natural killer cell activities. From fish it was reported that they have direct influence on both humoral and cellular components of the innate immune system. In common carp an increase of serum complement and lysozyme activity as well as phagocytosis and superoxide anion production was observed upon feeding nucleotide-enriched diets. Hybrid striped bass had higher blood neutrophil oxidative radical production than fish fed a basal diet. However, an effect of dietary nucleotides on respiratory burst of head kidney cells could not be demonstrated in salmonids. In turbot a decreased lysozyme expression from spleen and kidney was observed upon nucleotides but no effect was apparent in the gills . Interleukin-1ß showed a significant increase in gene expression after nucleotide supplementation of the feed, whereas transferrin and transforming growth factor ß were not affected.

In tilapia, an immunopotentiating effect was observed upon direct injection or immersion with killed *Aeromonas* bacteria after feeding nucleotide-supplemented diets on both humoral and cell mediated response. Antibody titres after vaccination were significantly and tremendously higher in fish fed nucleotide diets. Identical results were found in mitogenic responses of lymphocytes. Both findings had been confirmed in e.g. rainbow trout, hybrid striped bass and Atlantic salmon. In turbot an enhanced expression of IgM and recombinase activating gene in gill and spleen with simultaneous reduction in kidney was observed.

Lacking an effective biomarker for disease resistance, survival after a challenge is a widespread measure of disease resistance in fish and crustaceans. A reduction in cumulative total mortality was observed in Atlantic salmon (upon infectious salmon anaemia), rainbow trout (infectious pancreatic necrosis and *V.anguillarum*), coho salmon (*P.salmonis*), common carp (*A.hydrophila*) and striped bass (*S.iniae*). Moreover, dietary nucleotides affected the development of sea lice in Atlantic salmon, thereby reducing the cross-infestation of other fish.

In crustaceans the positive effects of dietary nucleotides on the immune system was also reported. Under conditions of stress, the susceptibility to infections with pathogens increases dramatically resulting in elevated mortalities. In several reports from experiments in tanks and in ponds, the positive effect of nucleotide-enriched diets was outlined. In cases of outbreak of white spot syndrome virus, the use of nucleotide-supplemented feed not only lead to a reduction in mortalities of shrimp but also to elimination of viruses from the ponds as determined by PCR analysis.

Although the supportive mechanism of balanced formulations of free nucleotides on crustacean immunity is not yet clear, most of the results suggest their impact on stabilization and enhancement of innate immune response by triggering gene expression and/or maturation of defense components .

Conclusion

In contrast to pro-, pre or synbiotics, purified dietary RNA/nucleotides are not restricted to species or applications. Their universally valid use and diverse functionality in every living organism allows them to be regarded as a management tool to control stress, performance and diseases in the livestock industry and aquaculture.

However, prolonged administration of medication or immunostimulants often leads to undesirable side effects on growth and disease resistance. RNA/nucleotides do not stimulate innate or acquired immunity. By providing the resource for unhindered cell proliferation, gene expression and signalling they facilitate adequate reactivity upon health challenges. Other processes in the organism e.g. growth, development or reproduction need not be suppressed upon an infection as basic materials for cellular and molecular functionality are adequately supplied.

Dr. Klaus Hoffmann joined Chemoforma Ltd. as Manager Scientific Services with responsibilities in R&D and QC in 2001. He received his PhD in Biochemistry from the Freie Universität Berlin (Germany) thereafter working on biotechnology, gene regulation and molecular biology in universities and industry. Email: klaus.hoffmann@chemoforma.com

Innovative feed and feeding strategies to maximise the profit margins in organic aquaculture

By John Sweetman and Steve Craig

Marine shrimp can be grown up to 23g in a single growing season, utilising a diet without fish meal by applying a unique sustainable, organic certified protein source. This production method features lower stocking densities, the exploitation and natural manipulation of the microbial food web and enhanced environmental and animal welfare. Production costs were highly reduced and a higher value, organic product was obtained.

Development of organic aquaculture

Diminishing fishery harvests, food-safety issues, environmental concerns, increased fish consumption, and the increasing market share of organic food is pushing for an increase in consumer choice for 'organic aquaculture'. While limited statistics are available on organic aquaculture production, it is obvious that the production volumes are still low at present. However, consumer demand may well drive the organic production of finfish, shellfish and other aquatic products in the next decade. It has been predicted that organic aquaculture harvests will achieve 1.2 million tonnes by 2030. The production of organic salmon, cod and sea bass and sea bream in Europe is a rapidly developing industry driven by both consumer preference and higher profit margins for the producers.

There are still several difficulties in achieving organic aquaculture standards, with the principal problem related to the supply of organic feed and nutrient resources. To realize the predicted increase in organic production, alternative feedstuff protein sources are required, especially if they can be applied in alternative production systems.

Yeast as alternative protein source

For more than three decades, alternative protein sources and their use in aquafeed formulations have been studied. Apart from plant materials, research has shown that single cell proteins, including microalgae, bacteria, yeasts and yeast-derived products, have several advantages.

Utilisation of yeast to replace fish meal in diets has been investigated for numerous species. Yeasts represent a sustainable alternative protein

source that is relatively inexpensive, is easily produced on an industrial scale and in most cases, can be certified organically. Yeasts have a high nutritional value, because they are a rich source of proteins, B-complex vitamins, complex carbohydrates, such as glucans, and nucleotides. Another benefit of the use of yeasts in diets for fish is that they are also low in phosphorus, which will lead to less water and environmental pollution than fish meal and other plant-based alternative protein sources that contain high levels of phosphorus.

While most studies involving single-cell protein utilisation in aquafeeds demonstrate detrimental impacts on production characteristics at inclusion rates above 30%, research at the Virginia Tech Aquaculture Center (VTAC), USA, have shown higher fish meal replacement rates. NuPro®, a yeast extract (derived from a specific strain of *Saccharomyces cerevisiae*, Alltech Inc., USA) has been demonstrated to be a true alternative protein source.

Furthermore, research with NuPro at VTAC, in collaboration with the Organic Aquaculture Institute (OAI), has resulted in the first commercial production of *Penaeus vannamei* with aquafeeds containing no fish products and utilising novel production methods for organically certifiable marine shrimp.

Innovative feeding strategies

The microbial community in seawater has an enormous impact on primary productivity and food web structures. Almost half of the carbon fixed in primary production is estimated to flow through the bacterial/protozoa pathway. The natural productivity of shrimp ponds also provides a supplemental source of nutrients for growing shrimp and studies have shown that over 50% of shrimp growth in a pond is due to grazing on pond biota.

As shrimp are slow feeders, most nutrients are released into the pond environment and thus become available for bacteria. This means that shrimp producers are partially feeding the microbes, which in turn are feeding the animals, especially under low stocking density. Given that shrimp feeds are relatively costly, the profit margin in marine shrimp culture could be increased by fully exploiting the microbial food web and applying cheaper feed formulations.

Until now, fertilizers have rarely been applied in manipulating the microbial food web to optimise its management for shrimp production. Adjustments in the C:N ratio must be made to fully manipulate the nutrient flux pathways so that bacterial growth is stimulated. Bacterial biomass is transferred through the trophic levels and a carbon-rich media is added to encourage bacterial growth on a particle that is within the optimum size range for penaeid shrimp.

Bearing these issues in mind, commercial-scale trials at the OAI have led to novel feeding strategies that attempt to fully exploit and manage the microbial food web under organic production regimes.

Figure 1. Growth performance of marine shrimp over two consecutive production years. No differences were apparent between animals fed a traditional fish meal-based diet and those in which NuPro® replaced 100% of the fish meal.

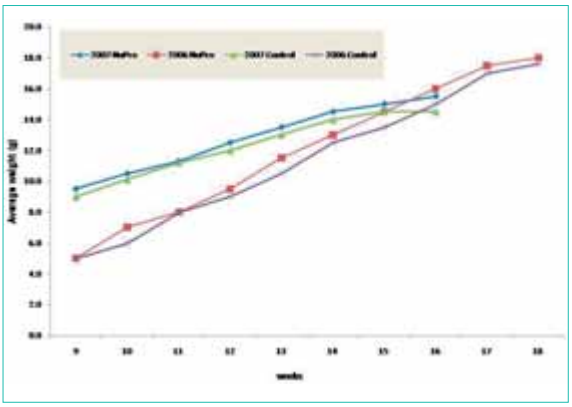
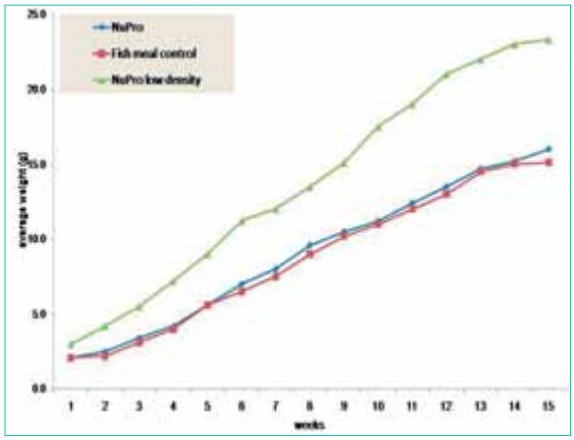


Figure 2. Weekly average weights of shrimp fed either a commercial shrimp aquafeed or one that replaced 100% of the fish meal with NuPro® on an iso-nitrogenous basis. The low density pond was stocked at 50% of the other ponds and fed the same NuPro®-based diet. All diets provided 30% crude protein on an as-fed basis.



Commercial organic shrimp production

Field trials were conducted at the OAI facilities in Imperial, Texas, USA, during the 2005 and 2006 growing seasons. In these trials shrimp were stocked at low stocking densities (10-12 animals/m^2) and fed either a commercial shrimp feed, or one that replaced the fish meal component with the yeast extract, NuPro®. These commercial-scale production runs were conducted under culture conditions that had previously been certified as organic.

The ponds were fertilised with organic compost, derived from dairy waste at a rate of 45-50 kg/pond/ either bi-monthly (2005) or daily (2006), to manipulate pond C:N ratios and thus maintain the microbial community at high levels for potential grazing by the shrimp. Additionally, the compost served as a substrate for further bacterial growth on which the shrimp could graze.

In the 2005-trials, diets were formulated to provide 35% crude protein (CP), either from a standard commercial diet, or in a diet in which the yeast extract replaced all the fish meal on an iso-nitrogenous basis. In all ponds, shrimp fed diets with the yeast extract were larger and had smaller individual variability when compared with shrimp from the control ponds. Survival in all ponds averaged 80% compared with a mean from 24 other shrimp farms in Texas of only 50%. Feed conversion ratios were 0.5 for both the control treatments. Typical shrimp FCR range from 1.5-2.0 when utilizing traditional culture practices. Clearly, the microbial community contributed significantly to the nutritional well-being of the culture system and the addition of compost maintained optimal C:N ratios for further microbial community enhancement.

In 2006, the yeast extract again replaced all the fish meal from a commercial shrimp formulation, but the protein levels were dropped to 30% CP. A standard commercial shrimp aquafeed containing 30%

CP diet served as the control. Shrimp were stocked at 10-12 animals/m^2. There were no differences in weight gain in shrimp fed either diet with increases from initial weight ranging from 550 to 610% and specific growth rates of approximately 2% body weight per day (Figure 1). Final harvest weight was 15.8 g/shrimp for the yeast extract -fed ponds compared with 15.1 g/shrimp for the control ponds.

In a parallel study, one pond was stocked at lower densities (5 shrimp/m^2) but fed using the identical protocols and yeast extract diet. This study was undertaken to assess the impact of stocking densities and lower protein feeds on animal growth potential. Shrimp in this pond reached an average harvest weight of 23.1 g (Figure 2).

Conclusion

Interest in organic aquaculture is based primarily upon the potential profitability of the organic sector. Field trials at the OAI have shown that the profit for the farmer can truly be maximised by exploiting the microbial food web, in conjunction with novel feeds such as NuPro®. In this way, high quality shrimp can be produced that meet organic certification criteria. The total yields for the farmer will be lower due to lower stocking densities, however, production costs will be dramatically reduced and higher margins are obtained for an organic product. For example, in the commercial field trials, over 70% of the feed costs were saved.

These studies at the OAI have been successfully completed on a commercial scale over two consecutive production cycles. Clearly the application of organic compost was a success in terms of providing the pond environment with a higher C:N ratio as well as a substrate for bacterial growth within the optimal forage size for marine shrimp. However, these trials need further refinement, and the results generated are likely to be region specific due to variations in microbial dynamics. Nevertheless the basic premise has been validated on a commercial scale and future trials will place greater emphasis upon nutrient flux pathways from the microbial community.

The movement towards true sustainability in terms of elimination of fish meal and fish oil products from aquafeeds is not only a concern of organic production, but of interest to the aquaculture industry as a whole.

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L-lysine sulphate in diets improves FCR and morphological parameters of hybrid tilapia

By Zhi-gang Zhou*, Pei-bin Wang, Hui-yuan Lv, Hui-kang Wang and Andreas Lemme

In a recirculation water system, hybrid tilapia fed diets with supplemental L-lysine sulphate showed better feed conversion ratio as compared to fish fed lysine-deficient diets. Growth performance was lower but fish had higher fillet yield

The tilapia is a widely cultured species in China with an output of 978,100 tonnes in China in 2005 (China Fisheries Yearbook, 2006). Hybrid tilapia *Oreochromis nilotica* ♀ x O. aurea ♂ is the main genotype tilapia because of its fast growth, disease resistance and good flavour. Information on the essential amino acid requirements as well as the ideal protein pattern in tilapia *O. nilotica* is available (Cowey, C.B., 1994; Santiago and Lovell, 1988) but none for this hybrid species.

Lysine

It is without doubt that feed is a major cost factor in intensive aquaculture. Costs have escalated in recent years with the continuous increase in fish meal prices. Replacing fish meal with plant protein sources might be an alternative to reduce costs. Plant protein sources are sustainable feed ingredients. However, the essential amino acid lysine is often the most limiting essential amino acid in plant protein sources. In soybean meals, peanut meals and corn gluten, lysine is present from 2.60 to 1.10% as compared to 4.96% in fish meal, Table 1). Supplementing free lysine compounds could be an efficient approach to reduce the diet cost, resolve the shortage of fishmeal, improve the feed quality and avoid excessive nitrogen pollution. However, the preliminary step is the study on the lysine requirement of the test species.

