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Asia Pacific

Focus on Disease Management

Parasitic diseases in marine fish
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Review on shrimp diseases

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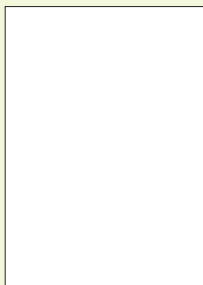
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From the editor

The Year Ahead

As we enter a new year, it will be fitting to reflect on the challenges and issues ahead for the industry. The message from the industry is that trade issues and market forces will continue to determine the direction of the marine shrimp industry, as it did in 2005. Increases in production will be from the culture of *P. vannamei*. For all species, Asian aquaculture will continue to face non tariff barriers unless there are more efforts for a responsible and sustainable aquaculture (RSA).

Generally, all high value products will one day face price erosion due to competition and market forces. This is a reality check for farmers that low prices for the marine shrimp are here to stay. Dr. M. Sakthivel from India's Aquaculture Foundation has put this aptly as "who will stay as sustainable producers at a production cost of USD 2.0/kg and sell shrimp at prevailing market prices?" The solution may lie in value adding and branding.

The processing trend is value-added finished products as consumers seek new levels of convenience. The industry is pressing ahead with this as it would allow them to capture larger shares of the gains from trade along the value chain. As this incurs substantial marketing expenses to develop the necessary brand name involved in value-added products, it has been slower in some countries as compared to others.

There are the trade and non tariff barriers facing the shrimp and catfish segments. At the last 2005 Global Shrimp Outlook Meeting in Vietnam, panelists said that the aquaculture industry's best approach to antidumping is to maintain a coordinated response to ongoing antidumping issues. The first administrative review on the shrimp antidumping will begin in February, 2006. This uncertainty and volatility of the US shrimp market (as well as the Japanese market), is pushing shrimp exporters towards market diversification.

The antidumping experience in the US market forced the Vietnamese tra and basa industry to revise its export market strategy. In 2004, the value of the EU market for catfish increased to 30% as compared to 19% for the US market. In the article on the shrimp industry (see page 10), Glen Iling mentioned the possibility of China becoming an import market for shrimp. Perhaps in the near distant future, China may become the market to the world rather than the factory to the world.

In an editorial in 2003, I mentioned the impact of the culture of *P. vannamei* in Asia on the global market for marine shrimp. Asia now produces 81% of world supply of shrimp and based on estimates of production, this will increase in 2006. *P. vannamei* culture has also turned the farming of shrimp in Asia into a volume business. However, will the market continue to be segmented into medium size *vannamei* shrimp and large size black tiger shrimp? Through partial harvesting, larger *vannamei* shrimp are being produced when densities are reduced. Now US researchers have shown that 34g shrimp can be harvested in intensive systems at 118 pcs/m². Unless more positive results emanate from work on the domestication of the black tiger shrimp, the species will continue to lose its lure. What will be the final equilibrium?

Today, it is not only innovative products that consumers are seeking. Products must be wholesome and safe. Unfortunately, aquaculture has had its share of bad publicity as a means of food production. In the new global agenda, RSA will be part of the market forces and there should not be any apprehension on the part of Asian producers to meet this demand. What does this mean for producers? This is aquaculture developed in a comprehensive and balanced manner to ensure its long-term sustainability and in harmony with the environment (FAO, 2005). This, together with new technologies to improve production, makes them more marketable. RSA is already embodied in the various codes of conduct for aquaculture and good aquaculture practices. Systems such as cage culture without considerations of carrying capacity and the environment will be at risk. In the future, there is the possibility that markets will favour countries where this is well planned and implemented.

and finally...

There have been several letters to the editor recently with regard to the article "Improving pond water quality with clinoptilolites" published in issue 6, pp 22 (see page 43). On this, it is important to state that the magazine's role is not to decide what is right or wrong for aquaculture. Our role is to serve as a platform where technologies can be debated upon scientifically to ensure all views are heard for the industry to reach the correct conclusion.

The team at Aquaculture Asia Pacific wishes all readers a Happy and Prosperous New Year.

WRITE TO THE EDITOR

We want to hear from you. Write your comments on the industry to the editor.

Send by fax to Zuridah Merican at +603 2096 2276 or email: zuridah@aquaaasiapac.com

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Sustaining growth of farmed shrimp

Top international shrimp buyers, producers and suppliers at the Global Shrimp Outlook (GSOL) meeting, held in Ho Chi Minh City in October 2005 recognized the need for both significant market expansion and continued vigilance against chemical residues to sustain the growth of shrimp aquaculture. The organiser, Global Aquaculture Alliance (GAA) said 300 participants from Asia, Europe, North America and South America attended the meeting.



At the GSOL 2005, international aquaculture experts considered such topics as market expansion, antidumping, facility certification and antibiotic residues in shrimp.

George Chamberlain, GAA president said, "While many producers have argued that zero-tolerance policies for trace levels of chemicals in shrimp are unrealistic, they recognize that such regulations in Europe and elsewhere may not change. As buyers reiterate, the market demands "clean" shrimp, so farmers have adjusted their practices to continue supplying the popular seafood".

In the session on antidumping, Matthew Nicely of Willkie Farr and Gallagher said that the aquaculture industry's best approach to antidumping, is to maintain a coordinated response to ongoing antidumping issues. Projections on production were discussed. Chen Dan of the Evergreen Group projected a rise in China's shrimp production to 450,000 tonnes in 2006, with more value adding and an emphasis on regional marketing to help absorb the additional product. Thailand's projections were not far behind. On the contrary, Werner Jost of Camanor said Brazil's fledgling industry is still adjusting its farm practices to deal with new diseases. Ecuador is steadily recovering volume after the country's devastating decline caused by White Spot Syndrome Virus.

The next step for Thai and Indian shrimp

In November, the US International Trade Commission announced that it will maintain the respective antidumping duties on frozen shrimp from India and Thailand. Thailand and India had applied for a Change Circumstances Review, citing the damage inflicted on the industry from the December 26 tsunami.

Following this decision, Thai shrimp farmers are seeking action from the government. In the Nation, Ekapoj Yodpinit from the Suratthani shrimp club said that this was important as the US market accounts for half of Thailand's shrimp exports. For the first 10 months of 2005, Thailand exported 231,769 tonnes of shrimp worth Baht 58 billion or USD 1.45 billion, according to figures released by the Thai Frozen Foods Association. Of this, 130,764 tonnes was to the US market.

A decision on whether Thailand will bring the case of double taxing its shrimp exports to the World Trade Organisation (WTO) is still pending. According to MCOT.net, the Thai Ambassador to the WTO suggested that the government should file a complaint to the world trade body over what it saw as the US government's unfair practice on imposing both antidumping duties and continuous bonds on Thai shrimp exporters.

During the first 10 months 2005, Thai shrimp exporters have posted continuous bonds worth Baht 2 billion or USD 50 million as required by the US government, according to the Thai Frozen Foods Association. The figure will double to Baht 4 billion or USD100 million over the next two years to guarantee Thai shrimp exports to the US market.

In India, the Business Standard said that the decision was a cold shower for Indian's shrimp industry. Nevertheless, they are confident that the issue will be brought to the disputes settlement body of the WTO. It said that if handled well, the Indian case certainly stood a chance of getting a favourable verdict. In the case of India, exports of shrimps to the US had dropped by nearly half since the imposition of the antidumping duty.

The report added that regardless of the final outcome of this dispute, one thing that is clear is that Indian seafood exporters cannot and should not depend too much on the US market. Though shrimp is the most sought after seafood among US consumers and the country depends largely on imports for meeting its demand, the fact is that shrimp prices are on the decline there and Indian exporters may find their profit margins shrinking with time. Indian processors also noted that while the Indian seafood exporters find the going tough, their counterparts in Thailand, faced with a similar situation, have moved into high value-added products.

Too fast too furious in Ca Mau

Shrimp farming in the southern province of Ca Mau, Mekong Delta, Vietnam has taken off at such a phenomenal phase that the majority of rice fields in the Dam Doi District have been completely rebuilt as shrimp culture ponds. Thanks to shrimp farming, the district's gross domestic product has increased from 12 to 24% a year, according to the Vietnam News Service.

The report quoted Hai Hong Nhanh, owner of a large shrimp farm in Thanh Tung Commune, "Previously, the entire area was rice fields and we had to work very hard for very little profit. In 2001, we decided to culture shrimp and our situation improved. Now, we have three hectares of shrimp ponds, and we earn VND500 million or USD 31,600 a year."

However, it is the unplanned development that is worrying authorities and they wonder whether this is sustainable. In order to access the water needed, farmers have destroyed dams to allow seawater to enter ponds. As a result, the waters are too saline. The local authorities are trying to find a solution to the problem. But what is clear, they said is that a balance must be sought by developing both shrimp and rice. The report concluded that Ca Mau is learning the hard way that sustainable development plans are the only ones that can last.



Highs in import alerts in 2005

The US Food and Drug Administration (FDA) said that the import alerts for shrimp, basa fish and crabmeat were at record highs throughout most of 2005. In a report in Intrafish, a Malaysian company was the latest to be added to the alert list for allegedly shipping frozen raw shrimp contaminated with chloramphenicol. The agency said that as there has been an extensive commercialisation and an increased consumption rate of aquaculture seafood products, the use of unapproved animal drugs will have an impact on the safety of aquaculture products for consumers.

There are 17 crab exporters from China, Vietnam and Indonesia listed due to shipments containing residues of chloramphenicol, 12 shrimp exporters from five countries on FDA warning lists, four basa catfish exporters from Vietnam, one eel exporter from China, and a "walking clarias" exporter from Thailand. These companies are listed for shipping products containing either chloramphenicol, malachite green or the banned antibiotic ciprofloxacin. Two Indonesian shrimp exporters are listed for shipments containing residues of another banned chemical called nitrofurans. The FDA requires five clean shipments testing negative for chloramphenicol, verified by an independent laboratory, before shipments can resume.

Acquisition of Sygen International by Genus

In December, it was announced that Genus plc has completed the acquisition of Sygen International plc. With this, Genus will be the largest animal genetics company in the world and leading bovine, swine and shrimp genetics. In the press release, it was stated that the prime objective was to combine the research and development activities of the two companies to meet the ever increasing demands of customers which are being driven by increasing economic, welfare and environmental pressures.