Table 1 Chemical composition and essential amino acid (EAA) content of the feedstuffs (% dry matter)*

Feedstuff	Fishmeal	Corn gluten meal	Peanut meal	Soybean meal	Rapeseed meal	Wheat flour	Whey, dehydrated
Moisture	10.35	7.16	11.74	13.26	10.79	13.83	4.43
Crude protein (%)	63.46	64.27	50.07	41.84	35.62	12.14	7.29
Crude fat (%)	6.86	1.64	0.61	0.54	1.18	0.89	0.20
Energy (kJ/g)	17.33	21.29	16.70	16.55	16.96	15.39	14.25
EAA (%)							
Threonine	2.94	2.22	1.32	1.67	1.50	0.31	0.41
Valine	3.45	3.07	1.84	1.96	1.82	0.48	0.30
Methionine+Cysteine	2.58	2.48	1.26	1.19	1.62	0.50	0.30
Ile	2.76	2.57	1.46	1.70	1.15	0.37	0.25
Leucine	5.21	12.97	3.08	3.10	2.32	0.80	0.27
Lysine	4.96	1.10	1.57	2.60	1.53	0.22	0.35
Histidine	1.54	1.34	1.17	1.18	0.86	0.26	0.13
Arginine	4.14	2.11	5.43	3.03	1.90	0.42	0.12
Tryptophan	0.68	0.33	0.52	0.61	0.46	0.12	0.20
Tyrosine	2.03	3.36	1.82	1.45	1.03	0.37	0.13

**Chemical composition was analyzed according to Zhou et al. (2003) and the analysis of the amino acid content for the feedstuffs was conducted in L-8500-A amino acid analyzer.*

L-lysine monohydrochloride (L-lysine·HCl) is a very common form of free lysine with 78.8% lysine content. It is used as the free lysine source in most research (Jackson and Caper, 1982). Recently, one economical alternative is L-lysine sulphate. This is the product of bacterial fermentation. However, the fermentation process differs for L-lysine HCl as the fermentation broth is not separated from the bacterial biomass and not transferred to the hydrochloric salt. The study of L-lysine sulphate in aquatic species is limited but suggested identical bio-efficacy relative to L-lysine HCl in a molar comparison (Rodehutscord et al., 2000).

The purpose of this eight-week feeding trial was to investigate the effect of supplemental L-lysine sulphate on the diet conversion and growth performance. In tilapia farming, body width and body weight of tilapia are key criteria in determining its market price by fish processing

Table 2. Ingredients and chemical composition of the experimental diets (%)

Ingredients	Diet 1	Diet 2	Diet 3
Fishmeal	-	-	7.0
Corn gluten meal	28.00	28.00	-
Peanut meal	15.00	15.00	20.00
Soybean meal	-	-	14.00
Rapeseed meal	10.00	10.00	24.50
Wheat flour	26.00	26.00	26.00
Soybean oil	-	-	0.60
Whey, dehydrated	10.00	10.00	-
CMC	2.00	2.00	2.00
Betaine	10.30	0.30	0.30
Ca(H2PO4)	22.00	2.00	2.00
Choline chloride (50%)	0.20	0.20	0.20
Coated vitamin C	0.05	0.05	0.05
Mineral premix2	0.50	0.50	0.50
Vitamin premix3	0.20	0.20	0.20
Cellulose	5.25	3.99	2.15
Lysine (50.7%)	-	1.26	-
Chemical composition (% dry matter)			
Moisture (%)	8.13	9.04	8.97
Crude protein	36.53	37.48	36.86
Crude lipid	0.51	0.43	0.81
Gross energy (kJ/g)	18.39	18.50	18.02

[1]Betaine as the attractant; [2]Vitamin premix (mg/kg diet): thiamin, 20; riboflavin, 20; pyridoxine, 20; cyanocobalamine, 0.020; phylloquinone, 10; folic acid, 5; calcium pantotheniate, 50; inositol, 100; niacin, 100; tocopherol, 50; biotin, 0.1; wheat flour, 645.2; ascorbic acid, 100; choline chloride, 1000; retinol, 55,000 (IU/kg); cholecalciferol, 10,000 (IU/kg); [3]Mineral premix (g/kg diet): NaCl,1; $MgSO_4..7H_2O$, 15; KH_2PO_4, 32; $Ca(H_2PO_4)_2$, 20; $FeC_6H_5O_7..5H_2O$, 2.5; $C_6H_{10}CaO_6..5H_2O$, 3.5; $ZnSO_4..7H_2O$, 0.353; $MnSO_4..4H_2O$, 0.162; $CuSO_4..5H_2O$, 0.031; $CoCl.6H_2O$, 0.001; KIO_3, 0.003; Cellulose, 0.45.

Amino acid content of the experimental diets (% DM)[1]

	Diet 1	Diet 2	Diet 3
Aspartic acid	2.71	2.69	3.36
Threonine	1.24	1.24	1.36
Serine	1.83	1.81	1.71
Glutamic acid	6.79	6.87	6.12
Glycine	1.34	1.34	1.89
Alanine	2.31	2.36	1.58
Cystine	0.64	0.65	0.66
Valine	1.67	1.73	1.78
Methionine	0.58	0.57	0.55
Isoleucine	1.39	1.48	1.50
Leucine	4.52	4.58	2.82
Tyrosine	1.50	1.56	1.26
Phenylalanine	2.08	2.15	1.83
Lysine[2]	0.93	1.43	1.66
NH[3]	0.88	0.89	0.75
Histidine	0.89	0.95	0.99
Arginine	1.90	1.91	2.67
Proline	2.59	2.78	1.96
Tryptophane	0.27	0.25	0.40
Total	35.17	36.38	34.11

[1] The analysis of the amino acids was conducted in L-8500 A amino acid analyzer;
[2] The lysine requirement of tilapia in NRC (1993) 1.43%.

plants in China. The need for a relatively higher fillet yield requires nutritional adjustments in order to reduce fish size variation at harvest (Zhou et al., 2003). Thus we also examined size variation and morphological parameters of growing hybrid tilapia fed a diet fortified with L-lysine sulphate in comparison with feeding a practical diet.

Experimental procedures

Juvenile hybrid tilapia (*O. nilotica*♀ x *O. aurea*♂) was obtained from a local aquaculture farm in Haikou city, Hainan province, P. R. China. After a 2-week acclimation in a recirculation aquaculture system in the aquaculture station of Chinese Academy of Agricultural Sciences in Hainan Island, China, the uniform tilapia (36.89 ± 0.02g) were bulk-weighed and randomly distributed into 24 aquarium (0.5 x 0.5 x 0.5m^3; water volume, 110 litres) with the density of 6 fish/tank.

Three iso-nitrogenous and iso calorific diets were prepared. The chemical composition of the main ingredients is given in Table 1 and that for the three experimental diets is given in Table 2. Considering relative lower prices of carbohydrates as compared to fat in China, the energy in the experimental diets was mainly supplied by wheat flour and partly by fat. The effects of a shortage in essential fatty acids (EFAs) were not considered in this study. The pure vegetable treatment diet (Diet 2) contained supplemental lysine in the form of 1.26% L-lysine sulphate (Biolys®, Degussa AG, Germany, 50.2% L-lysine) whereas the vegetable control diet (Diet 1) was supposed to be lysine-deficient but in line with NRC (1993). Diet 3 contained 7% fishmeal and represented a diet commonly used in China. Betaine was added into each diet as the attractant to improve the palatability of the experimental diets. The diets were made into 3 mm pellets with a pelletiser after pulverizing the feedstuffs into 250 micron particles, fan-dried and stored in sealed bags for use.

The three diets were fed to fish in eight replicate tanks. Fish were fed to apparent satiation within half an hour each day at 07:30, 11:00, 15:00, and 18:00. During this feeding period, 20% of the water volume was exchanged. Tanks were continuously aerated. Water quality was monitored at a range of 26-28°C, pH 7.6-8.0, ammonia nitrogen (NH_3-N) at less than 0.2 mg/l, nitrite nitrogen (NO_2^-N) at less than 0.01 mg/l, and dissolved oxygen above 7.0 mg/l. In addition, dead or moribund fish were removed and replaced with another individual with the same weight during the first and second week of the experimental period.

At the end of the 8-week feeding, fish were starved for 24 hours and individually weighed. The morphologic parameters including total length, body length, body width and height were measured. Viscera and hepatic tissue for each fish were dissected and weighed.

Feed performance

The feed conversion ratio, final weight, weight gain, size variation of hybrid tilapia fed the experimental diets are given in Table 3. Whilst inclusion of L-lysine sulphate (diet 2) did not affect final body weight compared to the negative control (diet 1) feed conversion ratio was significantly improved (FCR, $P<0.05$). This was in agreement with the results with the eel *Anguilla japonica* (Nose, 1969), chinook salmon (Halver et al., 1957), channel catfish *Ictalurus punctatus* (Dupree and Halver, 1970), Africa catfish *Claries gariephas* (Fagbenro et al., 1998), and tilapia *Tilapia zillii* (Wu et al., 1998) when fed diets with free lysine compounds. This was due to the improved essential amino acid pattern in diets formulated with crystalline lysine (Rodehutscord et al., 2000). However, tilapia which received the positive control (diet 3) grew better than those fed diet 2. It might be speculated that the supplementation level was too low because dietary lysine was much higher in the positive control or other nutritional factors limiting growth. Statistically, FCR of treatment 2 was not different to that of treatment 3 although numerically lower. This may indicate that lysine supplementation at least improved utilization of dietary nutrients and energy. Differences in survival rate of fish were not statistically different ($P>0.05$). However, fish fed diets with supplemental lysine had higher survival than those fed diet 1. Fish fed fish meal supplemented feed had the lowest mortality ($p<0.05$).

Feed intake

The lysine requirement studies on Japanese flounder (Forster and Ogata, 1998), red sea bream *Pagrus major* (Forster and Ogata, 1998), and grass carp *Ctenopharyngodon idella* (Wang et al., 2005) showed improved food intake in fish fed diets containing L-lysine HCl. In this study it was unexpected not to find the increased diet consumption when hybrid tilapia fed dietary L-lysine sulphate (Table 3). This might be simply due to the poor palatability of the vegetable diets although betaine was included as attractant. It could also be due to poor nutrient availability (Rodehutscord et al., 2000).Comparing the amino acid composition of the experimental diets it can further be speculated whether levels of threonine or tryptophan or even glycine which is assumed to be non-essential prevented an effect on feed intake. It is well established that amino acid deficiencies impair feed intake. It might also be that dietary betaine used as attractant concealed the difference or led to the violent inter-attack behaviour affecting normal feeding.

In the present study, fish fed the lysine deficient and L-lysine sulphate supplemented diets showed caudal fin rot. This morphological damage might be due to the violent inter-attack behaviour, possibly resulting from poor palatability of these diets. Moreover, dietary tryptophan levels of the vegetable diets were much lower than in the fish meal supplemented diet. Tryptophan is known not only as an essential amino acid for protein synthesis but also to suppress aggression in rainbow trout. Tryptophan is a precursor of serotonin (Winberg et al., 2001). However, the vegetable diet led to lower survival rates of 62.5% in the control group (diet 1, Table 3). Moreover, feeding rate could have been inadequate as fish fed on vegetable diet 2 showed a lower weight gain than the group fed the practical diet 3. In previous work, Ketol (1993) reported that lysine deficiency caused fin rot in rainbow trout. A higher mortality of fish fed lower lysine diets was also observed in the Japanese flounder *Paralichthys olivaceus* (Forster and Ogata, 1998) and in juvenile grass carp *Ctenopharyngodon idellus* (Huang et al., 2003). Again, dietary lysine of diet 2 was substantially lower compared to diet 3.

Size variation

From a marketing viewpoint, it is also desirable that the harvested fish are of uniform size (Zhou et al., 2003). Social interactions and dominance hierarchy formation can lead to the suppression of feed intake and growth in subordinate individuals (Jobling, 1994). It was obvious that

Table 3. Mean±S.E of performance parameters of hybrid tilapia fed the experimental diets*

Ingredients	Diet 1	Diet 2	Diet 3
Initial Body weight (IBW)(g)	36.86±0.83	36.89±0.94	36.92±0.72
Final body weight FBW (g)	145.04±16.69[a]	49.73±23.65[a]	62.38±28.65[b]
Size variation (SV of FBW(%)	19.83±3.30	21.92±2.48	22.15±2.09
Weight gain (%)	33.22±11.01[a]	47.00±11.58[ab]	70.10±8.62[b]
Daily feed intake (g/d/fish)	0.64±0.05[a]	0.63±0.05[a]	0.86±0.07[b]
FCR	5.25±1.46[a]	2.69±0.44[b]	1.98±0.19[b]
Survival rate(%)	62.50±13.27	68.76±12.37	89.58±6.25

**mean±S.E.in the same row not sharing a common superscript are significantly different.*
[1]Final body weight, of 30, 43, and 33 replicates for diet 1, diet 2, and diet 3 respectively.
SV (%): size variation (%) = 100 x s.e. of body weight/mean of body weight;
WG (%): weight gain (%) = 100 x (FBW – IBW) / IBW;
FI (g/d/fish): = diet consumed (g) / fish number / days (d);
FCR: feed conversion ratio = diet consumed (g) / weight gain (g);
SR (%): survival rate (%) = 100 x survival fish number / total fish number.

Table 4. Mean±S.E of morphological parameters of hybrid tilapia fed the experimental diets

	Diet 1	Diet 2	Diet 3
Total length	13.65±1.77	13.74±3.20	14.75±2.21
Body length	11.28±1.46	11.58±1.81	12.08±1.82
Body width	2.16±0.26	2.19±0.29	2.35±0.34
Body height	3.90±0.50	4.01±0.63	4.26±0.68
Condition factor[1] (g/cm^3)	0.455±0.024	0.457±0.026	0.481±0.024
Hepatosomatic index (%)[2]	1.94±0.69	2.13±0.66	1.96±0.55
Viscerasomatic index (%)[3]	8.62±1.58	9.08±2.16	8.49±2.01

Mean±S.E. of 30, 43, and 33 replicates for diet 1, diet 2, and diet 3 respectively. Means in the same row are significantly different ($P<0.05$)
[1]Condition factor (g/cm3)=FBW(g)/BL(cm) x BT(cm) x BH(cm);
[2]Hepatosomatic index (%)= 100 x epatic weight(g) / body weight(g);
[3]Viscerasomatic index (%) = 100 x visceral weight(g) / body weight(g).

dietary lysine sulphate did not improve the size variation which might be to the absence of an effect on feed intake. It could have reduced the formation of dominance hierarchy in hybrid tilapia (Table 3).