The company said that the name Sygen will no longer be used but Sygen trading brands, PIC and SyAqua will continue unchanged. SyAqua, established in 2002, is the shrimp aquaculture division of Sygen International plc, the world leader in applying genetics and biotechnology to animal breeding. SyAqua has operations in four countries, Thailand, Mexico, Brazil and the US. In Thailand, SyAqua Siam has a nucleus breeding centre and has a breeding program for selection under Thai conditions with 200 families.

Brief news

Clean process for catfish in Vietnam

An Giang Seafood Import Export Joint Stock Company (Agifish) will establish a model to raise the quality of tra catfish for export. This is in line with efforts to prevent the abuse of antibiotics in aquaculture, according to Vietnam News. This will involve seafood processing companies and fish farms. Farms will work in groups, with a total output of 5,000–12,000 tonnes for each group and each member must reach an output of at least 500 tonnes and upwards. Members will operate under the guidance and supervision of quality controllers to create a close process from breeding, production to fish processing. In this model, clients will have the right to check all stages of production before signing contracts.

US seafood consumption up

For the third straight year in 2004, US seafood consumption rose. The National Marine fisheries Service reported that the 2004 figure is up from 16.3 lbs/person or 7.4 kg/person in 2003, an increase of 2%. In 2001 the rate was 14.8 lbs/person or 6.72 kg/person and in 2002 it was 15.6 lbs/person or 7.1 kg/person. Shrimp continues to be a favorite among American seafood eaters. A record 4.2 lbs or 1.9 kg of shrimp were consumed per person in 2004 up 0.2 lbs or 90g from 2003. More details are available from <http://www.noaa.gov/stories2005/pdf/seafood-consumption-11-09-2005.pdf>

Indonesia extends ban on shrimp imports

The government has extended the ban on shrimp imports into the country. This was to prevent the entry of contaminated shrimp and shrimp disease. The extension of the ban for another six months was the second of its kind since the import of shrimp was banned through joint ministerial decrees dated December 28, 2004. The ban was later renewed on January 26, 2005 and limited to three species of shrimp, namely frozen and non-frozen shrimp of the *vannamei*, *monodon* and *stylirostris species*.

In a separate report, Antara News reported that the US government has denied reports that it planned to slap an antidumping duty on shrimp from Indonesia. It was previously reported that the US government would impose a 112% on Indonesian shrimps for alleged trans shipment of Chinese shrimp using Indonesian certificate of origin.

Sustainable fish feeds

Dragon feeds based in Wales, UK has pioneered a new technology in the production of sustainable fish feeds using polychaetes worms, according to icWales. The worms are farmed in Holland and processed at the company's Port Talbot mill. The company said that sustainable feed was the way forward to satisfy growing global demand for fish feeds. It added that unlike other foods which use fish meal and oils, their product is a sustainable solution developed in Wales. The company will launch their shrimp feed at Aquaculture Americas in Las Vegas which runs from February 13–16.

Award for GIFT tilapia development

The WorldFish Centre has been named a 2005 Tech Museum Awards Laureate for its development of GIFT tilapia (Genetically Improved Farmed Tilapia). "We are delighted to have been chosen for this prestigious award in recognition of more than ten years of research carried out by WorldFish and its partners in the Philippines, Malaysia and Norway", said Dr Stephen J. Hall, Director General of the WorldFish Center in the New Straits Times. "The GIFT tilapia strain is especially suited to the needs of poor farmers and consumers, and is aimed at reducing poverty and hunger in developing countries," he added.

GIFT was developed in the Philippines by the ICLARM, now the WorldFish Center, with the Institute for Aquaculture Research, Norway. The Asian Development Bank (ADB) supported the R&D and dissemination of GIFT by providing technical assistance from 1988 to 1997.

Increasing competitiveness of Taiwan fish

The Council of Agriculture Taiwan has outlined some strategies to regain its market share and confidence in its eel exports. The output value of eels declined 40% when fish exports were contaminated with antibiotics. It also wants to improve the quality of the Wuguo tilapia. Taiwan was the leading exporter of this tilapia until 2004 when China took the lead. Tilapia production is 89,000 tonnes and exports total 50,000 tonnes. Taiwan needs to produce quality fish by focussing on breeding technology as it cannot compete with Vietnam on price. The council also plans to look at new markets such as in the Middle East.

Euro 18 million for Europe's largest tilapia farm

This will be an indoor, recirculating tilapia farm and processing plant near Mouscron, Belgium with an annual production target of 3,000 tonnes of fresh product for major European retail markets. Funding is from European and Belgian subsidies and private investors. In Intrafish.com, skeptics say that Indoor European aquaculture producers have struggled with high costs and other challenges, with the notable exception of turbot. Mouscron is also far cry from the low-cost, high production countries in South America and Southeast Asia, which produce the overwhelming majority of the world's tilapia. Proponents believe that the tilapia has all the right credentials for Europe's big retailers, especially with its eco-credentials. Tilapia is probably the biggest seafood success story since farmed salmon. They quoted that Chilean salmon farmer AquaChile was buying a majority stake in Rain Forest Tilapia.

Successful tuna IPO in Australia

South Australian aquaculture producer Clean Seas Tuna had closed its AUD 18 million initial public offer (IPO) earlier than planned. Chairman Hagen Stehr said the company had been overwhelmed by the support of institutional and retail investors and its own employees. The company will use the funds from this IPO to expand the business of breeding and growing kingfish and mulloway and upgrade the hatchery to start the breeding of the southern bluefin tuna and grow tuna from its own stock.



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The challenge for tilapia in Vietnam

At the second Professional Aqua Farmers conference organized by Cargill Vietnam in December, around 200 tilapia farmers discussed how to bring the industry forward for tilapia to be the country's next major export commodity.

The aim of the conference in Ho Chi Minh City was to introduce new technology to the industry and help Vietnamese farmers improve the performance of their farms. Farmers were mainly from the South East provinces. Presentations included an overview of world tilapia production and factors affecting the tilapia culture industry. Dr Kidchankan Supamattaya, Head of Aquatic Animal Health Research Center, Department of Aquatic Science, Prince of Songkla University, Thailand gave a presentation on the impact of mycotoxins on the growth performance of tilapia.



Scott Ainslie (right), presenting a souvenir to a participant.

A growing US market

Scott Ainslie, General Manager of Cargill Vietnam gave some statistics on the US tilapia market. Global tilapia exports to this market in 2004 were 249 million pounds (113,000 tonnes), which represents an increase of 23% compared to that in 2003 and 68% compared to 2002. According to the US Department of Commerce, tilapia imports into the US market in the first 6 months of 2005 totalled 129.9 million pounds or 58,636 tonnes. This represents an increase of 11% compared to the same period of 2004.

Tilapia products are frozen, fresh and fillet. China is still the leading exporter to the US market with a 52% market share, followed by Taiwan at 23%, and Ecuador at 12%. Other major exporters are Indonesia and Costa Rica.

Scott said, "The US market is growing and represents a big opportunity for Vietnam if the industry can meet the requirements of US consumers. Vietnam already exports nearly USD 2.3 billion of fish and seafood, but this comprise mainly of shrimp, tra and basa fillet, squid and tuna. Tilapia is not on the list today".

Added to this, industry experts agree that demand for tilapia imports will grow in 2005 and 2006, particularly in the food service and restaurant segments.



Le Minh Man

Vietnam tilapia

Participants agreed that Vietnam has the potential to be a major producer of tilapia. Le Minh Man, Aqua Sales Manager of Cargill Vietnam said that suitable growing areas are located in the Mekong Delta in South Vietnam and also in the provinces around the red river in the North. Vietnam has the right environmental conditions for rearing tilapia.

But why is it that the tilapia is still being touted as a "potential species" only? The annual consumption of tilapia is still low and is limited to the domestic market only".

Man said that there are two reasons for this situation. One is the poor quality of fingerlings. The broodstock used to produce fingerlings were imported from Malaysia, Thailand and Taiwan some 10 years ago. Since these have been used for several generations they are showing the negative traits associated with inbreeding. These traits include reduced survival rates, poor growth and high susceptibility to diseases. Vietnam has not been able to build a "brand name" for tilapia breeding.

Secondly, the plan to export tilapia will require more support. Man said that more needs to be done to improve the standard, knowledge and the technical skill of Vietnamese tilapia farmers.

"We also need to improve the culture methods. For example, in Taiwan and China, farmers stock at a density of 30-50 pcs/ m² while Vietnamese farmers maintain the density at 80-120 pcs/m². This is almost 3 times higher than other countries with very developed industries. He added that the high density will slow down growth and increase food conversion (FCR). The FCR in Taiwan and China is around 1.5-1.7 while in Vietnam, it is higher than 2.

He also stressed on the importance of record keeping such as on feed usage for each stage, feeding schedule and the treatments used at the farms. Vietnam is not competitive as the cost of production for tilapia is USD 1.1/kg while in other countries, it is just USD 0.86/kg.

In summary, Man said, "Vietnam tilapia surely will be able to export to the US market if we can improve the above issues. The good news for Vietnamese tilapia farmers is that Cargill VN is working with a partner to set up a hatchery to help Vietnam farmers access a consistent supply of quality fingerlings".

New feed line and new plants

At the conference, Cargill also launched its new fingerling feed line, Aquaxcel. The company said that Aquaxcel will help fingerlings grow fast, will increase survival rate, enhance the immune system and reduce water pollution. Daniel Barziza, Cargill, USA, said, "Aquaxcel, with particle sizes of less than 1mm, was designed with a balanced amino acid and energy profile.

It is produced through extrusion technology. It reduces water pollution in fish ponds by sharply reducing the amount of feed that dissolves in water. Not only is this beneficial for the environment but it improves growth rate and survival of fish. Aquaxcel will meet the nutritional requirements of fish up to 20g".

Cargill has two plants under construction in the Mekong Delta. Scott said that the extruder in Cantho will open in early 2006 with the capacity of 70,000 tonnes/year. Another mill will be ready for production in early 2007 with the capacity of 150,000 tonnes/year in Long An. The investments for all the project was around USD 15 million.

"The Vietnam feed industry is still relatively young and Cargill Vietnam will continue to look for opportunities to build more plants in Vietnam to meet increasing demands for Cargill's industry leading technology".

Indian farmers shift to organic aquaculture

Farmers in coastal areas of Andhra Pradesh (AP) are being guided to shift to organic aquaculture with the assistance of the Marine Products Export Development Authority (MPEDA), NaturLand, the West German international certifying agency for organic farming and INFOFISH, Malaysia.

G Rathina Raj, deputy director of MPEDA said, "Following a serious setback to exports in the fiscal year of 2004–05 due to the presence of excess antibiotic residue in shrimp, 98% of the farmers culturing the freshwater prawn and tiger shrimp in about 100,000 ha in the coastal areas of AP have stopped using antibiotics".

Through workshops and training sessions, the group has succeeded in educating farmers on the harmful effects of antibiotics in overcoming diseases in shrimp. The farmers have been taught preventive measures such as the checking of virus affected postlarvae and adult shrimp through PCR-polymerase chain reaction tests. They have also been

provided with lists of 20 banned and harmful antibiotics, prawn culture parameters, required fatty acids, essential amino acids, vitamins, minerals and trace elements.

However, Raj was of the view that the adoption of organic aquaculture methods in toto is difficult as cost of production would escalate by 30% without any guarantee of remunerative price and purchase in world markets.

"It would be a great achievement if 5,000-10,000 ha are brought under organic aquaculture."

(Information courtesy of Andreas Stamer, Naturland).

China targets 70% of fish from farms

At least 70% of fish supply for the Chinese market will be from farms rather than the sea within five years, according to Chinadaily.com. The Vice-Minister of Agriculture Niu Dun said that this strategy is to meet increasing demands. However, this must come with improve quality and safety levels of aquatic products.

It was estimated that the size of the country's aquatic production will expand from 51 million tonnes in 2005 to 60 million tonnes by 2010. The current contribution from aquaculture is 67%. To push aquaculture, the country will continue to impose seasonal bans on fisheries in the seas off China and in the Yangtze River.

While drawing lessons from contamination of aquatic products by the antibiotic chloramphenicol and malachite green in recent years, the country also needs to tackle fish diseases. An initial survey in fish

farms nationwide last year found 126 varieties of fish diseases, which incurred losses of 15 billion RMB (USD 1.85 billion), according to Li Jianhua, director of the Fisheries Bureau under the ministry. Outbreaks of the disease in fish have to some extent, led to the overuse of certain chemicals, which have consequently added to the decline in the quality of aquatic products, according to Li. The bureau will examine aquatic product export centres to ensure they have kept daily logs on aquaculture production and drug use.

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Marine shrimp farming in Asia today

By Zuridah Merican and Iffa Suraiya

What has been happening in the marine shrimp industry in the last three years? Are we better off than before? Here are some views from the industry.

In 2004, 81% of the global production of farmed marine shrimp came from Asia. Production was estimated at 1.16 million tonnes for the top six producers in Asia, namely Thailand, China, Indonesia, Vietnam, India and Bangladesh. Additionally, some 63,000 tonnes are produced in Malaysia and Philippines. In comparison, some 13 countries in South and Central America produced 286,486 tonnes in 2004 (Chen, pers. comm., 2005; World Shrimp Farming, 2005).

In Asia, shrimp production has increased substantially by 27% since 2000 (FAO, 2005, Table 1). It has been difficult to ascertain the production from China. Various industry sources have estimated 350,000-450,000 tonnes in 2004. Official estimates are 650,000 tonnes in 2003 (Wang and Wang, 2005). Thailand and China lead in production. But it is the former that is leading Asian producers in the quality and technical aspects of production.

The general trend has been an increase in the supply of shrimp. Demand is also increasing as shrimp is an acceptable food matching consumer's demands for healthy meat with high omega 3 levels. Dr. Chen Ming Dang from Charoen Pokphand Public Foods said that the industry has also benefited as consumers moved away from meat because of fears from the Avian flu, BSE and foot and mouth diseases. Additionally, wild caught sources are declining and aquaculture is expanding due to the increasing demand for seafood.



Dr. Chen Ming Dang is Vice President, Charoen Pokphand Public Foods. He is based in Bangkok.

The situation today

Certainly the industry is of the opinion that it has come a long way in the control of diseases, improvements in production techniques and a much better understanding of the global industry. Most producers understand market demands and work towards this. It is, however, far from reaching the industrial level of the poultry industry and a level playing field for all countries and for all producers. Perhaps with the exception of Thailand, the level of industrialisation in the industry elsewhere remains very divergent.

The marine shrimp industry is now globalised with one major species that is *Penaeus* (or *Litopenaeus*) *vannamei*. Out of a total of 21 producer countries in 2006, 17 countries culture this species. In Asia, the jump in production in Thailand, China and Indonesia since the catastrophic years for the industry (1990-1997), has been correlated with the shift to this species. In 2004, 43% of the total production was attributed to this species. *P. vannamei* may have comprised up to 95% of the national production of Thailand in 2005. In Indonesia, it was 40% (SPB, 2005) and it is expected to form 2/3 of the national production in the future (Trobos, 2005). About 63% of China's production in 2003 was *P. vannamei*.

The industry still remains fragmented as indicated by the various levels of yields between countries and within regions in a particular country. The Thai model of succession from extensive to semi intensive (years 1987-1990) to intensive at 60 PL/m² (1990 to 1993) and currently the close system with stocking rates of 30-40 PL/m² have been adopted for the culture of the black tiger shrimp, *P. monodon* (Paneetatayasai,

2004). In *P. vannamei* culture, such as in Indonesia, the diversity is extreme. This is not only in stocking densities but also in yields per hectare of 60-80 pcs/kg which range from 0.5-2.0 tonnes/ha to 7-12 tonnes/ha at stocking rates of 20-35 PL/m² (SPB, 2005).

The industry in Asia is vulnerable to some common threats. Leading are threats from diseases such as the impact of the white spot virus on the *P. monodon* culture systems and from TSV on *P. vannamei* and other species. These are followed by fluctuating prices on world markets. Between countries, there are the competitive advantages of countries such as China over that of Thailand and Indonesia in *P. vannamei* culture and Vietnam and India over that of Malaysia and the Philippines for the black tiger shrimp. China remains the lowest cost producer. The cost advantage in Indonesia may be eroded with the recent hike in diesel prices. Nefo Ng, a farmer in Bali said that production costs per kg have increased 16%.

Some recent developments

A better understanding of pond and water management to control diseases has been a crucial factor in the success of many farms. This has been strongly advocated in many countries but less in others. Briefly some of these are given below.

Dr Chen said, "Prevention of disease is uppermost. Most producers undertake a thorough screening process for the post larvae to prevent the entry of diseases into the farming system. However, there are still problems where in the past, we would use antibiotics quickly to eradicate. Today, we use biological means such as probiotics. We know that if we reduce water treatment, we will be inviting diseases."

"In biosecure systems, growth targets are 1.2 to 1.3 g/week and most customers know the importance of this to increase survival. This practice has been instilled into culture practices for our customers in India, China and partially in Vietnam too. Our recommendations include 1:1 (pond: reservoir) for the black tiger shrimp and 4:1 for the white shrimp".

The awareness on being able to control the spread of diseases by controlling water quality means that water exchange is being minimized. Dr Pornlerd Chanratchakool said, "Whatever the system, farmers are now managing to control pH and dissolved oxygen at the optimum range, to minimize the risk of toxic substances such as ammonia, nitrite or hydrogen sulfide. They understand risk management and closed or semi closed systems are common."

The spread of the Taura Virus Syndrome (TSV) in farms in Indonesia has not only been attributed to poor quality postlarvae but also to the declining quality of incoming water. There is a similar problem in South China. Farms in Shunde County use ground water rather than that from the Pearl River and water exchange is limited to twice during the grow out cycle of 100-120 days. Probiotics are also used in improving water quality in ponds. Their use add to costs of production but as farm technician, Fadjril Kirom, of Lombok, Indonesia said, it has



Dr Pornlerd Chanratchakool is Technical Manager for Novozymes.



Fadjril Kirom manages 90 ponds in two locations in Bali.

helped them improve survival rates and provided some insurance against crop failures.

It is through partial harvesting and increasing stocking density that producers have managed to increase yields of *P. vannamei* shrimp. In Thailand, where this was initially practised, farmers could harvest 12-13 tonnes/ha from a 90 to 110 day culture period through two partial harvests. Similarly in Southern China, a farmer from the Shunde county markets three size ranges of shrimp by harvesting size 50-60 after 70 days, size 40-50 after 80 days and size 30-40 in 120 days. Survival rates are around 80% and three crops per year are possible when ponds are covered during the colder months.

Dan Fegan has pointed to another development. He said, "Previously, the bottlenecks in the industry were due to the lack of cooperation in the industry. Now we see farmers working together or within farmer groups, to exchange information and work together to overcome recurrent issues such as those relating to water quality and market issues. In the hatchery segment, after the development of standards for postlarval quality and health, the industry is increasingly adopting these as prerequisites for postlarvae to be stocked."



Dan Fegan is Alltech's Regional Technical Manager - Aquaculture Asia Pacific. He is based in Bangkok

Markets and prices

During the last three years, market issues have dominated events. Industry has categorized these as low international prices, trade barriers in the EU and US markets, non tariff barriers and traceability issues, particularly in the EU and Japanese markets and changing tastes according to demographics in Japan and intense global competition.

Common to all countries is the low international prices for the shrimp commodity, arising from over production. Farmers also have to contend with fluctuating prices. In early December, ex farm prices for shrimp from Indonesia were Rp 40,000/kg or USD 4/kg for size 50 and Rp 37-38,000/kg or USD 3.7/kg for size 70, down 7% from the respective prices in October. In November, prices in China were around 16-20 RMB/kg or USD 2-2.2/kg for 60-80 size shrimp. Indian producers said that lower shrimp prices were because processors were not happy with the quality of shrimp produced in some states.

"It was the usual trend for farmers to refuse to stock ponds when prices decline and then to restock when prices were up. This was the reason for the decline in production in Thailand in 2005", said Dr Chen.

The recent low prices have pushed countries to encourage domestic consumption of shrimp products. In Thailand, the domestic consumption increased from 72,500 tonnes in 2003 to 85,000 tonnes in 2005. This is small but volumes are expected to increase to 10.5 tonnes by 2007, especially when prices decline. Whereas in China, the domestic consumption of the total shrimp production (both farmed and capture) was 66% in 2002 (Kaelin, 2002) and remained at 70% since 2003. Some 340,000 tonnes in 2004 was consumed locally in 2004 (Patton, 2005).