Fillet size

Hybrid tilapia is usually processed into fillet for export in China. Tilapia with larger body width and relatively higher fillet yield (Einen et al., 1998) has a higher market value. The present study showed that body width was greatly affected by fish body weight, and partly by the interaction of dietary treatment and fish body weight (Table 4). The inefficiency of nutritional changes by incorporating dietary lysine sulphate on product quality of hybrid tilapia was evident in this study likely due to the above mentioned reasons such as differences in the amino acid profiles, etc.

Considering the close relationship between body weight and morphological parameters, MANOVA was used to evaluate dietary effects on the morphological parameters. The results were that body length and body height were significantly affected by dietary treatment, final body weight, and their interaction factor ($P<0.05$). Condition factor was obviously affected by diet and final body weight ($P<0.01$).

However, it was observed that total length, body width and hepatosomatic index (HSI, %) were not influenced by dietary treatment ($P>0.05$). Finally, the viscerasomatic index was independent of dietary treatment and final body weight ($P>0.05$).

In view of the importance of body width together with body weight in determining the market price of tilapia based on fillet yield, the relationships between final body weight (FBW) and body width (T) were calculated as follows:

Diet 1, $T=0.651BW^{0.319}$ ($R^2=0.950$, N=30)
Diet 2, $T=0.753BW^{0.279}$ ($R^2=0.864$, N=33), and
Diet 3, $T=0.685BW^{0.303}$ ($R^2=0.938$, N=43).

This showed that T was greatly affected by fish body weight ($P<0.01$), and partly by the interaction between dietary treatment and FBW.

Bottom line

In the current work, it was emphasized uniform size and fillet yield is important to obtain better market value. Here it was demonstrated that L- lysine in diets resulted in small improvements in final weight as compared with fish fed diets deficient in the amino acid. The condition factor was affected by final body weight and diets. Size variation was independent of diet.

Although most research showed that both L-lysine HCl and L-lysine sulphate are equally available to fed animals (Schutte and Pack, 1994; Roth, 1994; Rodehutscord et al., 2000), this study showed that the availability of L-lysine sulphate in hybrid tilapia compared to that of L-lysine HCl remains uncertain. The study was characterized by the absence of clear effects of supplemental lysine and several factors might be responsible for this: palatability of the vegetable diets was poor avoiding effects on feed intake, not only lysine but also threonine, tryptophan and glycine levels of the vegetable diets were lower compared to the practical diet. More investigations are required to help us formulate the low-cost, environment-friendly, and efficient diet for hybrid tilapia.

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Asian Pacific Aquaculture 2007- Prospering from dynamic growth

This can be said to be the crème de la crème for conferences and trade show for the aquaculture industry in Asia. Some 1,000 participants from 50 countries attended with 40 companies at the 70 booth trade show. There were 125 posters. The conference and trade show exceeded expectations. This clearly showed the interest in commercial fish and shrimp culture in Asia Pacific, in particular, that of Vietnam. The show was organized by the Asian Chapter of the World Aquaculture Society and the Ministry of Fisheries Vietnam. The main activity for Vietnamese participants is the one day producer session. Presentations were translated into Vietnamese for the 100 farmers in the audience.

Need for change in feed inputs

In his presentation on the "Meeting the feed needs of *Litopenaeus vannamei*", **Dr Sergio F. Nates**, Fats and Protein Research Council, USA, said, "One of the main constraints on increasing aquaculture production is the development of cost-effective feeds and feeding strategies. The preferred protein source in most aquaculture feed production is fish meal but prices have risen from around USD 550/tonne at the end of 2005 to over USD 1,100 /tonne in May 2007. The impact of this is that the replacement of fishmeal in aquaculture diets is a major international research priority".

There are several alternatives such as poultry meals, soybean meals, blood meal, grains and oilseeds. Animal and plant protein are good sources of protein, amino acids and the attractant, taurine. The demand is for cheaper feeds whilst simultaneously, there has been a good deal of movement toward more carefully designed feeds. In the case of the vannamei shrimp, formulations must suit the wide variety of culture practices, feeds and feeding strategies. Higher protein levels will be required for intensive systems. Feed have to be tailored for zero exchange systems as feed components will accumulate in the pond.

Over time, average crude protein in *L. vannamei* feeds, 38% crude protein in 1998 for grow out was reduced to 30% in 2004. In many cases, the % crude protein may not have changed, but quality of ingredient has changed. However, Sergio emphasized that formulators must now seek to use information such as energy values of various fat sources, fatty acid metabolism, hormones in metabolism and cholesterol in feed ingredients to better formulate diets.

SPF shrimp is required

Selective breeding has brought improvements in important commercial traits such as growth and disease resistance, according to **Mr Oscar L. Hennig**, Kona Bay. Specific pathogen free (SPF) *Litopenaeus vannamei* was first established in Hawaii at the Oceanic Institute. SPF vannamei is shrimp free from all listed pathogens but not free of all pathogens. However, Oscar reiterated that SPF status is linked with the biosecurity level of the facility where the shrimp is grown. The SPF status is not heritable and an SPF shrimp may or may not be SPR (Specific Pathogen Resistant). The company now markets SPF and SPF/SPR *L. vannamei* broodstock. All of the company's shrimp lines are SPF.

The surveillance protocol on its stocks includes the State of Hawaii SPF certificate with PCR twice a year and PCR and histology done four

The Uni-President team at their booth, front row from left, Chih Peng Hsieh, President of Provision Group, Uni-President, Taiwan, Dr Huey-Lang Yang, National Cheng Kung University, Taiwan, Mr Cheng Wen Chin, President of Uni-President, Vietnam. The second row, from left, Mr.Ming-Hsun Wu and Mr.Jie Cheng Chuang

Producer session

Building up *L. vannamei* shrimp in Vietnam by Ming Hsun Wu

At the opening ceremony, Mr Chih Peng Hsieh, President of Provision group, Uni-President, Taiwan, said "The rapid growth of aquaculture industry of Vietnam is really amazing. In 1999, shrimp production was just 50,000 tonnes and in 2006, it reached 260,000 tonnes. This is a +420% sharp increase over 8 years".

In 2006, the government opened up areas for the culture of the *Litopenaeus vannamei* shrimp. Culture practices for the vananmei shrimp are vastly different from that of the black tiger shrimp, which the Vietnamese farmers is well acquainted. As the Gold Sponsor at Aquaculture Asia Pacific 2007, Uni President Vietnam, a Taiwan-based food and feed company and market leader in both shrimp and catfish feed in Vietnam wanted an active participation and to ensure that shrimp culture moves forward in a structured manner.

Mr.Jie Cheng Chuang, Vice President of Uni-President, Vietnam, said "We chose vannamei shrimp culture as the main theme for this producer session because most farmers are shifting from culturing black tiger shrimp to that of vannamei shrimp. Black tiger shrimp culture is now facing several problems such as difficulties in obtaining healthy broodstock. Production seems to be affected by a slow growth syndrome. Through this session, we want to give farmers some knowledge and valuable experience in vannamei shrimp farming practices. We would like to see Vietnam's farmed shrimp industry keep up with the trend in other Southeast Asian countries where its culture is expanding".

Here are highlights on presentations covering nutrition and feeding, a priority as feeds encompasses 60-70% of production costs and post larvae taking 4-5% of inputs. Presentations on pond management and disease control followed. The session ended with how the consumers in Japan perceive vannamei shrimp versus black tiger shrimp and global trends in shrimp marketing.

The session was chaired by Professor Dr. Shi-Yen Shiau of National Taiwan Ocean University (left) and Dr. Le Thanh Hung, University of Agricultural and Forestry. On extreme right is Sergio Nates, President of Fats and Proteins Research Council, USA.

times a year at the University of Arizona (UAZ) , including on maturation and larval fresh feed. The breeding objectives are focused on pond performance in different environments, disease resistance, high maturation performance. Maturation and hatchery performance are tested in a commercial environment.

Diseases have changed the way shrimp are farmed

Reviewing the history of diseases in *L. vannamei* culture in the Americas, **Dr Donald Lightner**, University of Arizona, USA said that during 1970 to 1992, the principal disease were BP (*Baculovirus penaei*) and IHHNV (Infectious hypodermal & Hematopoietic necrosis) as well an vibrosis. Later after the TSV (Taura Syndrome virus) in 1991/92, it was WSSV in Central America in 1999 and Infectious Myonecrosis (IMNV) in Brazil in 2004.

This changed the way shrimp are farmed in the Americas. The industry ended its dependence on wild postlarvae and wild broodstcok. It is now managed by a combination of biosecurity and the practice of culturing domesticated specific pathogen-free (SPF) stocks or specific pathogen-resistant (SPR) stocks. There was an increase in shrimp specialists and diagnostics surveillance laboratories.

He added, "An interesting historical note was the relative resistance of *L. vannamei* to IHHNV compared to the otherwise superior Pacific Blue Shrimp, *L. stylirostris*. This was a major factor in the development *L. vannamei* by the industry as the dominant species farmed in the Americas".

Recent WSSV and IMNV outbreaks in Brazil and WSSV and TSV outbreaks in Venezuela, Mexico and Central America have resulted in significant losses. Also causing concern to the industry was the emergence of a new genetic variant of TSV that appeared in the Lake Maracaibo region of Venezuela in early 2005, and resulted in the loss of around 90% of the *L. vannamei* then in production. In Asia, the focus is now on IMNV which was reported in Indonesia in 2006 and in Hainan, China in August 2006. It is suspected in several other countries. In Brazil, where IMNV was first reported in 2002, probably from native penaeid shrimp, it caused USD 200 million in losses.

Health and pond management for profitable vannamei shrimp culture

Dr.Pornlerd Chanratchakool (Novozymes, Thailand) said in most farms, the usual practice for improved profits from shrimp farming is to increase stocking density. However, without proper water and soil management, this can be futile unless farmers understand the common cause of problems. SPF postlarvae is required but health and basic pond management for different farming system is one of the key factors for successful farming. Disease screening alone cannot guarantee 100% disease prevention, so maintaining the optimum water and soil quality is critical. This is to minimize the stress factor that may trigger an outbreak of different diseases.

Health and basic pond management for different farming systems is one of the key factors for successful farming. Pornlerd said that maintaining high level of dissolved oxygen at above 4 ppm. is crucial, especially at the later stage of the cycle when the organic loading in the pond is very high. Routinely monitoring pond sludge to ensure that aerobic conditions are maintained is also necessary to prevent ammonia, nitrite or hydrogen sulfide build up. Massive phytoplankton die off can also cause anaerobic soil condition.

It was concluded that before stocking, farmers should have a clear plan. They need to decide on the stocking density, the expected size at harvest based on their farm infrastructure and farming system as well as the market requirement.

Marketing shrimp

Dr. Jacques Gabaudan, DSM Nutritional Products, Thailand said that in Japan's consumer market for shrimp, black tiger shrimp occupies a central position. Using a market research firm, DSM conducted a survey on shrimp purchasing behaviour in Japan among married women from 21 to 59 years of age and living in selected area and purchasing medium to large shrimp at least once every 2 to 3 months. The results showed that some 90% of respondents knew the name and appearance for black tiger shrimp and 80% of them purchased the shrimp. In contrast, only 18% were aware of the name of the white shrimp. The second part of the survey showed that the processing formats in which shrimp are the most commonly purchased are (1) frozen and headed followed by (2) frozen headed and peeled and (3) fresh and headless. The top five preferences were price, freshness, size, colour and safety.

Trends in the global marketing of shrimp showed increases in the production of vannamei shrimp and in value added shrimp, said **Dr Brian Hunter** in his presentation. Vannamei shrimp production rose to 95% of production in Thailand, 50% in Indonesia and 24% in Vietnam in 2006. In China, *L. vannamei* production increased to 23% in 2006.

"Production will continue to rise and with continued downward pricing pressure. Disruptive effects of tariffs, bonds and prohibition will continue and forex fluctuations will affect markets. The Baht appreciation has affected that in Thailand. The change in the US anti dumping duties for shrimp from Ecuador will affect shrimp from Asia".

The main markets are the USA, EU and Japan. Soon these will be joined by the affluent Asian markets. USA imported about 600,000 tonnes of shrimp in 2006. Major exports came from Thailand, Ecuador, Indonesia, China, and Vietnam. The EU imported about 475,000 tonnes of shrimp in 2006. In 2006, producers increased exports to Germany, Italy, and Spain. India's exports increased to France and the UK. Average prices were also up in major EU importing countries in 2006 compared to 2005. The chilled market segment is increasing in France and the UK.

Japan's imports in 2006 were approximately 300,000 tonnes and the price was steady from the previous year. Japan imported more *L. vannamei* and less *P. monodon*, a trend that is expected to continue.

Continuing its support for industry, Uni-President will be a sponsor at World Aquaculture 2008 in Busan, Korea, 19-23 May 2008 and later it will be the exclusive co-organizer of The 7th Symposium of World's Chinese Scientists on Nutrition and Feeding of Finfish and Shellfish 2008 in Beijing, China to be held from 24-29 September 2008.

Ming-Hsun Wu is Manager of Formula Design Section of Uni-President Enterprises Corp., Taiwan. Currently he is also responsible for part of business in Uni-President, Vietnam. Email: mhwu@mail.pec.com.tw

Trade show at Asian Pacific Aquaculture 2007

Exciting markets in Vietnam and Asia Pacific

The numbers of booth were limited by the venue, but most exhibitors were happy with the constant stream of visitors.

Opening the trade show. Mr Chih Peng Hsieh, President of Provision Group Uni-President, Taiwan (left) and Dr. Nguyen Cong Dan, Vice Director, Aquaculture Department, Ministry of Fisheries, Vietnam.

Aquaculture research

Three **Research Institutes for Aquaculture** (RIA), under the Ministry of Fisheries, Vietnam were at the trade show. RIA1, located in Bac Ninh in the north has several field stations at Cua Lo, Catt Ba and Qui Kim. Its project with support from Norway on the building of advance research and education capacity has entered its second stage. It covers four areas; tilapia breeding output, aquatic health, marine aquaculture and education. RIA3, located in the Khanh Hoa Province in central Vietnam, has carried out work on the breeding of artemia cysts in salt pans, culture of the mud crab, swimming crab, babylonia snail, lobsters and blood cockles. Some of these were in cooperation with international organisations (www.ria1.org; www.ria3.org.vn).