A major issue plaguing the industry was the US antidumping duty which affects four main producers in Asia, (in addition to Ecuador and Brazil). An industry member said that countries have completed round one with the US International Trade Commission (ITC) ruling. In next round it will be on country basis and this will be where medium size companies will be investigated and this may evoke more issues. However, despite the imposition of antidumping duties and US customs bonds (imposed in March 2005), the US still remains the major market for most countries. Shrimp imports to the US in 2005 were dominated by Asian suppliers at 72%. A new record was set as imports increased 4% in the first three quarters of 2005. Despite antidumping tariffs, Thailand, China and Vietnam increase volumes of exports, Indonesia was the second largest exporter to the US after Thailand (Globefish, 2005).

There are also changes to the market structure. Countries are now looking at large markets in the EU and Asia. The reduction of the GSP for Thailand from August 2005 and the removal of the 100% inspection on antibiotic residues for seafood from China in July 2005 now mean that these countries will focus on exports to the EU. For Vietnam, the EU and Japan offer a potential market but these countries have warned Vietnam of the quality of her shrimp products. South Korea has also added 25 exporters from Vietnam to its list of approved importers. In 2003, Indonesia was the leading exporter of shrimp to Japan. But in 2004, it lost this position to China and Thailand. Now exporters are revitalizing exports into Japan again (Rabobank, 2005).

Food safety and traceability

Thailand, the leading exporter of farmed shrimp is far ahead of the other countries in the implementation of traceability programs. This was initiated in 2002 with the issue of raw product movement documentation (Tookwinas, 2004). This means that any product to be marketed or processed requires this document and the origin of products for exports can be easily traced. Thai quality shrimp means that it has to have standard and environmentally friendly production protocols, according to Paneetayatsai (2004). He said that the industry has agreed to commit to produce hygienic products in a sustainable manner that provides for long term economic benefits.

"It is important to be able to process clean products from antibiotic free culture practices. This means the application of traceability concepts and good manufacturing follow the requirements of Code of Conduct (CoC)," said Dr Chen.

The requirement for quality shrimp is pushing governments in Asia to implement good aquaculture practices (GAP) and traceability programs to ensure the security of their products. In China, farmers can obtain quality certification for their products after a year of quality assessment by authorities. The procedure includes monthly tests on the various sizes of shrimp and water. In Indonesia, Dr Bambang Widigdo said that a biosecurity program, well implemented can be effective (AAP, 2005). Additionally, all players from those in broodstock supply to grow out are responsible.

Indian shrimp farmers have the assistance of NACA (Network of Aquaculture Centres) in Asia and MPEDA (Marine Products Export Development Authority) to improve shrimp quality. This is a four year health management project which has helped to reduce the incidence of diseases to 15%. Importers from Japan and Canada have expressed interest in shrimp from these ponds (NACA, 2005).

The processing trend is also towards more direct purchasing from farms and from contract farming. Asia's fully integrated companies such as Grobest and CP control the production process and can assure the traceability of their products. More and more feed companies are becoming fully integrated to assist customers assure quality products all along the production process. However, despite authorities assuring that quality of exports have reached international standards, occasional rejections by importers continue to be reported.

According to Glen Iling, "Non-integrated companies do have options to ensure traceability for the processors to meet export criteria. There are various international accreditation programs such as the Aquaculture Certification Council, FXA or similar programs which, individual farmers, companies, farming groups or co-operatives can subscribe that will satisfy the traceability requirements. These programs can link information from the whole shrimp chain, hatchery, feed supplier, shrimp farm and processor. This may be the future direction in traceability."



Glen Iling is Managing Director of SyAqua Siam.

2006 and beyond

In Table 1, Dr. Chen has made some estimations on the growth of the industry in 2006. At the Global Shrimp Outlook meeting in October 2005, Chen Dan of the Evergreen Group in China projected an increase in China's shrimp production to 450,000 tonnes in 2006.

Table 1. Estimates on production volumes in 2004 to 2006 (Chen, pers comm.)

| | 2004 | 2005 | 2006 |
|-------------|-----------|-----------|------|
| China | 352,000 | 300,000 | -14 |
| Thailand | 325,000 | 280,000 | -14 |
| Indonesia | 238,341# | 230,000 | 12 |
| Vietnam | 106,000 | 115,000 | 9 |
| India | 100,250 | 100,000 | - |
| Bangladesh* | 40,000 | 40,000 | na |
| Malaysia | 28,000 | 32,000 | 14 |
| Philippines | 35,000 | 35,000 | - |
| Total | 1,224,591 | 1,132,000 | |

*World Shrimp Farming, 2005; #actual, SPB, 2005

Table 2. Production volumes in 2000 to 2002 (FAO, 2005) and industry estimates for 2003 from various industry sources

| Country | 2000 | 2001 | 2002 | 2003 |
|-------------|---------|---------|---------|-----------|
| China | 217,994 | 304,182 | 384,141 | 390,000 |
| Thailand | 305,644 | 276,500 | 160,300 | 260,000 |
| Indonesia | 117,917 | 129,465 | 137,548 | 160,000 |
| Vietnam | 69,433 | 67,500 | 67,500 | 220,000 |
| India | 96,715 | 102,930 | 114,970 | 155,000 |
| Bangladesh | 59,143 | 55,499 | 57,881 | 70,000 |
| Malaysia | 15,894 | 27,014 | 25,582 | 32,000 |
| Philippines | 40,467 | 40,698 | 35,491 | 30,000 |
| Total | 864,064 | 948,289 | 925,532 | 1,287,000 |

The government wants to revitalise the industry in Indonesia which should contribute USD 1 billion in exports. Made L Nurjana, Director General Aquaculture at the Ministry of Fisheries and Marine Affairs, said that the target in 2006 is 350,000 tonnes which is 17% above the current levels of production (also see interview with the Minister Freddy Numberi on page 13).

According to India's Dr M Sakthivel, the government would not want to lose its present share in the world market because of diseases. "If and when disease resistant broodstock is developed elsewhere for *P. monodon*, India and other countries which are pessimistic with *P. vannamei*, will go for a major expansion with this species. If she decides to join the race in shrimp production through introduction of disease resistant variety, the present production figure will then double".

In the marketing of shrimp, processors in China, Thailand and Vietnam have been emphasizing the value added segment during the last three years. Globefish (2005) reported that imports of headless shell on frozen shrimp products into the US have declined in volumes in 2005 as compared to 2004. In contrast, breaded frozen products recorded strong increases. Products from India constitute only 20% value added as compared to 90% of products from Thailand, according to the Seafood Exporters Association of India (SEAI). The new strategy is to increase value adding to products as well as introduce branding

of the products to revive exports and gain market share.

Industry has forecasted that China, now a net exporter of shrimp may become a net



Dr M Sakthivel is president of the Aquaculture Foundation of India. Based in Chennai, AFI was established in 1994 as a non-profit organization (NGO) for the promotion of aquaculture in India (web: aquaculturefoundation.in).

importer. This is because of the increasing demand for shrimp products as the purchasing power of consumers increase. China will require imports to meet domestic demand and also for its reprocessing industry (Rabobank, 2005). Glen Iling said, "Current estimates indicate that China will be a net importer within five years. If the country experiences disease challenges, this may come earlier which will change the shape of the global shrimp trade dramatically."

In its wish list, the industry would like to see improvements in culture technology. These include more efforts in the domestication of the black tiger shrimp. Meat quality traits such as proportion of tail meat and fatty acid compositions including that of omega 3 fatty acids, will become more important, according to Glen Iling. SyAqua has determined differences in these traits between families and therefore can be developed through genetic selection enabling processors to develop new and more innovative products.

"If the present production cost continues, the shrimp market in both developed and developing countries will expand faster than the present rate in the coming years. However, only if the production cost of shrimp comes down perhaps through lower feed costs, then the shrimp market for middle class consumers in developing countries will expand rapidly". said Dr Sakthivel.

Many producers would also like to see more transparency and fairness in trade, marketing and setting of prices to ensure that competition takes place on a level playing field and producers are adequately compensated for their products. The impact of anti-dumping tariffs in the US on demand, prices and markets and the strong influence of importers in setting low prices have caused many producers to face losses and consider switching to other species.



Iffa Suraiya is Executive Secretary of the Shrimp Club, Indonesia. She is based in Surabaya.

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How to gain an edge

Freddy Numberi, Minister of Fisheries & Marine Affairs, wants to revitalise the farmed shrimp industry in Indonesia. In December, he talked to Iffa Suraiya on this, the recent issue with the EU prices on contaminated consignments and on how to help farmers overcome the recent hike in diesel prices.

What is the government's strategy to increase shrimp production and make shrimp as a prime export commodity in 2006?

Our main strategy is to revitalize the industry with programs in shrimp culture and intensification of shrimp farming. The Directorate General of Aquaculture will look at species diversification; improvements in broodstock and shrimp fry quality and also feed quality. Of course, good aquaculture practices. The implementation of all these will certainly need the right degree of communication between packers and farmers. Therefore, we need to establish immediately an Indonesia Fisheries Incorporated.

To stop rejections against our shipments, it is important that processors keep maintaining HACCP and any traceability, farm and hatchery certifications by a competent authority (CA). Then we have to make sure that any CA continues to upgrade and follow any new rules and standard imposed by the European Union (EU). We will have intensive promotions in ESEs (European Seafood Expositions), and work closely with SIPA (Seafood Importer and Producers Alliances) and SIPPO (Swiss Import Promotion Program). Of course, there should be the right synergy with CA and the Indonesian Embassy in the EU.

What steps can the government take in hygiene and food safety, especially for markets in the EU and US?

We have taken the necessary steps to ensure this. We have a monitoring system in place for all in the fisheries industries such as fishermen, shrimp farms and processors to comply with the requirements and standards of international markets. We also conduct training/inductions, intensive monitoring and supervision. Another important thing is that we have a communication line with importing countries (USA and EU) and coordinate within government institution offices for the higher fiscal/import fees. This includes close supervision by authorities for import products that are linked to GSP facilities.

Pertaining to the recent hike in diesel prices, what are the solutions to assist farmers?

The increase in diesel price prices has had a huge impact on the shrimp industry in Indonesia as most farms use diesel for electricity generation and for pond aeration. Not to mention, for big farms and hatcheries that consume large volumes of diesel. Therefore, we will need to assist

farmers so that they continue operations. If these farms fail, then we'll be facing a great loss in revenue as well as huge numbers of unemployment.

Therefore, the government will support farmers by supplying "solar packed dealer" (solar=diesel) to allow them to purchase supplies at controlled prices. The House of Representatives (DPR) has already approved some funds for the setting up fuel gas station for fishermen and farmers only.

On the issue of antibiotic contamination and rejections of Indonesian shrimp from the EU, what are the solutions?

We have already resolved that. The inspection team from the EU have come and seen for themselves several shrimp farms, especially those suspected of producing contaminated products. The team has met us to report their findings. We have also put forward our complaints with regards to their trade practice of shipping back all our exported products (Indonesian shrimp) despite the fact that only 2 out of 1,000 containers were positively identified as contaminated. This is not fair.

For us, the European Union (EU) is the largest shrimp export market after Japan and USA. In 2003, Indonesia's shrimp exports reached 20,849 tonnes, valued at USD 115.3 million. In 2004, it reached 21,685 tonnes, valued at USD 115.31 million. Now, their team has personally seen the processes in our shrimp production and they have not indicated any problems with these.

Nevertheless, I have asked the Directorate of Aquaculture and Directorate of Marketing of Fishery Products, to keep monitoring our shrimp production process. If once again, our products encounter problems, then it would be far more complicated and we will be in an extremely difficult situation.



*Freddy Numberi,
Minister of Fishery & Marine Affairs*




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Part 1 – The parasites

Important parasitic diseases in cultured marine fish in the Asia-Pacific region

by Leong Tak Seng, Zilong Tan and William J. Enright

Parasitic infections and associated diseases are becoming more frequent with the intensification of mariculture systems in many parts of the Asia Pacific region. In this two- part article, the authors provide information on the various pathogenic parasites and their control measures.



Traditional marine fish farming in South-East Asia. Different species of fish with overlapping generations are cultured at one farm site. The lack of good health management practice, such as high stocking density, feeding trash fish and poor sanitation, has led to a high incidence of diseases.

Mariculture is a form of rearing aquatic organisms for commercial purposes, either in an open coastal ecosystem or in a controlled marine ecosystem. It is an important aquaculture activity in the Asia-Pacific region. There are over 40 marine fish species commonly cultured, such as groupers (*Epinephelus* spp.), snappers (*Lutjanus* spp.), Asian seabass (*Lates calcarifer*) and golden pompano (*Trachinotus blochii*). They are typically cultured in open floating net-cages along the Asia-Pacific coastal areas, with an annual production of approximately one million tonnes.

The increasing intensification of production and lack of health management measures have led to many disease problems of bacterial, viral, fungal and parasitic origin. In recent years, the improper use of chemicals and antibiotics has raised concerns regarding both human and environmental safety.

Under natural environmental conditions, coastal waterways are free of obstructions. However, the placement of floating net-cages along these waterways has created 'artificial islands', resulting in the congregation of a diverse biological community comprising both vertebrate and invertebrate organisms.

Therefore, one would expect to find a similar congregation of bacteria, viruses, fungi, parasites and other pathogens within this newly- created ecosystem, as well as the natural occurrence of other wild aquatic organisms.

Mortality of a large number of fish is seldom observed in the wild and, when it does occur, it is most

likely to be due to sudden environmental deterioration. However, in the confined net-cage environment, mortality is often seen. Signs include abnormalities in behaviour, darkened body, exophthalmia (pop eye) and ulcerations on the fish body. There are many causes of fish mortality in the confined net-cage environment but possible causes for these disease outbreaks are pathogenic parasites.

What are parasites, how do they enter the net-cages and how are they maintained there?

Parasites are invertebrate organisms; some are free-living and can become opportunistic parasites; others require hosts for their survival and reproduction, and these are referred to as obligate parasites. Both opportunistic and obligate parasites are found in fish hosts but most parasitic diseases in fish are generally caused by obligate parasites.

Types of parasitic diseases

Most apparently healthy fish usually harbour various parasites but at low numbers, either on or in their bodies. The low number of these parasites generally causes little or no harm to the fish. However, when the number of parasites per fish increases significantly (the natural parasite-host balance becomes broken) due to overstocking, changes in water temperature or salinity that are favourable to the reproduction and growth of parasites, or that cause a reduction in fish immunity

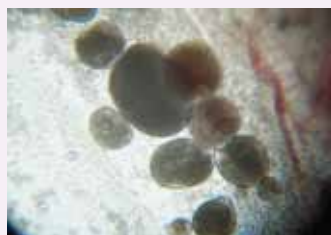
Examples of some of the parasites that cause diseases in marine fish in the Asia-Pacific region.



Neobenedenia sp. (skin fluke)



Haliotrema spp. on gills (gill fluke)



Cryptocaryon irritans (white spot)



Caligus sp. (sea lice)

Table 1. Fish diseases caused by protozoan parasites at different stages of mariculture in the Asia-Pacific region. The severity of infection is indicated as (+++ = severe; ++ = moderate; + = slight; - = seldom observed)

| Parasite | Site of infection | Hatchery | Nursery | Grow-out | | Major signs |
|---|------------------------------------|----------|---------|---------------|----------|---|
| | | | | Newly stocked | Grow-out | |
| Ciliates | | | | | | |
| <i>Cryptocaryon irritans</i> (white spot) | Gills & body surface | ++ | +++ | +++ | +++ | Whitish spot on body surface, darkened body, lethargy, exophthalmia, increased mucus production, rub body surface against net. |
| <i>Trichodina</i> spp. | Gills & body surface | ++ | ++ | + | + | Lethargy, non-feeding, pale gills with increased mucus production, rub body surface against net, hyperplasia and necrosis of epidermis. |
| <i>Brooklynella</i> spp. | Gills & body surface | +++ | +++ | ++ | + | Lethargy, non-feeding, rub body surface against net, subcutaneous haemorrhage. |
| <i>Henneguya</i> spp. | Gills & body surface | +++ | +++ | ++ | + | Pale gills and hyperplasia. |
| Dinoflagellate | | | | | | |
| <i>Amyloodinium ocellatum</i> | Gills & body surface | +++ | +++ | ++ | + | Fish gather at water surface or aeration outlet, rapid gill operculum movement, pale gills, darkened body, increased mucus production in gills. |
| Myxosporean | | | | | | |
| <i>Sphaerospora epinepheli</i> | Kidney, liver, spleen, & intestine | - | ++ | ++ | + | Loss of equilibrium, floating upside down, some with swollen abdomen & haemorrhages on mouth and body surface. |
| Microsporidian | | | | | | |
| <i>Glugea</i> spp. | Internal organs | - | + | ++ | +++ | Swollen abdomen, black nodules on internal organs. |
| <i>Pleistophora</i> spp. | Internal organs | - | + | ++ | +++ | Swollen abdomen, black nodules on internal organs. |

Table 2. Fish diseases caused by plathyhelminthes at different stages of mariculture in the Asia-Pacific region. The severity of infection is indicated as (+++ = severe; ++ = moderate; + = slight; - = seldom observed)*

| Parasite | Site of infection | Nursery | Grow-out | | Major signs |
|--|----------------------|---------|---------------|----------|--|
| | | | Newly stocked | Grow-out | |
| Capsalid Monogenean (skin flukes) | | | | | |
| <i>Benedenia</i> spp. | gills & body surface | +++ | +++ | +++ | Darkened body, erratic swimming behaviour, rub against net, pale gills, lethargy and loss of appetite, opaque eyes, patches of "dryness" on scales or loss of scales at forehead (above the eyes), haemorrhage & necrosis on body surface. |
| <i>Neobenedenia</i> spp. | | +++ | +++ | +++ | |
| Diplectanid monogenean (gill flukes) | | | | | |
| <i>Pseudorhabdosynochus</i> spp. | Gills | ++ | ++ | + | Darkened body, rub against net, pale gills, lethargy, loss of appetite, excess mucus production. |
| <i>Diplectenum</i> spp. | | + | + | + | |
| Dactylogyrid monogenean (gill flukes) | | | | | |
| <i>Haliotrema</i> spp. | Gills | +++ | +++ | + | Rub against net, devoid of scales at forehead (above eyes), pale gills, lethargy, loss of appetite, excess mucus production. |
| <i>Dactylogyrus</i> spp. | | + | + | + | |
| Microcotylid monogenean (gill flukes) | | | | | |
| <i>Heterobothrium</i> spp. | Gills | +++ | +++ | + | Show no clinical signs except lethargy, loss of appetite, pale gills and anaemia. |
| <i>Heteraxine heterocerca</i> | | +++ | +++ | + | |
| <i>Microcotyle</i> spp. | | ++ | ++ | + | |
| <i>Bivagina</i> sp. | | ++ | ++ | + | |
| <i>Choricotyle</i> sp. | | ++ | ++ | + | |
| Sanguinicolid digenean (blood flukes) | | | | | |
| <i>Cruvicola lates</i> | Circulatory system | ++ | ++ | + | No obvious signs, affected fish gasp for air at the water surface, gill lamellae fusion & hyperplasia. |
| <i>Pearsonellum corventum</i> | | ++ | ++ | + | |
| <i>Cardicola</i> sp. | | ++ | ++ | + | |
| <i>Paradeontacylix</i> spp. | | ++ | ++ | + | |

* These parasites are seldom observed in hatcheries

(due to these stressful conditions), parasitic disease outbreaks often occur. Parasitic disease and other pathogens are interrelated. For example, bacterial and viral diseases can weaken fish and make them more susceptible to parasitic infestation and *vice versa*. In an aquatic ecosystem, where the health conditions of cultured fish are not easily observed, proper care of the fish and their environment are of the utmost importance. This is to help the natural immune system of the fish react and keep the pathogens in check.

A large variety of parasites have been reported in cultured marine fish. Some of these parasites have caused serious disease outbreaks in farmed fish resulting in significant financial losses to fish farmers. Parasites either cause major disease outbreaks in cultured fish or rather contribute to a chronic sub-clinical effect. In general, the fish are most susceptible at the early stages, particularly at the hatchery and nursery stages of the culture cycle when fish are small.