The **Institute of Tropical Aquaculture** (AKUATROP), Malaysia was set up in 2004. Currently, the centre is involved in several collaborative projects with private and other government bodies in Malaysia. Located in Trengganu on the East Coast of Peninsula Malaysia, the centre which is part of the University Malaysia Trengganu, also offers short term courses to entrepreneurs on aspects of aquaculture such as in basic disease diagnosis and hatchery management.

At the trade show, Prof. Faizah Shahrom, an expert in fish parasitology launched the centre regionally. It wants to support developments in Malaysia and Asia with consultancy and technology transfer. Some of ongoing projects are species improvement and breeding of the local catfish *Clarias* spp, clown fish, hybridisation of the *Pangasius* spp and on the feasibility of using coconut kernel residue in aqua feeds. It holds several patents including the KHV detection kits and other disease detection systems. (www.umt.edu.my/akuatrop/)

Hervé Lucien-Brun (centre) at the Aqua Techna booth.

Feeds and additives

Some 17 companies were marketing feeds and feed additives. Hervé Lucien-Brun, **Aqua Techna**, France said, "We had a lot of contact with people from Asean countries and also from Bangladesh and India. They were mostly interested by some of our products: Perfostim, Immutech, Vitatech, Calci-S and Hepatofish. Another interesting product was the ArteRoti plus, a product to enriched the rotifers and the artemia in fish hatchery". The company provides innovative and reliable solutions to hatcheries and crustacean, marine and fresh water fish producers, feed manufacturers and processing firms.

Products for the feed mill by **Novus Aqua** are Mera Met 84% methionine and 12% calcium. a source of methionine, organic calcium, organic acids.This can replace 2-3% of fish meal, depending on species. Mera Met Plus contains 25-27% crude protein with astaxanthin to improve shrimp and fish growth as well as colouration. It can replace 5-10 of fish meal, depending on species. Both work well in marine shrimp and carp according to trials conducted in China, Thailand and Vietnam with feed companies. The company is developing Mera Pak which is planned for the total replacement of fish meal. Another product is a selenium product, popular with catfish farmers as it whitens the flesh. For on farm feeds, there is a glucan product.

Japan's **Higashimaru Co**, well known for its larval and shrimp feeds will soon start production of the Higashi range of feeds in Vietnam. At the show, the range of larval feeds currently in the market include microparticulate feeds as substitutes for diatoms and during the zoea and mysis stages in *P.monodon* culture. Liquid feeds in market in Vietnam included those with rotifer and artemia for larval marine fish.

At the show, **Uni President Vietnam** announced the launch of new feed lines for the production of slow sinking feeds for the grouper, seabass and cobia at its new plant in Tien Giang in the Mekong Delta. Grouper feeds contain 43 to 46% crude protein from high quality fish meal and krill meal and are prefect replacement for trash fish. The market for these feeds will be the expanding cage culture areas mainly around Halong, Vung Tau and Nha Trang in the North and Central provinces and ponds culture in the south. Supply for these markets will be from warehouses set up in Nha Trang and Da Nang.

The company also produces feeds for the catfish where their market share has been increasing. Production is ISO 9001/HACCP certified.

Future shows in Korea and Australia

The next meeting of the World Aquaculture Society will be in Busan Korea, 19-23 May 2008. Following this, from 3-8 August, 2008, the Asia Pacific Chapter (APC-WAS) will join the National Aquaculture Council of Australia to organize the Australasian Aquaculture 2008 in Brisbane.

(See page 42 for more product news)

Improving conditions in shrimp and fish ponds

By Claude E. Boyd, Olivier Decamp, Roselien Crab and Willy Verstraete

The use of a multifunctional natural product commonly used in Latin American to improve ponds conditions can be particularly useful in shrimp aquaculture in Asia.

Nitrogen is an important factor in aquaculture pond management. Most aspects of the nitrogen cycle (Figure 1) function within the aquaculture pond ecosystem. Ammonium (NH_4^+) and nitrate (NO_3^-) are essential plant nutrients. They are often added to ponds as fertilizer. Protein contains 16% nitrogen, and protein nitrogen in aquatic plants, other natural food organisms, and manufactured feed is a source of protein nitrogen for shrimp or other culture species. A portion of the nitrogen added to ponds in fertilizers and feeds is converted to nitrogen in the culture species and harvested. The remainder becomes waste in the culture system. The major nitrogenous waste product of aquatic organisms is ammonia (NH_3). This compound and nitrite (NO_2^-) that is produced in oxygen-less zones in ponds can be toxic to culture animals.

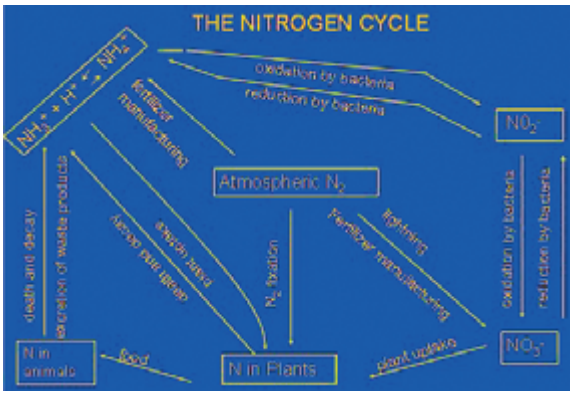
The SQM Company of Chile manufactures a product, distributed in Asia by the health division of INVE Aquaculture under the trade name 'Sanolife Nutrilake' that can be used by shrimp and fish farmers to exert better control over the nitrogen cycle in ponds. This product contains sodium nitrate, sodium silicate, and various trace elements. Sanolife Nutrilake is made from a natural mineral known as caliche, the ore of which is mined from the Atacama Desert in Northern Chile, the driest place on earth. The components are extracted from caliche in water and processed into a granular material. It becomes a high quality, natural product that contains no harmful impurities. It is safe to use in aquaculture ponds in which shrimp or fish are produced for export.

The product has three functions in aquaculture ponds. It serves as a fertilizer, it is a water quality conditioner, and it is a bottom soil oxidant. Because these functions are important in shrimp and fish ponds, they will be discussed separately.

Fertiliser

The nitrate in the product is an excellent source of nitrogen for phytoplankton and is superior to ammonium resulting from urea and most other nitrogen fertilizers. Nitrate is the preferred nitrogen source for diatoms and the silicate in the product also encourages diatoms. Ponds fertilized with this product have higher percentages of diatoms and less blue-green algae in phytoplankton communities than ponds fertilized with urea and other nitrogen sources (Figure 2).

Figure 1. The nitrogen cycle



Conditioning water

Furthermore it improves water quality because it is non-toxic, non-acid forming and does not consume dissolved oxygen. In contrast, when urea is used in ponds, it dissolves and hydrolyzes to release ammonia and carbon dioxide. Most other nitrogen fertilizers also dissolve and release ammonia. Ammonia can increase to concentrations high enough to stress and reduce the growth of culture animals, especially at the start of culture when the fertilizer is applied and the (more sensitive) postlarvae are stocked.

Each milligram per litre of urea applied to ponds can increase total ammonia nitrogen concentration by 0.45 mg/l and (Table 1). Acidity from the oxidation of ammonia to nitrate by nitrifying bacteria also reduces the total alkalinity of pond water, thus increasing the need for lime. Each milligram per litre of urea applied to ponds can lessen total alkalinity by about 1.61 mg/l, and can consume about 2.06 mg/l of dissolved oxygen (Table 1).

Figure 2. Good algal blooms of green algae and diatoms and without bluegreens are established by applying NO_3-Si fertilizers

Table 1. Potential changes in total ammonia nitrogen (TAN), total alkalinity (TA), and dissolved oxygen (DO) concentrations following application of common nitrogen fertilizers and Sanolife Nutrilake at 1 mg/L.

Fertilizer	TAN (mg/L)	TA (mg/L)	DO (mg/L)
Ammonium sulfate (20% N)	+0.16	-1.18	-0.73
Ammonium nitrate (33.5% N)	+0.21	-1.51	-0.96
Urea (45% N)	+0.45	-1.61	-2.06
Sanolife Nutrilake (15% N)	0	+0.53	+0.56

However, the product does not increase the total ammonia nitrogen concentration because the nitrogen already is in form of nitrate. Its application in ponds does not create toxic conditions, reduce alkalinity or lessen the dissolved oxygen supply. In fact, the nitrate can serve as a source of dissolved oxygen for denitrifying bacteria and spare dissolved oxygen for use by culture animals.

Figure 3. Appearance of the bottom of a pond treated with nitrate (left) and the bottom of a control pond (right). The lighter colour of the bottom of the nitrate-treated pond indicates that the soil was well oxidized.

Each milligram per litre of product applied to a pond conserves about 0.56 mg/L of dissolved oxygen. Moreover, when denitrifying bacteria use oxygen from the nitrate, they release hydroxide ions into the water. The hydroxide reacts with carbon dioxide to form bicarbonate ion and increase total alkalinity concentration. Each milligram per litre applied can increase the total alkalinity by about 0.53 mg/L (Table 1).

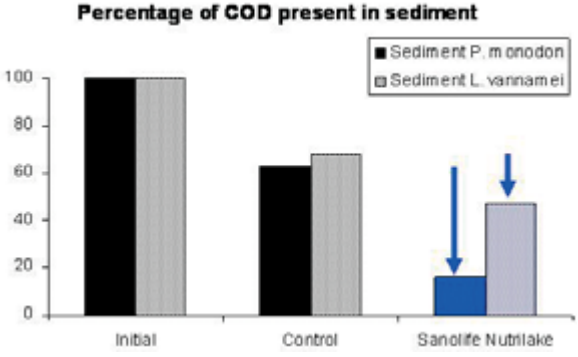
Pond bottom amelioration

Pond bottom soils often become anaerobic because the movement of dissolved oxygen from pond water into the pore water of bottom soil often is slower than the rate at which microorganisms in the pond bottom use oxygen in respiration. Under such conditions, microorganisms produce reduced iron and manganese compounds and hydrogen sulfide that can diffuse into the pond water. Reduced iron and manganese compounds can precipitate on shrimp causing undesirable strains on the exoskeleton. Hydrogen sulfide is highly toxic to shrimp and fish.

By maintaining nitrate in pond water by periodic applications of the product, denitrifying bacteria in the upper layer of bottom soil will not be limited by an absence of nitrate. This will prevent the redox potential at the soil-water interface from falling low enough for the microbial production of more reduced compounds such as ferrous iron, manganous manganese, or hydrogen sulfide.

An experiment conducted in Australia by Drs. N. Morrissy and C. Lawrence revealed that ponds treated with nitrate had more dissolved oxygen in bottom waters than untreated ponds. Also, when the ponds were drained for harvest, the nitrate-treated ponds had brown, oxidized soil while the untreated ponds had dark gray, reduced soil (Figure. 3). This is clear evidence that the nitrate in the product is a strong soil oxidant.

Figure 4. The percentage of organic matter (COD) remaining in the sediment after 4 weeks incubation at 25-30°C in control and Nutrilake.



The improved biodegradation of organic and nitrogenous compounds following its application was evaluated under laboratory conditions, using sediments originating from *Penaeus monodon* and *Litopenaeus vannamei* farms in Thailand. The addition improved the degradation of organic matter in the sediment (Figure 4). About 84% of the COD was degraded in this treatment for the first sediment sample and about 53% of the COD for the second sediment sample.

General benefits

Shrimp farmers in Central and South America have been using this product as a standard pond treatment for more than a decade. The benefits are more desirable phytoplankton blooms, better water quality, and improved bottom soil condition. These benefits can lead to the production of more and higher quality shrimp than achieved in non-treated ponds. Experiments conducted in Thailand also showed that this product improved water and bottom soil conditions in ponds. Moreover, the use of performing microbial products in ponds is compatible with the use of this product and the nitrate will enhance growth of the denitrifying bacteria included in the Sanolife PRO probiotics.

There is much interest in improving the environmental performance of aquaculture and shrimp farming in particular. Ammonium and ammonia applied to ponds in traditional fertilizers are much less desirable in pond effluents than nitrate. Moreover, there are no food safety concerns with the use of Sanolife Nutrilake. It is an ecologically-friendly product that can improve aquaculture pond management. It is particularly useful in shrimp aquaculture and its use is compatible with normal pond management procedures.

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Black tiger shrimp in Australia

Success with domestication leads to selective breeding

The initial target of this large collaboration between government research agencies and industry was to understand and remove the barriers to black tiger shrimp *Penaeus monodon* domestication. With steady improvements in growth performance achieved with third generation domesticated stocks, they will now progress toward selective breeding.

Controlled raceways

Nigel Preston

This project on the domestication of the black tiger shrimp in Australia was started in 2002 with AUD 5.5 million (USD 4.6) funding from the Australian Government through the Fisheries Research and Development Corporation (FRDC), industry and research agencies. The project members comprise the Australian Institute of Marine Science (AIMS), the Marine Research and Livestock Industries of CSIRO (CMR and CLI) and the Queensland Department of Primary Industries (QDPI). Industry partners are two Queensland shrimp farms; Seafarm Pty Ltd, a farm on the northern coast of the state of Queensland and Gold Coast Marine Aquaculture on the southern coast of Queensland and the Australian Prawn Farmers Association (APFA). This is the largest and most coordinated research project carried out on the black tiger shrimp in Australia.

In Australia, the black tiger shrimp, endemic to the country is the main farmed species. The industry produces 4,000 tonnes annually, valued at AUD 70 million. By 2010, the industry targets sales to reach AUD 200 million (www. apfa.com.au). A long standing production priority is the domestication of the black tiger shrimp which will reduce industry's dependence on wild brood stock.

At the Asian Pacific Aquaculture Conference, 2007 in Hanoi, Principal Investigator, Dr Nigel Preston from CSIRO, spoke on the progress to date and on future research.

"We started with some stocks collected from the Gulf of Carpentaria and from the East coast of Queensland. We selected these as we knew that the stocks from the Gulf of Carpentaria had no signs of Gill associated virus (GAV) and a low level of Mourilyan virus disease (MoV). Stocks from the East coast were 100% GAV infected. We kept these two stocks separated with AIMS and QDPI holding the stocks from the East coast and CSIRO and Gold Coast Marine Aquaculture holding stocks from the Gulf of Carpentaria".

"Together, we produced three successive generations of captive reared monodon. With each generation, survival, growth rate and fecundity improved to a stage where by the second generation we were

Controlled environment tanks

approaching the industry target of 200,000 eggs per spawner and the industry standard of 100,000 nauplii per spawner. This we achieved in the third generation".

"With the second generation domesticated stocks, we carried out some grow out trials. The harvest was 7 tonnes/ha. The following year, it reached 10.5 tonnes/ha. Results were still not spectacular but were significantly better than the industry average. This year, results were the best ever at 12.8 tonnes/ha which is nearly 3 times that of the current industry average of 4.5 tonnes/ha per harvest. Added to this, survival was better. Shrimp were larger in size with an average price of AUD 16/kg. Farmers were very happy", said Nigel.

With the fifth generation completed, the team will go beyond domestication to the next stage viz. selective breeding using genetic technologies to ensure maximum gain without losses or compromising the stocks due to inbreeding. As they progress towards selective breeding, they will also work on problems with nauplii production.

"During the five years, there has been some selection to get the improvements in growth etc. Through the selection of survivors, we appear to have selected for disease tolerance. Our broodstock do not have YHV and WSSV. Using genetic marker systems developed in our laboratories, we have detected a loss in genetic diversity in successive generations of stock. To improve diversity, we will need to add another 20-30 families into the population. Now we have 30 families from the East Coast and Gulf Carpentaria. During this process, we have learnt a lot. Our results indicated that trying to rear *P. monodon* broodstock in commercial production ponds to speed up the domestication process is risky. Although this works for *L. vannamei* shrimp, it appears that controlled environments give better results for *P. monodon* at this early stage of their domestication".

"For the next five years, we will continue to work at increasing the number of farms in Australia that have access to the progeny from domesticated stock. Our target is to provide the whole industry access to domesticated stocks selected for high performance. We will be focusing on improving fertility and hatch rates of eggs, to increase current hatchings of 20-30% to above 50%. In parallel, we will focus on genetically improving the domesticated stocks for high pond performance.

On the future position of *P. monodon* farming in Australia, Nigel said, ***"For the next few years monodon shrimp will form a niche market for customers who want larger shrimp. It is unlikely that monodon will be the dominant species in Asia ".***

At the Asian Pacific Aquaculture 2007 in Hanoi, Vietnam, members of the research team from CSIRO presented findings on their latest work.

Success with total control in clean waters

In his summary on the domestication work, Dr Greg Coman showed that success required a fully integrated approach. The key goal for the future is a controlled breeding program including genetic selection.

Domestication in clean water systems such as raceways and tanks has provided higher control over biosecurity. Working with these systems instead of ponds, they have been able to control temperature, feeding and the rearing environment. Such conditions reduced the risk of losses in the early generations and allowed them to replicate these systems.

In determining the relationship between viral diseases and health, he said that with successive generations, the impact of GAV on health and survival was reduced. GAV has 99% prevalent in wild brood stocks. His research also demonstrated how increases in spawning performance can be achieved by reducing the maturation rearing densities. The final step towards commercialization is improving hatching, through refinements in feed and environment.

Coman,G., Preston, N., Cowley, J., and Li, Y., 2007.Progressing from domestication to selective breeding of Penaeus monodon in Australia. Extract from a presentation at Asian Pacific Aquaculture, 2007. 5-8 August, Vietnam

The feminine route to higher yields

In her presentation, Melony Sellars, said that stocking more females can increase pond yields as females grow up to 30% larger than males in the same period. Working with *P. japonicus*, Melony said that in Australia, substantial research has been conducted on developing sterile all-female shrimp induction technologies. This can prevent unlicensed breeding of elite genotypes developed in Australia and also improve farm profits through increased yield. There are three approaches that the CSIRO research team have been investigating to produce all female and/or sterile shrimp. These are chromosome set manipulation (triploidy), irradiation and genetic engineering. Of these three techniques triploidy induction is at a stage where it is ready for industry trials.

Triploid shrimp are all female and sterile, and have comparable growth to diploids in *P. japonicus* but better than diploids for P. chinensis. Using CSIRO's induction methods, routinely 80% triploid shrimp is possible. Taking conservative *P. monodon* figures from the collaboration farm on the Gold Coast, with a stocking density of 350,000/ha, survival of 71%, and early 5 month harvest, the increase in yield is 570 kg/ha. As 80% of the population is female instead of the usual 50% in normal populations shrimp receive the highest price per kg (i.e. AUD $16 in 2007). This translates to an increase in profit by AUD $9,120 / ha.

Sellars, M.J. and Preston, N., 2007. Techniques to produce sterile all female shrimp: current findings from Penaeus japonicus research. Extract from a presentation at Asian Pacific Aquaculture, 2007. 5-8 August, Vietnam

Saponin in tilapia feed to control maturation

By Christian Lückstädt, Paz Kühlmann and Yasmin Primavera-Tirol

A preliminary trial indicated that saponin-supplemented diets could substitute for hormones in the control of reproduction of tilapia in brackishwater ponds

In the 1940s, tilapia was introduced to Asia from its native Africa. The decade from 1960 and 1970 saw the farming of the fish for the production of food for local consumption and for social elevation of rural populations related to agriculture and animal husbandry. By 2005, production of farmed tilapia reached more than 2.0 million tonnes.

Today the international trade in tilapia is growing rapidly and prospects of million-dollar businesses with the tilapia is attracting interest in its culture in Asia, Africa and Latin America. The top producers of tilapia however are still in Asia, with China, the Philippines, Taiwan as well as Indonesia and Thailand top ranked. Those 5 countries had 75% of the total tilapia production in 2005.

Large-scale commercial culture of tilapia is limited almost exclusively to three species: *Oreochromis niloticus*, *O. mossambica* and *O. aureus*. Of these, the species with recognized aquaculture potential, the Nile tilapia, *O. niloticus* is by far the most common species in fish farming. However farming of tilapia *O. niloticus* in freshwater or brackishwater ponds usually result in early maturation in as low as 70 g fish body weight. With excessive breeding, overcrowding and stunted growth follows and farming becomes unprofitable.

Early maturation

These early maturation and frequent spawning of the tilapia has prompted several workers to seek ways to control reproduction in order to produce good-size marketable fish. The technique of using hormones to sexually inverse tilapia to an all male stock is a common practice in farm production. The use of hormones however poses apprehension among fish consumers due to its possible negative effect to human health.

The use of hormones is prohibited in some countries. Such steroids for sex reversal for instance are a cause of concern since the US Food and Drug Agency (FDA) does not approve the sale of tilapia treated with steroids and harmless approved agents are yet to be identified.

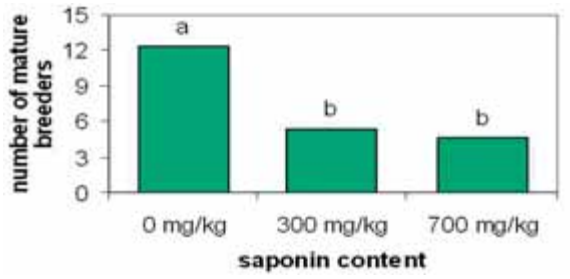
Saponin in reproduction

Saponin, a glycoside linked to hydrophobic aglycone (sapogenin) that may be a steroid in nature, can be an alternative to androgenic hormone used for tilapia sex inversion and sterility. Studies on the effect of saponin on the reproductive activity of tilapia recently showed the possible infertility of females when fed with diet containing 300 mg/kg saponin, sex inversion to all male population at 700 mg/kg saponin inclusion, and higher number of males in fish fed with 150-500 mg/kg saponin diet. These positive results on saponin in aquaria experiment however may require testing it in large pond production to ascertain its positive effect.

It was therefore of general interest to investigate reproductive capability of female and male tilapia under commercial conditions, when fed diets supplemented with different levels of saponin; treatment I: 0 mg/kg, treatment II: 300 mg/kg and treatment III: 700 mg/kg). Commercial feed containing about 25-30% crude protein and 5-7 % fat supplemented with 0, 300 and 700 mg/kg saponin was fed to saline tolerant tilapia reared in brackishwater ponds with three replicates in a randomized complete block design (RCBD).

The trial carried out at the Aklan State University in the Philippines investigated the following parameters: growth (length and weight), specific growth rate, survival, sex ratio, fry count, egg count, number of nests, gonadal development (number of mature breeders, egg development stages and egg diameter) and egg production.

Number of mature tilapia breeders after 120 days of pond culture



After 120 days of culture, the final weight of fish did not differ significantly between treatments (75.3±1.4 g, 71.8±6.2 g and 72.4±1.5 g for I, II and III respectively). Survival was also not different between treatments. The first mature breeders were observed during day 75 of the pond culture period. On day 120, the mean number of mouth brooders in treatment I was significantly highest (12.3 fish per pond, $p<0.05$) compared to treatments II and III (5.3 and 4.5 fish per pond respectively), which did not differ from each other (Fig. 2). The sex ratio of treatment I tended to be higher than treatment II ($p<0.1$), indicating more males than females in the latter.

However, the sex ratio in treatment III did not differ significantly from that of either the control or treatment II. Egg diameter varied from 0.30 mm in treatment II to 0.43 mm and 0.47 mm for treatments I and III respectively, but without statistical significance. Histological analysis of a sub-sample of 21 female tilapia per treatment showed higher numbers of fish with eggs in the vitellogenic stage.

Conclusion

The results of this study showed no differences in final weight which did not support previous reports of depressed growth. It did not agree with reports on growth enhancement due to the application of saponin. However, tilapia in this study indicated lower numbers of mature breeders and of females when fed with saponin-supplemented diets.

This showed the potential of saponin as a substitute for hormones in the control of reproduction to produce good-sized fish and sex inversion of tilapia. The non-detection of significant effects on egg development may have been due to experimental error where sample sizes were too small. Repeat trials to cover more than one growth period was suggested to confirm these results.

**The article was partly based on a poster presented at the XII. International Symposium on Fish Nutrition and Feeding in Biarritz, May/June 2006.*

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Anesthetics in aquaculture: the emerging popularity of clove oil

By Amani Al-Yaquot and Charles M. James

Clove oil and its derivatives have become popular fish anesthetics due to its availability, low cost and apparent safety to both fish and humans. In this article, the authors demonstrate its efficacy in handling and transportation of the silver pomfret and a marine shrimp.

Juvenile silver pomfret Pampus argenteus

Penaeus semisulcatus

Anesthetics are frequently used during transportation of live animals to prevent physical injury and reduce metabolism (DO consumption and excretion). They are also used to immobilize fish so they can be handled more easily during harvesting, sampling, brood-stock management and spawning procedures. With the growth of the aquaculture in recent years, the use of various types of anesthetics, chemical as well as physical (non-chemical) agents, to aid the capture, handling and transportation of fish as well as crustaceans is increasing.

An ideal anesthetic should perform calm induction for rapid immobility. It has to give a safe and rapid recovery from anesthetic without any toxicity and at a minimum cost. Physical or non-chemical methods involve hypothermia where the water temperature is lowered to tranquilize or immobilize the fish and crustaceans. Electro-anesthesia uses electrical stimulation to immobilize the animal but is not a desirable method because of safety reasons. Furthermore, it is not so effective in seawater.

The only anesthetic product currently approved by the US Food and Drug Agency (FDA) for use in food fish is tricaine ethanesulfonate (MS-222). Nevertheless, a number of other anesthetics are used in aquaculture because of the mandatory requirement to induce anesthesia in the live fish and crustaceans.

Among them, clove oil is gaining popularity because of its worldwide availability, ease of handling, efficacy and low cost. Even an untrained farmer will know of this plant product and will have easy access to it locally.

Efficacy of clove oil as an anesthetic

Clove oil is distilled from flowers, flower stalks and leaves of the clove tree *Eugenia aromatic*. In dentistry, it is used worldwide as an analgesic and disinfectant. It is also an additive in perfume and is common as a safe product for human use in food flavouring (Maura et al., 1989; Curtis 1990).

Clove oil is a mixture of different compounds containing 85-95% eugenol, 5-15% isoeugenol and methyleugenol. Isoeugenol is the compound considered by some aquaculturists to have the best anesthetic effect. Eugenol is considered to be a noncarcinogenic, nonmutagenic and generally recognized as safe (GRAS) for use in dentistry or as food additives by FDA, however neither clove oil nor any of its components are approved by FDA for use as an anesthetic for fish.

The efficacy of clove oil as an anesthetic for marine as well as freshwater fish has been demonstrated in various species such as carp, rainbow trout, channel catfish, rabbit fish, European seabream, seabass, Atlantic salmon, sockeye salmon, zebrafish, milkfish, Asian seabass and grouper. The anesthetic effect of clove oil has been confirmed in crustaceans, including the American lobster, marine shrimp, freshwater prawn and crabs as well as in the common octopus.

Currently, the major use of clove oil is for the transportation of live seed stock to grow-out ponds, such as with freshwater prawn *Macrobrachium rosenbergii* in the US.(Tidwell et al. 2005), and for live transportation of pond harvested prawns to distant live markets because of their territorial and cannibalistic nature. In such cases, the use of anesthetics is necessary to achieve success. Recent studies show that application of MS-222 and 2-phenoxyethanol are ineffective in the freshwater prawn. The oil generally induced anesthesia faster and at lower concentrations than Aqui-STM or quinaldine. It has been shown that at high concentrations, prawns suffered 60% mortality in the Aqui-STM , 20% mortality in quinaldine and 0% mortality in the clove oil treatment.

Use of clove oil for silver pomfret and shrimp – a case study in Kuwait

The silver pomfret, *Pampus argenteus*, locally known as 'zobaidy' is a highly priced food fish with a worldwide market demand. larval rearing and culture of silver pomfret has been developed since 1998 at the Mariculture and Fisheries Department (MFD), KISR, Kuwait. As the fish is very sensitive, capturing and keeping them alive from the wild has been a challenge. Careful handling of the fish is obligatory under domesticated culture conditions.

Table 1. Effect of selected anesthetics on 22-38g silver pomfret.