Parasitic organisms affecting cultured fish can be grouped into

Table 3. Fish diseases caused by crustacean parasites and leeches at different stages of mariculture in the Asia-Pacific region. The severity of infection is indicated as (+++ = severe; ++ = moderate; + = slight; - = seldom observed)*

| Parasite | Site of infection | Nursery | Grow-out | | Major signs |
|------------------------------------|-------------------|---------|---------------|----------|---|
| | | | Newly stocked | Grow-out | |
| Copepods | | | | | |
| <i>Caligus</i> spp. (sea lice) | Gills | + | + | + | Lethargy at the water surface, haemorrhages, erosion of scales and skin at affected body surface, loss of appetite, pale gills and excess mucus production, haemolysis, hyperanaemia and hyperplasia. |
| <i>Pseudocaligus</i> spp. | | + | + | + | |
| <i>Lernanthropus latiss</i> | | + | + | + | |
| Isopods | | | | | |
| <i>Rhexanella</i> sp. | Body surface | ++ | ++ | + | Loss of appetite, rub body against object on side of net, sluggish swimming, rapid gill operculum movement with isopods in buccal cavity, necrosis of skin and gill filaments. |
| <i>Nerocila</i> sp. | | ++ | ++ | + | |
| Hirudina (leech) | | | | | |
| <i>Zeylanicobdella arugamensis</i> | Body surface | + | + | + | Frayed fins, haemorrhagic and swollen at site of attachment loss of appetite, sluggish swimming. |

* These parasites are seldom observed in hatcheries

three main groups, namely, protozoa (Table 1), plathyhelminthes (e.g., flatworms & roundworms; Table 2) and crustaceans (Table 3). At each stage of the culture cycle, the pathogenicity of a particular pathogen on a fish host may differ. For example, the protozoa *Amyloodinium ocellatum* is very pathogenic to fry and fingerlings at the hatchery and nursery stages. At the initial stage of the grow-out phase of net-cage culture, the newly stocked fish become increasingly susceptible to parasitic diseases caused by capsalid monogeneans.

Many of these parasites can cause disease outbreaks and significant financial losses. Severity of parasites at various stages of the grow-out period and the disease signs are presented in Tables 1–3.

Entry of parasites to the culture system

Many species of marine fish are now produced in the hatchery for culture in ponds or net-cages, but some are still wild-caught. At the nursery stage, these fish are placed in cement tanks, ponds or net-cages for some time, before being transferred to grow-out cages.

It is very unlikely that fish nursed in cement tanks would have monogenean infections but they could be infected with protozoa. If the fry are nursed in ponds or nursery cages, they could acquire protozoa and monogeneans, as well as other pathogens. The wild-caught fingerlings could have been infected with pathogens before stocking.

Fingerling suppliers may also combine various batches of fish from different sources so as to have sufficient numbers of fish for distribution. However, an infected batch will spread disease to the others. Furthermore, net-cage farming is an open system whereby fish reared in the cages are in close proximity with wild fish which may transfer pathogens to those inside the cages. Also, in this region, trash fish are commonly used as feed which can act as a source of parasites.

One of the major problems in implementing control measures to prevent parasitic infection in net-cage fish farming in Asia is the overlapping generations (and species) of fish. There are no breaks in the production cycle or fallowing before the next batch of fish is stocked. As a consequence, naïve fish introduced into the farm would likely be infected with one or more species of parasite which already exist on the farm. Therefore, the fish farm itself is a reservoir for parasites.

Given the above scenario, how would one then be able to control parasitic infections in a farm? It is not possible to have a parasite-free environment; however, one can implement preventative and control measures to limit the populations of parasites in fish and to minimize the associated diseases. Fish infected with few parasites show no ill effects. Usually, parasitic diseases are caused by a high density of

parasites. Very often, concurrent secondary bacterial infections occur, imposing an additive or synergistic effect on fish mortality.

Suggested Reading

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Part 2 of this article will appear in the next issue and will address the principles of control measures for parasitic diseases.



Dr. Leong Tak Seng

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How to overcome disease problems in shrimp culture

by Chalor Limsuwan

For the last 18 years, Prof Chalor Limsuwan has been advising the shrimp industry in Thailand. He has a good understanding of the problems of the farmers as he operates his own farm. Aply, at the NACA-ALLTECH shrimp school, Prof Chalor was there with tips on how to handle the major diseases in shrimp ponds.



Extreme size variation in black tiger shrimp infected with MSGs

In Thailand we have been farming shrimp intensively for the past 18 years. Looking back, we did not seem to have any problems and had the impression that shrimp culture was a simple process. However, the more we understand the process, we find that there are lots to learn in pond and disease management. Our experience in Thailand is similar to those in other countries and the recommendations below are applicable regionally.

Current problems with black tiger shrimp are related to the Monodon Slow Growth Syndrome (MSGs) and both white shrimp *P. vannamei* and *P. monodon* have problems with white spot virus syndrome (WSSV) and Taura syndrome virus (TSV) which has only recently been added to the diseases affecting black tiger shrimp.

.....on MSGs

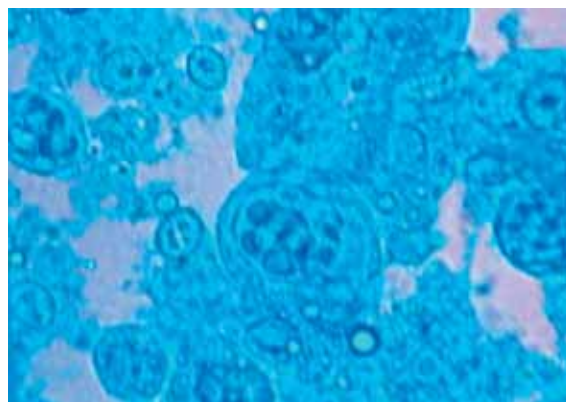
From 2000, economic losses from this disease became apparent and more attention was given to this by the industry. It affects only black tiger shrimp and the most drastic consequence to the farmer is the uncertainty of final harvest output and value. In a typical case, after 3–4 months of culture, the farmer sees size variations from 80 pcs/kg to 300 pcs/kg in a single pond.

Because we could not isolate the causative agent(s) of the disease or develop prevention measures, the industry convinced the Department of Fisheries to allow the culture of domesticated white shrimp. As a result, today around 80% of production is white shrimp from SPF postlarvae (PL).

One way to overcome MSGs is to use good quality PL. However, the industry is constrained by unpredictable sources and quality of wild broodstock. It is easy to carefully select good PLs from the hatchery and once we are confident that the PLs are of good quality, we continue to purchase from the same source. However, it is more usual that PL quality deteriorates when the hatchery tries to increase production to meet demand. In Thailand, the standard for PL15 is more than 1.3 cm length. A simple way to judge the exact age of the PL, is that there should be 5 rostral spines as each spine denotes 3 PL days.



The number of rostral spines indicate the age of postlarvae



MBV from wet mount



WSSV in black tiger shrimp

It is also important to check for monodon baculovirus (MBV) and, although usually not done, PCR tests for hepatopancreatic parvovirus (HPV) are also recommended. Today, farms culturing black tiger shrimp stock at 25 pcs/m² and will only increase stocking to 50pcs/m² if they manage to procure higher quality PL.

.....on WSSV

Every now and then we hear of WSSV outbreaks. WSSV can cause mortality in both the black tiger and white shrimp as well as to the banana shrimp *P. merguensis*. However, it must be emphasized that with WSSV, not every infected shrimp develops clinical signs. WSSV disease can start after 20 days of culture and only 30% of the population may develop the white spot, despite good PLs and good water and pond management.

It is usual to see shrimp with black gills during the first attack. In the second, shrimp appear clean and the virus is only apparent from PCR tests. In the case of white shrimp, it is more difficult to see the infection with the naked eye and histology may be required. The virus particles are also clearly seen with an electron microscope.

The best method of prevention of WSSV is not to stock during poor weather conditions, i.e. during winter and monsoon season. For example, in Malaysia, stocking is not recommended during the monsoon season from November and in Thailand, from October to end January. However, some farmers take the risk of stocking during these periods especially when harvests were good in July and August.

Additionally, there must be control of the entry and movements of carriers such *Metapenaeus* shrimp in the reservoir water, egrets and crabs. Pond water must be well treated and disinfected. Egrets may spread the disease by feeding on infected or dead shrimp after the pond was abandoned after mass mortality. Other important procedures are to prevent the spread from pond to ponds by not sharing equipment and nets between ponds.

..on TSV

In white shrimp, a reddish colour indicates TSV disease. As the shrimp is usually very active, another sign of the disease is when shrimp become less active and more remain in the feeding tray during sampling. Mortality signs are similar to yellow head virus (YHV), where shrimp eat a lot and grow very fast, followed 3 to 4 days later by mortality. Another sign of

the disease is when shrimp come up to the surface since healthy white shrimp rarely do this. If we see this, we need to check for dying shrimp on the pond bottom. In all, this means that, to detect TSV quickly in white shrimp, we need to monitor shrimp activity closely.

Shrimp affected by TSV develop soft shell but mortality only occurs when shrimp molt. The crop can be saved if we can stop shrimp from molting by keeping the conditions in the pond stable. We do this by not changing the water, not adding chemicals and cut down on feeding and continue aeration. We can also prevent molting by adding lime to the pond water until the pH is approximately 8.0 in the morning. (Note that shrimp has to reduce pH in the haemolymph before molting). If mortality occurs, infected shrimp should be removed from the edge of the pond bottom but do not worry if shrimp consume infected shrimp. Surviving shrimp will have darkish patches indicating previous infections but these will disappear after subsequent molts (see below).



Darkish patches in surviving shrimp

In the black tiger shrimp, infections are more chronic than acute which means that there will be gradually reduced survival rather than heavy mortality in affected ponds. In the case of chronic infections in the black tiger shrimp, black spots are seen on the exoskeleton. In the laboratory, shrimp infected by TSV do not die but in pond conditions,



TSV in black tiger shrimp

mortality occurs when they are simultaneously infected with bacteria, microsporidians, protozoans, gregarines and other infections.

On the whole, if you know how to handle diseases and have good quality PL it is possible to produce white shrimp of 30g and above. We have managed to achieve 25g in 112 days. For the black tiger, I would recommend to stock from 25 to 30PL/m² and that we produce sizes of at least 30g. Otherwise, we cannot compete with the production of



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white shrimp. However, all this depends on demand and supply and has to be linked with the requirements of the processing plant.

Related article

NACA Alltech workshop on Shrimp Health Management, Volume 1, issue6, November/December, 2005, pp23-25.

Some Q&A with Chalor

When we detect a TSV attack in white shrimp, you have recommended that we do not change the water. Will this cause a plankton bloom? *Fadjril Kirom, Lombok, Indonesia, Farm Technician of 14 years*

As we usually stock white shrimp at rates of 90 PL/m², more feed will be used. For TSV control, we need to lower feeding at least by 50%. In white shrimp culture, overfeeding will cause plankton bloom and thus you can use this as a food indicator. But when you cut down on the feed, 2–3 days later you will see that the plankton population and water colour will be normalized. This is because the white shrimp will also consume plankton. In my farm we do not feed for 2 days.