Dosage		Observations				
		Dose effect	Sleep time	Recovery time vs dose	Post recovery	Other effects
Clove oil	10-70 ppm	Increasing dosage reduced sleep time	Increase from16.6 to 0.74 min with increase in concentration	No change with increasing dose	No mortality even after 96 hours of post recovery period	
Quinaldine	4-15 ppm	Increasing dosage reduced sleep time	Sleep time decreased from 2.3 min to 0.58 min as dosage increase	Decrease with dose from 1.92-1.38 min.	No mortality during this period.	Twitching and contraction of muscle was observed.
MS-222	50-200 ppm	Sleep /recovery time decreased with increasing dosage	Decreased from 4.44 min at 50 ppm to 0.76 min at 200 ppm. of MS-222.	Decreased from 2.61 min to 0.9 min with increasing dose.	No mortality	All tested fish exhibited agitated behaviour at all the concentrations

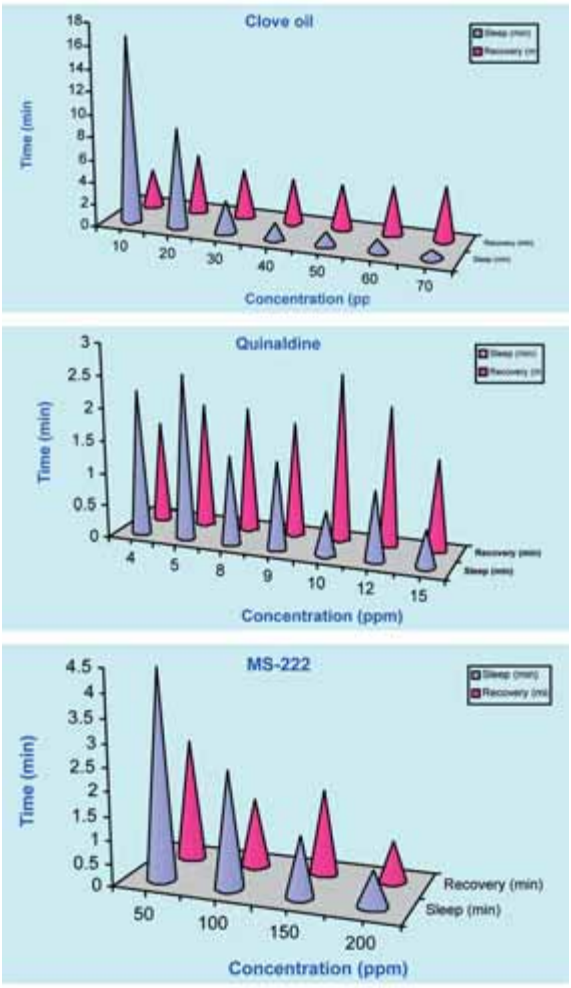
In order to identify a suitable cost-effective anesthetic for silver pomfret, experiments were carried out using 22-38g size silver pomfret fingerlings produced at the MFD hatchery from the eggs collected from wild spawners. The most conventional anesthetics such as MS-222, quinaldine and clove oil were evaluated. Results of these investigations tabulated above showed that clove oil can be used as an efficient anesthetic for silver pomfret fingerlings.

Clove oil for marine shrimp

Further investigations concentrated on studying the efficacy of clove oil on the local marine shrimp *Penaeus semisulcatus* for handling and transportation of both PL20 larvae and adult shrimp stages. In this species, clove oil was used at 100-400 ppm for PL20 (Figure 2). Results indicated that sleep time decreased from 4.5 to 0.68 min with increasing concentrations. Recovery showed a declining effect with increasing concentration but with no correlation. Larvae also showed a calm induction of sleep and recovery without any mortality.

Adult shrimp weighing from 17-21 g showed a steep decline in the sleep time from 6.4 min at 100 ppm to 0.68 min at 300-400 ppm concentration (Figure 3). The recovery time also declined from 8.1 min to 1.1 min at concentrations from 100-400 ppm clove oil without any mortality. Low concentrations of 5-10 ppm did not induce total sleep even after 60 minutes, demonstrating that clove oil at low concentrations could
be used for transportation of shrimp over long distances.

Figure 1. Effects of clove oil (a), Quinaldine (b) MS222(c) on the pomfret.



Some general observations

Chemicals used in aquaculture are now subjected to strict control, particularly with regard to food safety and residues issues. In fish, anesthetics are absorbed and excreted mainly through gills. Eugenol, its compounds and metabolites are quickly removed from the blood and tissues of fish. The presence of these substances in muscle tissues of fish is not considered toxic or mutagenous (Maura et al. 1989). In fact, substances derived from clove oil are considered to be anticarcinogenic (Zheng et al. 1992).

The recommended dosage for clove oil for adult rainbow trout is 30 ppm and 40-60 ppm for juveniles to induce anesthesia with a relatively short recovery period. Based on the observations at the MFD hatchery, such concentrations of clove oil are also recommended for use in silver pomfret, adding one more species in the list. In several fish species, eugenol induced anesthesia faster and at lower concentrations when compared to MS-222.

In a study using clove oil anesthetized Atlantic salmon, *Salmo salar*, no change in the concentration of blood glucose and increased concentrations of lactate and cortisol was observed. About 5 ppm clove

Figure 2. Effect of clove oil on *Penaeus semisulcatus* at PL20.

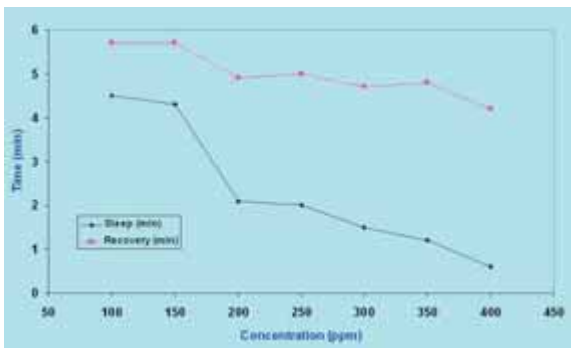
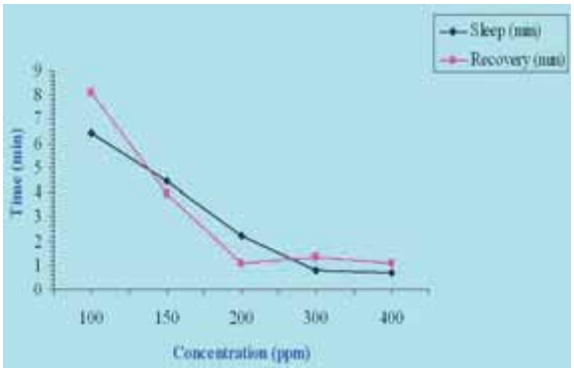


Figure 3. Effect of clove oil on adult shrimp.



oil is used in transporting some of the freshwater fish species without any stress. Test results show that clove oil can mitigate the stress response in some of the freshwater fish subjected to transport without increasing the plasma cortisol, glucose and ions.

Conclusion

Clove oil and its derivatives (eugenol and iso-eugenol) are becoming popular fish anesthetics in recent years because of their low cost and apparent safety to both fish and humans. It is used as an anesthetic in the handling of marine and freshwater fish, crustaceans, decapods and mollusks.

Clove oil is effective under long-distance transport conditions of up to 48 h. Several studies carried out with reference to the dose response, anesthesia induction, recovery time, ventilation rates and mortality after prolonged exposure suggests that it could be used for commercial aquaculture for various species. Though it is not yet approved for use in food fish in Canada and in USA, the Japanese have legalized the use of FA-100 (10% solution of eugenol) for anesthetic purposes.

These investigations carried out on clove oil suggests that it could be used as an effective anesthetic and when compared with the only FDA approved drug MS-222. Clove oil is approved for use in aquaculture facilities in Australia, New Zealand, and other Indo-Pacific countries with no withdrawal period for human consumption and release of the fishes in the environment (Kildea et al. 2004). The use of clove oil for aquaculture purposes have to be encouraged because this natural organic anesthetic is becoming more evident as a safe and low-cost alternative to several chemical drugs.

References are available on request from the authors.

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Conventional anesthetics

MS-222 is the white crystal tricaine methanesulfonate which is also marketed as Tricaine-S and Finquel. Soluble in water, it lowers pH and this acidic condition can irritate fish with harmful side effects. One of the major draw-backs of MS-222 is that even when fish are deeply anesthetized, handling still increases levels of plasma cortisol concentrations, an indicator of stress. The advantage is that induction is rapid and can take as quick as 15 seconds.

The dosage required is species and size specific. It is more potent in warm waters with low hardness. It is excreted in fish urine within 24h. It is approved to use on food fish in the USA and UK, but is banned in Canada. The withdrawal time stipulated by FDA for MS-222 is 21 days which makes it impossible to be used as an anesthetic for fish en route to markets.

Benzocaine or **ethyl aminobenzoate** is a white crystal insoluble in water. Therefore it must be first dissolved in either ethanol or acetone. Benzocaine is neutral and therefore causes less hyperactivity and initial stress reaction than unbuffered MS-222. The dosage is similar to tricaine but is not safe for any exposure longer than 15 minutes. The recovery time can be prolonged in older fish. It is not approved by FDA for use in food fish.

Quinaldine as an oily liquid has limited water solubility. It needs to be dissolved in acetone or alcohol before use. It is also an irritant to fish. However, the low cost of quinaldine has made it popular to use in the aquarium trade. Quinaldine sulfonate is a water soluble powder but it is more costly than quinaldine or tricane. The effective concentration of using quinaldine varies with species. Normally, quinaldine does not produce deep anesthesia which is required for surgery. Due to reflex responsiveness, the fish under full quinaldine anesthesia usually do not stop gill ventilation. It is not approved by FDA for use on food fish.

2-Phenoxyethanol is an opaque oily liquid that is freely soluble in ethanol. It has bactericidal properties and is therefore useful in surgery. The substance has a large margin of safety and produces a range of effects from light sedation to surgical anesthesia at various concentrations according to the size and species. It is not approved by FDA for use in food fish.

Metomidate anesthetizes fish without stress. Induction is rapid, 1-2 min, and recovery is faster than with MS-222. Dosage depends on the species and size. With larval gold fish and red drum it has been reported to produce inadequate anesthesia with high mortalities. It is not approved by FDA for use in food fish and is not widely used.

Carbon dioxide has been used as an anesthetic for many years for transport of fish. However, it is difficult to control the final concentration of CO2. Using of this requires a long induction time. Adjusting and maintaining the required pH is inconvenient and makes other methods more preferable. The advantage is that it is a 'low regulatory priority' substance in the US and therefore it is used for harvesting and transporting food fish to market.

Aqui-S™. This commercial product contains 50% isoeugenol and 50% polysorbate 80. A dosage of 20 mg/l is effective for most fish species and induction is described as stress free as the substance suppresses plasma cortisol. It is also used for crustaceans. It is approved for use in food fish in Australia and New Zealand. It is used primarily for the 'restricted harvest' of commercial fish species, where the low stress induction improves the colour, texture and appearance of the product that makes it a valuable anesthetic when transporting live food fish to market.

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FIAAP

Moana

Full scale marketing of SPF BT post larvae in Vietnam

After seven years in developing genetically improved SPF black tiger shrimp, Moana is ready to market post larvae to the region. It will begin in Vietnam.

In the November/December 2006 issue of Aqua Culture Asia Pacific, we featured a report on the progress of Hawaii based Moana's business in supplying SPF *Penaeus monodon* post larvae in Asia. At the recent Asian Pacific Aquaculture 2007 conference and trade show, held from 5-8 August 2007 in Hanoi, Vietnam, Mr Yuan Wang, CEO spoke on its activities in Vietnam, the positioning of the company and future strategy for their genetically improved SPF black tiger shrimp post larvae business.

Development work in Vietnam

There are two concurrent activities: a multiplication centre and pond trials to demonstrate growth performance of post larvae. Together with Research Institute for Aquaculture No 1 (RIA1), the construction of a multiplication centre will begin next month which will come on stream by September 2008. This multiplication centre will receive post larvae of pedigree stock from the nucleus breeding centre in Hawaii. Whilst waiting for this, production will be from a leased hatchery.

Simultaneously, they have been conducting grow out trials in farmer ponds as well as demonstration ponds leased by the company in South Vietnam. For the pond trials, small volumes of breeding stock as PL were brought in and were grown in Vietnam for spawning. PL produced from these parents were stocked into 6-7 demonstration ponds in Vinh Chau, Soc Trang Province in March. In these ponds, all variables remained the same with the exception of Moana PL and complete biosecurity. In April, a limited number of PLs were also supplied to 12-15 farmers.

"We have harvested our demonstration ponds so that we could have some results present at this show. We used stocking densities of 30 PL/m^2 in accordance to industry practice. The culture period was 120 days and survival was 76% which is higher than the industry average of <66% for good harvests. The average growth rate was 0.25g/day and at lower stocking density, it was 0.3g/day. We are very pleased with these results as harvest volume was 7.2 tonnes/ha of 30-35g shrimp and farmers can obtain a net profit of more than USD 15,000 which is twice that of the average for good harvests. The ex farm price of this size shrimp was USD 5.9 (24 July, 2007). Overall we are pleased with the results especially since growth was uniform and shrimp appearance was good. In their ponds, our customers are delaying harvest by 30-35 days to obtain larger size shrimp".

"So far, we have conducted trials in more than 50 ponds and no diseases have been reported in our ponds. There were reports of diseases in neighbouring farms. We also followed closely current practices in Vietnam. Stocking density is usually low but with one customer, we stocked at 45-50 PL/m^2. Our objective is to work within the parameters of practices of commercial Vietnamese farmers. In this way, we can present something meaningful which they can relate on a day to day basis".

Full scale marketing

"Our real commercial work will be after the Vietnamese new year in 2008 (February/March). Since our customers want this fast we will start with our leased infrastructure. By 2009, we will go full scale in the new multiplication centre. We have global pricing for the PL at USD 15 per 1000".

At its booth, from left: Bruno Decock, General Manager, Flor Indigne, President and Yuan Wang. In 1999, Flor invested considerably in this ambitious project to support the revitalization of black tiger shrimp farming.

"Basically, we are a PL and not broodstock producer. Completely domesticated SPF breeding stock are brought into Vietnam as PLs and grown out in the multiplication centre for 11-13 months to reproductive size. These are used to produce PL10-15 for stocking into ponds. Then we will restart with new broodstock from Hawaii. We are constantly breeding for improvement using our propriety processes and previous stocks will be obsolete. We will always send new and improved versions to the multiplication centre".

Together with each supply, the company provides a certificate for the farmers. There is a code of the shrimp origin which includes the pedigree. PLs are specific pathogen free for a list of viral diseases significant to the specific local market. This is not the end as new disease becomes a threat; they will be added to the list".

"The customer will be guaranteed that it is a genuine Moana product. We make delivery direct to the end user. We do not use middle men, brokers etc. At the farm, we will open the box and supervise the stocking into the customer's ponds".

"Before we deliver, our extension and sales team inspect the ponds. They ensure that the farm has a basic program on biosecurity or help the farmer put together a biosecurity program. This is important to make the best of the PL. However, once the PLs are in the ponds it becomes the responsibility of the farmer to practice good management practices including guarding the shrimp from disease introduction so that a successful harvest can be achieved".

After Vietnam

In India, the company will work with two companies as well as with the National Fisheries Development Board. Next will be Thailand, where the market for the black tiger shrimp is considered small in comparison to Vietnam and India. In both countries, they have strong government support. Once these markets work well, it plans to enter markets in Asia, Middle East and later on in Latin America.

Grobest I Mei

Upstream expansion

In Asia, the Grobest group is involved in aquaculture integration from farming to processing. In Vietnam, Grobest & I- Mei Industrial produces fish and shrimp feeds, and operates a processing plant and research farm in South Vietnam. By September 2007, it will be able to supply SPF *Penaeus vannamei* post larvae and quality *P. monodon* post larvae. This will be from its new hatchery in Nha Trang, in the central region.

Shen Yen Ling, Vice General Manager, said, "It important to have traceability along the supply chain. Currently all post larvae are provided by private hatcheries. They can assure us they are free of diseases but we do not have absolute control in the production process, although most know that antibiotics or banned chemicals cannot be not be used during production. Our feeds are already traceable with a computer recorded code for each batch of feed and processing plants have HACCP and EU accreditation".

The Grobest team around the NIR machine. From left Chen Fu Chin, Business Manager, Pao Cho Chang, Factory Manager and Shen Yen Ling.

"Culture of the vannamei shrimp is picking up around Halong and Da Nang in the North. Selling prices have been attractive in comparison to costs of production. In June it was it was VND 60,000 (USD 3.75) for 100 pcs/kg shrimp. Recently prices have declined to 40,000 VND/kg (USD 2.5). Farmers said that the FCR is low at 0.98. At a stocking density of 200/m^2, the cost of production was VND 35,000/kg (USD 2.2) for shrimp of sizes 70 to 100 pcs/kg".

Vietnam remains strong in the production of the black tiger shrimp which usually sell for higher prices. The company also plans to set up a domestication centre for this species in An Giang Province. This will be on the mainland, but secluded enough to have complete biosecurity. As the species is endemic to Vietnam, it will also be the centre for R&D in domestication and selective breeding development for its projects in Asia.

The company will also construct a new feed mill in South Vietnam for the production of fish and shrimp feeds. This will increase their total feed production capacity to 3,900 tpm. It is near to Cambodia where Grobest has started to sell feeds. This will be in addition to the current feed mill in Dong Nai outside Ho Chi Minh City producing feeds for the marine shrimp, grouper, catfish and tilapia.

Demand for feeds for the black tiger and vannamei shrimp has been increasing. Some 75% of their production of shrimp feeds is for black tiger shrimp. Shen said that farmers culturing *P. vannamei* in Nha Trang region use feed formulated for black tiger shrimp but those in Da Nang use feeds for the vannamei shrimp.

"With our feed, the farmer not only sees large but also heavy shrimp. This is because we have added enough fishmeal to ensure growth. From our research, we know that when the feed is not cooked enough faeces are white. This does not happen with our feed. Feed formulation is also adjusted depending on salinity, seasonal changes (rainy *versus* dry season) and availability of raw material. No changes are made in the premix. To maintain quality of shrimp feed, we raised prices twice in 2006 and once in 2007 because of large increases in raw material prices".

The R&D in aqua feed production is carried out in Taiwan and these are transferred to the mill in Vietnam. Consultants from the head office in Taiwan, provided technical support to mills in China, Vietnam, India, Thailand and Indonesia. They have 120 and 8 sales and technical staff for shrimp and fish feeds, respectively.

" In Vietnam, our strong point is that we can assure feed quality quickly by using an NIR machine (Near Infrared Analysis) to check feed composition which is only possible if there is a large enough database on ingredients. Each sample analysis takes 3 minutes", said Shen.

Dan Fegan joins Cargill's Aquaculture Team

In June, Dan Fegan joined Cargill Animal Nutrition's aquaculture team as a Regional Technical Manager, based in Bangkok, Thailand. At the recent Asian Pacific Aquaculture Conference and trade show, Dan talked on his move.

"I was impressed with Cargill's vision and plans for their aquaculture business, both regionally and globally and when they invited me to join in this role, I was pleased to have the opportunity to contribute to these efforts." He added that the new role with Cargill will allow him to get more involved in providing technical support and working directly with Cargill's feed customers and sales teams.

My role with Cargill will also allow me to broaden my experience through working closely with Cargill's Technical Deployment and Innovation Teams in the region and in the USA. I have just returned from one month working with the staff at the new Aquaculture Research Center in Elk River, Minnesota. I am excited about the cutting-edge research program and scope for further involvement in these efforts, and I look forward to helping implement these new technologies to bring solutions to our Asian customers".

Fegan, who spent five years at Alltech working with colleagues to provide support to the Asian aqua industry and to build Alltech Aqua's business in Asia, stated "It was a difficult decision to make as I have enjoyed working with my colleagues in Alltech. At the same, I also feel that the Alltech Aqua team is in place and will continue to grow their business successfully".

Dan's new role with Cargill will allow him to broaden his experience by working more with fish culture, feeds and nutrition. Although mainly known for his work with shrimp, he is confident that he will be able to contribute through application of general aquaculture principles and his range of experience working in different production conditions. "Although there are obvious differences in the biology of shrimp and fish, there are as many, if not more, similarities than differences, particularly in practical farm management. A good understanding of the relationships between successful aquaculture production, environment, pond management and health management as well as an understanding of aquaculture as a business, is fundamental to successful aquaculture regardless of the species."

"Cargill believes aquaculture is a future growth industry, not just in Asia but globally. We are keen to build our position in the aquaculture business and are looking at ways in which we can expand our activities by helping align our customers with the seafood industry. We have just hired a "seafood category leader" to help identify how and where Cargill can build our role in bringing high quality, nutritious seafood products to consumers while providing the assurances and traceability they demand. We will also increase our research efforts to supply nutritional solutions to meet these market needs".

Integrated Aquaculture International (IAI)

New experts join


Dr Kerry Claydon

The company dedicated to improving the efficiency and sustainability of aquaculture has announced new additions to its team of experts. **Dr Kerry Claydon** is **Director of Aquatic Animal Health**. Kerry has a doctoral degree in Microbiology from James Cook University in Queensland, Australia. Her PhD research specialization was crustacean cell culture. She is experienced in immunohistochemistry, histopathology, DNA extraction and sequencing, viral isolation and purification and real-time polymerase chain reaction (RT-PCR). Kerry will be managing the Aquatic Animal Health Laboratory in IAI's joint project with the Department of Fisheries (DOF) of Brunei Darussalam to produce Specific Pathogen Free lines of shrimp.


Dr A. Victor Suresh

Dr A. Victor Suresh is **Director of Nutrition and Feeds**. Victor received his Bachelor, Master and PhD degrees in fisheries and aquaculture from India, Thailand the USA, respectively. He has 11 years experience in the global aqua feed industry in commercial feed formulation, product development, technical service, research program management and new business start up. Victor will be based in India and travel internationally to support IAI's clients in Asia, Europe and Latin America.

Biomin

Support for product applications

Marnie Betts, an agricultural science graduate has joined Biomin Singapore Pte as **Product Application Manager**. Marnie has over 18 years experience in the premix, feedmilling and feed additive business in Australia and across Asia, most recently as the Regional Sales Manager for Adisseo based in Singapore. Marnie will divide her time between supporting Biomin's product applications in Asia and Key Account management in Australia.

WWF

New director of aquaculture program

Jose Villalon, a 26-year veteran of the aquaculture industry, is the **new director of World Wildlife Fund's (WWF) aquaculture program**. His primary role is to oversee the Aquaculture Dialogues, a set of multi-stakeholder groups developing standards for more sustainable aquaculture production (see page 5).

"I am delighted to be part of the growing aquaculture team at WWF," said Jose. "WWF has a mature and solid framework for credible standards development and we look forward to accelerating this process. It is energizing to see how the industry sector has embraced this program and we anticipate working side-by-side with industry to make it a worldwide success."

Prior to coming to WWF, he operated his own consulting business in Mazatlan, Mexico for five years. The firm worked with private industry on technical shrimp production protocols and farm accounting systems. Previously, he operated a 470-acre shrimp farm in Mazatlan for two years. Jose's career also included five years at AquaNova, which operated a shrimp feed mill and processing plant and at Marine Harvest International in Guayaquil, Ecuador from 1983 to 1994, covering shrimp farm production, with bottom-line accountability for its hatchery, feedmill, and farm operations. Jose has an MSc in fisheries biology from the University of Washington in Seattle and a BSc from Florida International University, USA.

Alltech

Advances further in the Asia-Pacific region

Alltech has opened a new regional office in Davao in the Philippines, a market of increasing importance in in the Asia-Pacific region. This new office will allow Alltech to access key regions such as Visayas and Mindanao in order to meet growing customer demands and provide local customer service. The office was officially opened in June. Additionally, it is increasing its presence in the Australian market with the opening of another office in Brisbane. The office will be a local base for technical support and services to the livestock markets in Queensland and Northern New South Wales.

Steve Bourne, director of Asia-Pacific, Alltech, said, "Asia-Pacific is becoming a region of increasing importance for Alltech since the demand for natural solutions is continuously increasing as a result of the growing cost for raw materials. As a result Alltech is continuing to meet this demand by further expanding in these important markets."


Orla McAleer

Orla McAleer is now **marketing manager** for the Asia-Pacific region. Previously, she was the European and Asian communications manager. Orla will be responsible for overseeing the marketing and branding of Alltech and its brands throughout the Asia-Pacific region. Prior to this, she worked for a publishing company and graduated from Trinity College Dublin, Ireland. She will be based out of the European Bioscience Centre in Ireland.


Dr. Yadunandan

Dr. Yadunandan is **market development manager** for South Asia. He will be responsible for the marketing and business development of the region. Previously, Dr. Yadunandan worked as a veterinary medicine consultant. He received his degree in veterinary medicine from the University of Agricultural Sciences, Bangalore, India and in 2006, completed an MBA from Stockholm University School of Business in Sweden and ESC-Pau in France. Dr. Yadunandan will be based at the South Asia headquarters in Bangalore, India.

Pornpun Yutharaksanukul has joined Alltech Thailand as **business development manager** – aquaculture. Yutharaksanukul has worked in the aquaculture industry in Thailand, where he has gained extensive experience and expertise in the area with various organisations. He has a MSc. in aquaculture and a BSc. in aquaculture from Kasetsart University in Thailand.

INVE- Nutri –Aid

Now with aquaculture additives

Since 2006, this business unit of INVE has screened specialty additives and ingredients first developed and marketed for the poultry feed industry for zootechnical applications in aquaculture.

The company is translating their R&D experience in nutritional health in animal rearing to that for fish and shrimp culture. In addition there are some products uniquely developed for aquaculture. The first portfolio of products was launched in 2007 and the company is obtaining feedback from users. Currently, these are specialty additives such as antioxidants, mold inhibitors, nucleotides, enzymes, binders and pigments. In 2008, a product specifically designed to fit in the company's immuno-aid concept will be launched. Also a mycotoxin binder with a multifunctional approach will be in the new portfolio.

At the booth during Victam International 2007, Utrecht in May, Els Vanden Berghe, Product Manager Aqua Additives, said that the products are designed for both large and small aqua feed producers. The bottom line is cost effectiveness of these additives and ingredients. To assess these, the company conducts field trials as well as obtains information from suppliers on the feed performance. As most of the clients will be looking at replacements for fish meal, it means that enzymes, nucleotides and attractants will be needed to improve feed performance when non marine sources of protein are used. For diets based on plant meals, Nutri-Zym Aq, an enzyme mixture will increase availability of nutrients. Except for the EU, the enzyme has been approved for use worldwide. Another product is Oxy –Nil, a synergistic combination of anti oxidants and chelators designed to stabilize feeds, premixes and concentrates and secure quality. This has an exacting role in shrimp and fish feeds rich in free fatty acids and unsaturated fatty acids.

There is now increasing evidence on the effects of mycotoxins in aquatic species. As the industry moves to using more plant meals, the requirement will be broad spectrum mycotoxin binders such as Toxy-Nil Aq Dry. In a unique way, it absorbs, binds, captures and transforms a broad range of mycotoxins, according to Els. It can be used as preservative (low dose) or detoxification (high dose) of feeds and raw materials. It is also relatively stable to heat processing and can be applied to raw material and finished feed before extrusion. Other products are Nutri-Bind Aqua Dry, a non toxic low inclusion binder from modified urea. The solution for attraction and feed stimulation of fish and shrimp diets is Nutri Track, a combination of amino acids and organic flavor compounds which uses Talin®an electrostatic carrier. More information: Email: info@nutriadinternational.com

Venture More

New products for fish/shrimp health

This Malaysian based company has announced a series of new products. These are the natural growth promoter (CEM B1) and the natural antivirus and anti stress (CEM 77). Both contain wheat germ extract with a proximate analysis of 65.36% of moisture, 1.12% of crude protein and 0.72% fat. It contains inverted sugar (8.09%) and trace amounts of minerals such as calcium, phosphorus, magnesium, manganese, iron, cobalt, copper, zinc, sodium and potassium.

CEM is an amino vitamin protein feed, developed via molecular biology without genetic effects, according to Raymond Chee, Marketing Director. These nutrients will enhance the disease resistance against virus and bacteria infections and strengthen the immune system thus reducing mortality. Fish and shrimp had brighter scale and shell colour.

Raymond added that the special feature of using these products is that meat texture is improved and thus lengthening the post harvest shelf life of the final product. With improved feed conversion, culture period can be reduced from 7 to 5 months for fish and shrimp by 5 to 10 days. Grow out can also continue during cold and rainy spells.