In Indonesia, the common practice is to stock at 200-250PL/m². What will be the severity of a TSV attack during cold weather? *Akhmad Supriyadi, Sulawesi, Indonesia, Farm Manager of 12 years*

In Thailand, in the lower salinity (1-5 ppt) areas, most of the serious outbreak was in summer when water temperatures were 34°C or more in the afternoon and in the south, when water temperatures were 23-24°C during the monsoon season. Overall, infections with TSV can be all year round. But the most serious attacks have been reported in areas with low saline waters of less than 5 ppt. Under these conditions, it takes longer for the molt to complete as shrimp need to take more of the minerals (magnesium and calcium) from the water. Thus, I recommend that in inland areas with low salinity, minerals need to be added during molting and so that shrimp may recover quickly.



Some of the participants from Indonesia with Dan Fegan, Alltech's Asia Pacific Regional Technical Manager, (from left), Viriya Bhakti, Akhmad Supriyadi, Dan Fegan, Agung, Haris Muhtadi and Fadjril



When black tiger shrimp have white faeces disease, what should we do? *Mai Sony Ardianto, Sales Supervisor of PT Matahari Sakti, Indonesia*

White faeces in the black tiger shrimp, can be from bacteria or protozoan (gregarine) infection. However, most of the time, it is from bacterial infections. Before they develop the disease, shrimp do not eat, even under ideal weather conditions. The shrimp farmer should realise this quickly or when there is an inconsistent phytoplankton bloom. The pond bottom should be checked and quickly cleaned. In Thailand, we use chain dragging followed by aeration. The issue is how quick will be the reaction of the farmer. For most farms, it may be too late.

Reviewing shrimp diseases in Asia

By Tim W Flegel

In the Asian shrimp industry, the major diseases in order of economic impact have been WSSV, YHV, HPV and MBV. Following the introduction of *P. vannamei*, TSV and IHNV have been added to this list. To help producers monitor these diseases, information on each disease and the current detection tools available for simple diagnosis are presented in this article.

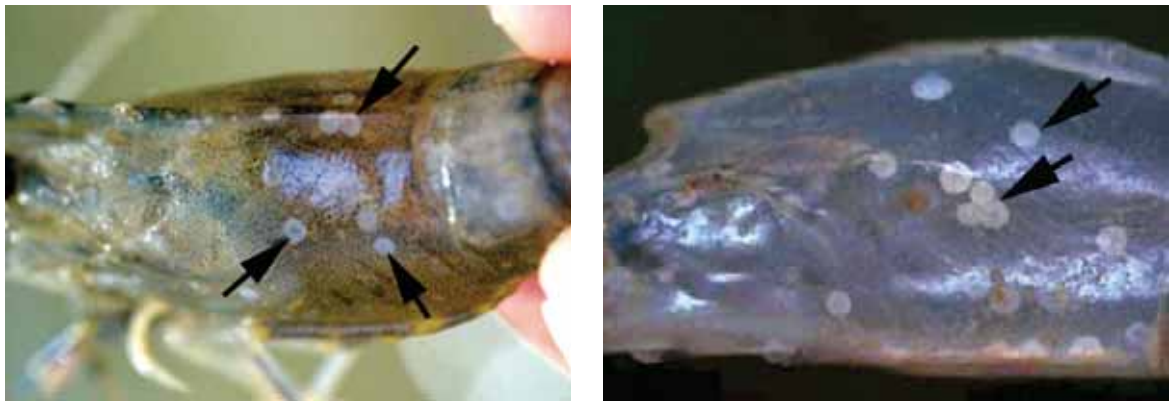


Figure 1. Gross signs of WSSV infection. White inclusions in the cuticle of moribund shrimp are indication of infection with this virus. Note that the inclusions are embedded in the cuticle and cannot be scraped-off with the thumbnail. To confirm the infection, histological examination must be made.

Shrimp production problems in Thailand have mirrored those in the rest of Asia although Thailand's recovery from viral epizootics has been much better than in other countries. Since 2002, *Penaeus monodon* has largely been replaced by *P. vannamei* (also known as *Litopenaeus vannamei*) as the main farmed species. At Centex Shrimp, much of our work has involved characterizing the causative viruses and developing rapid diagnostic probes for their detection.

White spot syndrome virus –WSSV

WSSV appeared in 1993 and was the second major viral disease (after YHV) to affect the industry in Thailand. Typical gross signs are white inclusions in the cuticle that cannot be scraped off with the thumbnail. Similar white spots caused by bacteria have been seen in shrimp so white spots are not conclusive proof of WSSV infection and confirmation by PCR or microscopic examination of tissues is needed.

Early studies showed that ponds stocked with infected postlarvae (PL) have a high risk of failure and the development of postlarvae screening by PCR (polymerase chain reaction) to eliminate infected PL has probably saved the Thai industry millions of dollars in losses.

Several studies of this virus have shown that the principal means of transmission is through infected (but apparently normal) broodstock infecting their offspring. We recommend that hatcheries test broodstock by PCR to ensure that they are free of WSSV. PCR tests are more reliable if spawners are tested after spawning. It is also a good idea to routinely wash eggs and nauplii as this can reduce rates of vertical transmission.

WSSV also infects a wide range of decapod carriers that can transmit the virus to shrimp. These can be eliminated through good pond preparation and using fine screens to keep them out of the production ponds. However, it appears that horizontal transmission rates are quite low since we have not seen a high incidence of infection in imported *P. vannamei*, even in the vicinity of affected black tiger shrimp ponds.

The usual method of detection is by PCR and there are now a number of commercially available PCR kits. Simpler, although less sensitive tests have also been developed such as chromatographic test strips, available from Japan and Thailand. DNA hybridization probes for WSSV and primers for PCR detection have been developed in Thailand by the Shrimp Biotechnology Business Unit (SBBU) and these are widely used in Thailand for the screening of postlarvae.



Figure 2. Gross signs of yellow-head infection are seen here in the 3 shrimp on the right. They are generally bleached in colour with a yellowish discoloration of the cephalothorax (“head”) region when compared to shrimp of normal appearance on the left.

Yellow head virus-YHV

YHV has been a serious problem in Thailand since 1990. Classically, the virus causes yellowish head and pale colour of infected or moribund shrimp. Before an outbreak, infected shrimp look normal, eat a lot and grow fast but this is followed by massive mortality. YHV is best diagnosed by characteristic basophilic (purple following H&E staining) inclusions in the gills, although these are only present in the final stages of the disease when it is too late for preventative measures.

Several types of YHV are known from different countries, including Thailand, Vietnam, Madagascar, India and Australia. Not all of the YHV types are pathogenic and there may be other, as yet unknown, types. The commercial kit from Farming Intelligene can be used, depending on the geographical region, to differentiate YHV types 1, 2, 3 and 4 but not 5 and 6. A monoclonal antibody specific for YHV type 1 has been developed in Thailand. In the future, it may be possible to develop kits that will identify the other variants of YHV. As an RNA virus, YHV is detected by RT-PCR but samples must be quickly processed as the virus deteriorates rapidly, even at -80°C .

Hepatopancreatic parvovirus-HPV

Gross signs of HPV are not distinctive and so diagnosis is via histology and identifying the characteristic intranuclear inclusions in the hepatopancreas. Nested PCR tests for small tissue and faecal samples, and haemolymph have been developed as non-destructive tests. Using molecular tests, two types of HPV have been identified, one in *P. chinensis* from Korea and another in *P. monodon* from Thailand that is closely related to an Indian strain.

HPV infection became apparent in Thailand when stocking density of *P. monodon* increased to 50–100 postlarvae/m². Although generally not lethal, it causes financial losses when cultured due to its effect on growth. There is a strong correlation between HPV and shrimp size and our research suggests that infected shrimp grow slowly, often reaching only 5g at harvest.

Dr Lightner of the University of Arizona has suggested that HPV transmission could be vertical. However, recent work on feeding uninfected shrimp with infected shrimp suggests that horizontal transmission through cannibalism could be a serious problem for farmers.

The source of HPV in farms remains a mystery as we have not seen it in either the hatchery or captive stock. It was found in PL acclimatized outdoors which suggests that there may be wild carriers. Insects such as the “water boatman” and “water skaters” have tested positive for HPV but we still do not know if they are really carriers. To avoid this possibility, tanks in hatcheries and nurseries can be covered to prevent insects getting into them and PL can be checked for HPV by PCR. Although we still need to identify the virus reservoir and an “acceptable” HPV prevalence, postlarval batches with high prevalence should be discarded.

Some new viruses

Infectious myonecrosis virus (IMNV) was discovered in Brazil but it has not yet been reliably reported in Asia. Some mortality of *P. vannamei* shrimp (20%) has been reported but none for *P. monodon* and *P. stylirostris*. IMNV causes white muscle discoloration that may not show clearly in *P. monodon* because of its dark exoskeleton.

Another white muscle syndrome in *M. rosenbergii* is associated with a new nodavirus (MrNV) and an extra small virus (XSV). It is not known whether either or both viruses are required for disease and we do not know whether the virus(es) can jump species. Mortality from this syndrome has been reported in postlarvae from hatcheries in China, India and Thailand. Recently it has been reported from juveniles in Thai rearing ponds.

Besides these, we commonly find dual and multiple viral infections in shrimp and we need to understand better how these viruses might interact. For example, wild *P. monodon* often have triple infections of YHV, HPV and MBV and sometimes more than one virus can be found even in a single cell.



Figure 3. Gross signs of HPV infection. The small shrimp on the right is infected with HPV, while that on the left is not. Note that apart from size, the shrimp is not otherwise abnormal in terms of coloration or length of antennae. These gross signs are not sufficient for HPV diagnosis.

Monodon baculovirus –MBV

MBV was implicated in the crash of the Taiwanese shrimp industry in the 1980s but was later found to be neither a serious pathogen nor the cause of the Taiwanese mortality. However, it is still desirable to eliminate it from farmed shrimp since it may affect growth.

Postlarvae in Thailand are regularly tested for MBV with PCR and a very sensitive nested PCR that works for MBV in Thailand and Australia has been published. In Thailand, many farmers accept level of 20% prevalence in postlarvae. As MBV is a DNA virus similar to WSSV, it may be possible to develop a multiplex PCR method that will be able to detect both of these DNA viruses in a single reaction.