In contrast, the product for natural antivirus and anti stress is used specially in shrimp culture to prevent white spot and other diseases. It can also be used to reduce transportation stress. The application of both products are either mixed into the water or mixed into the pellets before feeding. Since these products do not contain any hormones, steroids, enzymes or beneficial microbes, it is not constrained by the type of feed and water. More information: Email: venturem@streamyx.com

Astaxanthin Partners Ltd

EU approves natural astaxanthin

The June 2007 meeting of the EU's Standing Committee on the Food Chain and Animal Health (SCFCAH), has approved Aquasta® , a natural astaxanthin for use in salmon and trout feed for flesh pigmentation. This followed from the earlier positive evaluation by the FEEDAP panel and the European Food Safety Authority (EFSA) on the safety and efficacy of the product.

"This is an important milestone in our effort to create a global business. Aquasta® has been on the market for several years already in Chile, Canada and the US and consumer trends towards more natural foods have been positive for us. " said Peter Castelli, President of Astaxanthin Partners Ltd.

Astaxanthin is an important nutrient for salmonids in addition to imparting the characteristic orange-pink colour to the flesh of the fish. In the wild, the salmon obtains its natural source of astaxanthin from the diet of crustaceans. This is also in the same isomeric form as the astaxanthin found in Antartic krill. As a free non-esterified form it is absorbed very efficiently. Due to the unique natural enzyme process employed to crack the yeast cell wall, its bioavailability is typically around 90%.

Aquasta® is natural because it is made by *Phaffia rhodozyma* yeast, a living organism that is found in nature. The yeast is grown in large tanks using traditional fermentation techniques, similar to those used for other food products such as beer. The process uses renewable ingredients such as cane sugar, corn and wheat, making it is a sustainable product. Unlike the synthetic options, Phaffia based astaxanthin is also an acceptable way of pigmenting salmon by some certification bodies for organic aquaculture.

Aquasta® is marketed by Astaxanthin Partners Ltd., a 50:50 joint venture formed in 2003 between Tate & Lyle PLC and Igene Biotechnology, Inc. More information: Email: robert.hodson@tateandlyle.com

At Asian Pacific Aquaculture 2007

Palatability solutions

As the aqua feed industry is moving towards formulating feeds with less fish meal and fish oil, additives to increase palatability will be necessary. The team at the **Aquativ** booth from the commercial offices in France, China and Vietnam introduced their wide range of palatability enhancer (PE) as a solution. Trials conducted with the marine shrimp *Penaeus vannamei* showed that improving the feed palatability increased feed intake. In these trials in a shrimp pond, a commercial feed coated with the enhancer at 1% was significantly preferred by the shrimp. Feed was placed in feeding trays in strategic parts of the pond. The higher feed efficiency was also reflected in better water quality and lower wastage of the feed.

In a tank study, growth performance of marine shrimp fed feeds with low levels of fish meal at 12.5% with added PE (LM) was compared to that in shrimp fed diets containing 25% fish meal (HM). The cost of the feed with less fish meal was 15% lower. Results after the 90 day trial showed that mean body weight of shrimp and specific growth rate (%) were comparable to shrimp fed the FM diets.

The company will continue to carry out trials in pond conditions typical of the countries in Asia to further ascertain the efficacy of the enhancer. In Thailand, trials will be conducted at the Songkhla University. In Vietnam, they will start some trials at RIA2 with freshwater fish. They company is focussing its research on shrimp, seabass, catfish and tilapia. The end user of the additive will be feed millers. At their booth, Thomas Levallois, Sales Manager, said that the enhancer is heat stabile and extrusion will not affect its nutritive properties. More information: contact@aquativ-diana.com

The Aquativ team from left; Bing Wu, Vincent Fournier, Thomas Levallois and Nguyen Anh Ngoc

Pond and aeration products

For the Asian market, the 'Aerotube' was displayed at the **Tekni-plex**, USA booth. This has been in the US markets since 1998 and was only introduced to Asia in 2006. John Lui said that the tube, made of rubber and plastic, dispenses fine bubbles into the water. Some of the advantages are energy savings in that it adds more volume of air into the water than traditional aerators, less start up costs and better oxygen transfer. The tubing is available in 200 feet or 61m coils. is the world's number one manufacturer of garden hose and aeration tubing with a manufacturing facility in Suzhou, China. Production in China will begin in 2008. In aquaculture the applications for Aerotube include in raceways, recirculating systems, hatcheries, grow-out ponds, cage culture and transporting trucks. More information: www.coloriteaerationtubing.com

Tekni-plex booth with an aquarium to show the aerotube

GSE Lining Technology is marketing its liners to Vietnam through an office in Ho Chi Minh City. The Asia Pacific office is in Bangkok. In Asia, there is the GSE HD, a high quality and high density HDPE geomembrane. It has outstanding crack resistance, UV exposure and thermal aging characteristics and thus is suitable for exposed areas, according to the company. GSE is the world's largest manufacturer of geo membranes and applications in aquaculture are for containing water, preventing intrusion of pollutants from ground water, maintaining water quality and erosion control.

According to the company, with the liners, diseases cannot be eliminated but it does allow for rapid cleaning of the water and disinfection. Geo membranes are resistant to microbial attack. It added that GSE's liners are reliable choices for aquaculture projects all over Asia-Pacific region, in particular shrimp farms in Indonesia for over 2 decades. More than 30 million m^2 of GSE 0.75 smooth black HDPE geomembrane liners are used in shrimp farms in Lampung. In Vietnam, GSE has been supplying liners for shrimp farms in Quang Ninh, Hai Phong, Nghe An, Ha Tinh, Hue and Nha Trang Provinces and to date these cover more than 500,000 m^2. More information: tranh@gseworld.com; www.gseworld.com

ALLTECH
Settles patent infringement lawsuit

A statement released by Knobbe Martens, an intellectual property law firm acting for Alltech Inc., Lexington, Kentucky announced that Alltech has settled its patent infringement lawsuit against Cenzone Tech, Inc. and its founder Jung Fu Wu. The parties settled their dispute under confidential terms, with Cenzone agreeing to pay an undisclosed sum to Alltech. The settlement concludes over 18 months of federal litigation and was reached shortly after the United States District Court for the Southern District of California ruled that Cenzone's Microbond product infringed Alltech's U.S. Patent No. 6,045,834, directed to compositions and methods for combating mycotoxins in animal feed. The patented composition, which was discovered by Alltech's scientists approximately ten years ago, is now incorporated into Alltech's successful MTB-100 and Mycosorb products.

Dr. Pearse Lyons, Alltech's founder and President, stated "Alltech invests heavily in research and development in an effort to bring innovative products to its customers and this case demonstrates Alltech's commitment to enforcing its intellectual property rights that result from such research."

Alltech AquaThailand
Product lines for farm market

In conjunction with Alltech's aquaculture road show in southern and eastern Thailand from June 25 to July 5, 2007, the company launched the aqua products – Bio-Mos® and NuPro® for the farm market. These are packed in newly designed 1 kg bags. Previously, these have been sold only to feed mill customers.

Mr. Pornpun Yutharaksanukul at the launch.

The aquaculture road show visited various locations such from Surat Thani, Phuket, Phang Nga, Ranong, Chumporn, Trad, Chantaburi to Chachoengsao. Besides the introduction to product application, the road show also covered challenges facing the industry such as bacterial diseases and the current shrimp prices. Bio-Mos derived from a specific strain of yeast, improves animal performance by feeding the gastrointestinal tract and therefore, plays a critical role in animal nutrition and production. NuPro, a protein extracted from a specific strain of yeast, helps improve feed efficiency and growth.

Richard Chong, general manager of Alltech Thailand said, "Thailand is the number one shrimp exporter in the world and as result this business plays a pivotal role in the country's future economic development. Alltech would like to contribute to this growth by using their capabilities and technologies to further develop aquaculture production and increase the farmer's profitability in the sector."

Mr. Pornpun Yutharaksanukul, business development manager - aquaculture, Alltech, further explained, "One of Alltech's key business objectives is to provide natural solutions and this road show will work as a good platform for Alltech to build a strong relationship with farmers in these specific regions of Thailand".

What to expect in AQUACulture Asia Pacific Magazine in 2008

Issue	January/ February	March/ April	May/ June	July/ August	September/ October	November/ December
Focus on current trends & challenges	Aqua Feed Production	Disease & Health Management	Food Safety	Sustainable Aquaculture	Organic Aquaculture	Cage Culture
Industry review	Marine shrimp	Marine fish	Catfish	Tilapia	Freshwater prawn	Hatchery
Features on success stories, best practices, new technology and developments						
Feed technology NEW	Enzymes & feed additives	Feed processing	Immuno-stimulants & Feed ingredients	Novel protein meals & amino acids	Nutrition & Formulation	Extrusion & Larval feeding
Technical	Culture technology	Recirculation technology	Product quality & markets	Biotechnology & diseases management	Pre & Pro-biotics	Health management/ Larval feeding
Shows	Victam & FIA Asia 2008	World Aquaculture 2008	Vietfish 2008	Australasian Aquaculture 2008	Aquaculture China	

September 23-28
14th Annual Practical Short Course on Aquaculture Feed Extrusion, Nutrition and Feed Management
Email: mnriaz@tamu.edu
Web: www.tamu.edu/extrusion

September 28 -29
Aqua India 2007
Chennai, India
Contact: Pramila Rajan
mail: pramirajan@gmail.com
Web: http://www.aquaprofessional.org/sapnew/

October 23-25
Livestock Asia 2007
Kuala Lumpur, Malaysia
Email: mha@ambexpo.com
Web: www.livestockasia.com

October 24-26
Fish Africa & Aquaculture Africa
Capetown, South Africa
Web: www.fishafrica.net/

October 24-27
Aquaculture Europe
Istanbul, Turkey
Tel: +32 923 34 912
Email: ae2007@aquaculture.cc
Web: http:www.easonline.org (p33)

November 6- 9
Caribbean and Latin American Aquaculture
San Juan, Puerto Rico
Tel: +1 760 432 4275
Email: worldaqua@aol.com
Web: www.was.org

November 6-8
China Fisheries & Seafood and China Aquaculture
Dalian, China
Web: www.seafare.com

November 20-23
8th Asian Fisheries Forum
Kochi, India
Tel:+91 484 2394798
Email: 8aff2007@gmail.com
Web: www.8aff2007.org/

November 27-30
Iran 5th International Fisheries and Aquaculture Exhibition
Kish Island, Iran
Email: iranseafoodexpo@cororg.com
Web: www.iranseafoodexpo.ir/

January 27-February 1
18th Practical Short Course on Feeds and Pet Food Extrusion
Texas A&M, USA
Email: mnriaz@tamu.edu
Web: www.tamu.edu/extrusion

February 9 – 12
Aquaculture America
Lake Buena Vista, Florida
Email: worldaqua@aol.com
Web: www.was.org

March 5-7
Victam Asia 2008/ Feed Ingredients & Additives Asia Pacific
Bangkok, Thailand
Email : andrew.west733@ntlworld.com
Web: http://www.victam.com/asia.php

March 6
Aquafeed Horizons Asia 2008
Bangkok, Thailand
Email: conferences@aquafeed.com
Web: www.aquafeed.info

May 19-23
World Aquaculture 2008 Busan, Korea
Email: worldaqua@aol.com
Web: www.was.org (IBC)

June 22-26
DAA VII-7th Symposium on Diseases in Asian Aquaculture
Taipei, Taiwan
Email: daaseven@gmail.com
Web: http://homepage.ntu.edu.tw/~daaseven/index1.htm

List your events in AQUA Culture AsiaPacific Magazine for FREE. Fax details to: +603 2096 2276 or email to the Editor at zuridah@aquaasiapac.com

6th Practical short course -Aquafeed EURO-ASIA 2007

Aquaculture Feed Extrusion, Nutrition, & Feed Management

23 & 24 October 2007, Novotel Istanbul, Zeytinburnu, Istanbul, Turkey

This is a crash course for new plant personal and opportunity for those with experience to meet experts in the field to discuss their current problems to enhance their plant operations. The course material will also serve as a useful reference for processors, product formulators, chemists and technicians as well as business managers familiar with aquaculture feed, extrusion, nutrition and feed management. Some of the topics and speakers are:

- Fundamentals of extrusion technology & Aquatic feed extrusion: applications of twin screw extruders & High fat extrusion for aquafeed -Jan Swiers and Nigel Lindley, Wenger Overseas, Inc., Belgium
- Feed preparation and new extrusion technology with online control of product density and specific mechanical energy input-Thomas Landert, Bühler AG , Switzerland
- Aqua feed quality: lipid oxidation, and palatability- Dr. Tom Verleyen, Kemin Europa NV, Belgium
- Grinding for Aquatic Feeds and feed pelletisation-Arthur vom Hofe, CPM Roskamp Champion, Netherlands
- Drying of aquafeed- Andy Sharpe, Aeroglide Europe, United Kingdom
- Absorption coating by means of vacuum- Peter Raeven, Dinnissen BV, Netherlands
- Feed coating and micro encapsulation- Jacques C. Wijnoogst, Tema-International BV, Netherlands
- Larval nutrition and starter feeds- Dr. Süreyya Özkızılcık, Nutra Yem Ltd. Sti, Turkey

More information: Email: aquafeed@scarlet.be; Web: http://www.membraneworld.com/aquafeed2007.htm

8th Asian Fisheries Forum

20-23 November, 2007, Le Meridien, Kochi India

"Fisheries and Aquaculture: Strategic Outlook for Asia "

This is the triennial meeting of the Asian Fisheries Society and is organized by the Asian Fisheries Society in association with the Indian Branch of the Asian Fisheries Society and several other co-sponsors. This event is expected to attract over 1000 scientists, technocrafts, development workers, fisheries professionals, traders, fisheries organizations, governmental agencies, planners and activists.

There will be concurrent technical sessions, a poster session, two special symposia, a trade exhibition and post forum tours. The two special symposia will be

- Second global symposium on "Gender and Fisheries: Solutions through Gender Research"
- Shrimp Aquaculture in Asia: Current Status and Future Prospects

The international trade exhibition will bring exhibitors and manufacturers together to showcase the latest technologies, R&D innovations, equipment, services, etc to the participants of 8 AFF 2007 and the key international stakeholders interested in developing modern aquaculture and fisheries.

More information: conatct: The Secretariat, 8 AFF 2007, Tel: + 91 484 2394798 Fax: + 91 484 2394909; Email: 8aff2007@gmail.com; Web: http://www.8aff2007.org/html/aff_cont.html

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