It is likely that MBV is transmitted vertically from infected spawners, probably through fecal contamination of the spawning tank. Spawners should not be fed for four hours before spawning to reduce faeces and the chance of vertical transmission. MBV incidence can be reduced during the larval stages by washing eggs and early nauplius stages with clean water or disinfectants. Other preventative measures are separate rearing of larval batches and discarding infected batches of larvae or postlarvae. Complete elimination requires routine screening by PCR or development of SPF stocks.

Some studies have shown that infected shrimp are significantly shorter than uninfected ones but this is only obvious at a late stage in culture. Thus, MBV may result in slow growth as has been reported in the Philippines. These shrimp can reach the desired size if grown longer but this can increase production costs.

Infectious hypodermal and hematopoietic necrosis virus – IHHNV

IHHNV is a native Asian virus but was first reported in the Americas. We found it in Thai *P. monodon* in 1992 but it was not associated with any mortality or pathology. Today, we estimate the prevalence is 15% in *P. monodon* broodstock.

There are several different types of IHHNV found in Asia and although, histologically, IHHNV disease resembles the early stages of WSSV infection, this is also not sufficient to characterize the different types of IHHNV. The IHHNV from Hawaii is virtually identical to that from the Philippines and essentially the same as that from Taiwan and Thailand but different from that of Tanzania, Madagascar and Australia. The OIE Aquatic Animal Health manual describes a PCR method and commercial IHHNV probes are available from DiagXotics. Other tests range from digital colour correlation to real time PCR in either single or duplex assays. A rapid test strip method is also being developed in Thailand.

There is significant species difference in susceptibility to IHHNV infection and disease. IHHNV does not seem to affect *P. monodon* and there is even some evidence that suggests *P. monodon* infected with IHHNV are better able to withstand WSSV. IHHNV survivors of white and blue shrimp can carry the virus for life and transmit it horizontally and vertically. In *P. vannamei*, IHHNV causes irregular growth and shell deformities, leading to commercial losses. Vertically infected larvae and early postlarvae of *P. stylirostris* (also called *Litopenaeus stylirostris*) show mass mortalities at 35 days or more although infected adults rarely show signs of IHHN disease. Recent work showed that persistently infected *P. stylirostris* were markedly protected from mortality following WSSV challenge but that acutely infected *P. vannamei* was not. IHHNV does not appear to be infectious for *P. chinensis*, *P. indicus* and *P. merguensis*, all of which are sometimes placed in the genus *Fenneropenaeus*.

Taura Syndrome Virus –TSV

In *P. vannamei*, in the Americas TSV appears to be spread through infected larvae. Since the introduction of *P. vannamei*, careless importation of non-SPF stocks has led to outbreaks in many countries in Asia and it has been found in *P. monodon*, *P. japonicus* and even *Macrobrachium rosenbergii*.

In *P. vannamei*, TSV infections are characterised by reddening of the tail and visible necrosis of the epithelial tissue. In the acute phase, infected shrimp die while molting. Recovering survivors have black lesions on the shell that are lost in subsequent molts. These shrimp then look normal but continue to carry the virus and can transmit it to uninfected shrimp. Histologically, acute TSV infection is identifiable by “buckshot” epithelial tissue lesions while chronic stages show spherical clumps of cells in lymphoid tissue. Similar clumps are caused by other infectious agents so it is important to confirm chronic TSV infections by RT-PCR or antibody detection.



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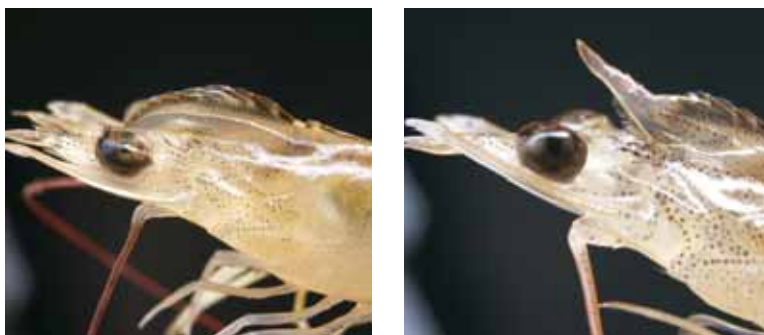


Figure 4. Runt deformity syndrome (RDS) caused by IHNV in *Penaeus vannamei*. Two shrimp specimens showing deformed rostra – one curved down and the other up and both shorter than normal.

TSV does not seem to be very harmful to *P. monodon* although recent injection trials have shown mortality up to 20%. Its effect on other crustaceans is unknown. However, TSV is an RNA virus and appears to be rapidly undergoing genetic change in Asia. The effects of these mutations on pathogenicity are still unknown but as a precaution, the practice of stocking *Macrobrachium* and *P. monodon* in ponds with *P. vannamei* that may carry TSV should not be encouraged. This could select for TSV mutants that are pathogenic to *P. monodon* and may trigger another disaster.

Conclusion

Although we cannot treat shrimp infected with virus diseases, we can implement a thorough prevention strategy. To reduce vertical transmission, we can screen broodstock and postlarvae, and possible carriers. Epidemiological and other research can also suggest ways to reduce transmission or disease risks. The most rapid and sensitive tests use PCR technology that takes approximately 3 hours to complete. However, more recently, strip tests based on nanogold-labeled antibodies have been introduced. Although less sensitive than PCR, they are highly specific, inexpensive and user-friendly and can be used at the pond side to diagnose disease outbreaks. These strips are now available for WSSV and work is now ongoing to develop similar tests for TSV, HPV, MPV and IHNV.

Reference

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Training Course on the biology and pathobiology in the Penaeid shrimp

Every year, Centex Shrimp at Mahidol University and SBBU, organises an international course on the “Biology and Pathobiology in the Penaeid shrimp”. This year, the course will be from 17-28 April 2006 in Bangkok.

This is a two-week intensive training course covering key aspects of the biology and pathobiology of *Penaeus* spp as they are relevant to the shrimp industry in Thailand. It is designed for postgraduate students engaged in research on any aspect of the Penaeid shrimp technicians or researchers involved in shrimp research or related fields and others. Lecturers comprise relevant experts from the Centre of Excellence for Shrimp Molecular Biology and Biotechnology at the Faculty of Science and from other Thai universities and institutes engaged in research on the black tiger shrimp. Daily sessions consist of 3h morning lectures followed by afternoon practical sessions.

There is also a one day field trip to a shrimp hatchery and a shrimp farm. The lectures cover the life cycle, anatomy, physiology and immunology of the black tiger shrimp, including information on the nature and diagnosis of all major pathogens. The practical sessions focus on shrimp anatomy and on techniques for disease monitoring and diagnosis ranging from gross observation to light and transmission electron microscopy and advanced molecular biology techniques including the use of monoclonal antibodies (Mab) and polymerase chain reaction (PCR) technology.

The maximum number of students is 30 for laboratory sessions, but those interested can register for the morning lectures only, ie half-day. Registration fees are USD 650 (incl books, but not accommodation and meals). The registration will close on the 17 March. Last year, SBBU said that they had to turn down many participants. Participants can contact SBBU at info@shrimpbiotec.com for more information and for registration forms.

Using pond liners for intensive shrimp culture in Southern China

By Ng Chee Kiat



Plastic liners are extensively used in shrimp farms like the P.T. Dipasena project located in South Sumatra, Indonesia.

The use of plastic liners in shrimp farming has been practised in areas of poor quality soil that would have otherwise been deemed unsuitable for aquaculture. This has been the case in major shrimp farming projects like P.T. Dipasena in Indonesia and Agrobrest in Malaysia. The conventional thinking has been that such plastic liners are only practical in suspect soils and are not necessary elsewhere. On a recent trip to Southern China in the Guangdong province, we found an interesting development.

The recent problem with shrimp disease in China was a major reason why polyethylene liners are becoming very popular. As recent as 1997, China was the largest producer of farmed shrimp in the world. This dropped in subsequent years as a result of disease problems which were blamed on poor management and sanitation of shrimp farms. One of the main reasons for the disease outbreak was the pond bottom which harboured many pests and pathogens and was difficult to remove without removing the soil.

In Southern China, the whole coastline from Zhuhai southwards is now dotted with shrimp farms. The use of concrete tanks to farm shrimp was tested and found to be fairly successful in combating diseases. This was, however, very costly. Plastic liners were introduced in 2000 and were found to be equally effective in controlling the spread of diseases. As a result, farmers have been able to produce more shrimp with better survival.

In two of these farms in Yangxi and Taishan, all of the ponds were fitted with plastic liners. Both these farms had been in operation for about 4 to 5 years and currently produce the white shrimp *Penaeus vannamei*. Their success hinge on the ability to control the three fundamental factors in shrimp culture, i.e. water, shrimp and feed.

Water Supply Quality

The farmers in Guangdong are well versed on the critical role of incoming water for the success of their culture. Water is pumped from under the seabed after it has been filtered by the coastal sand. The intake

point is buried under the seabed by about 4 meters. The sandy bottom acts as a natural filter for the raw seawater before it is pumped into the ponds. According to Mr Ou of Kaewon Invest Shrimp Farm located in Yangxi, survival and growth rates have vastly improved since he adopted this method of water filtration and intake. In fact, he has also installed a freshwater supply from a 9 meter deep well so that final salinity is about 20 ppt upon entering the supply canal.



Mr. Ou showing the sea-water intake point of his shrimp farm which is buried 4 meters under the seabed and located about 150 meters out to the sea.



Circular ponds lined with plastic and central drain. Aerators are absent in the photo as they had been removed to avoid being damaged by the typhoon that was blowing in at the time.

Shrimp farm design and operations

The farm started operations in 2002 and is one of the largest in the Yangjiang district. It consists of 32 circular ponds, all lined with plastic with central drain. Each pond measures about 6 mu (0.39ha, 1 mu = 650 m²) and water depth ranges from 2.8 to 3 meters. Water is discharged via a central drain.

Initially, it was difficult to maintain a healthy phytoplankton population in ponds lined with plastic. However, with the help of the South China Sea Institute of Oceanography, a stock compound fertilizer has been developed commercially. With applications of 2 kg per week per pond during the first month and 1kg per week in the second month, the primary productivity in these plastic lined ponds have been impressive, with healthy populations of green algae.

Production has also been impressive with initial crops averaging 20 tonnes/pond, from a stocking of 1.2 million postlarvae (307 PL/m²). In the last 2 years, production has dropped to 12 tonnes/pond, from a stocking of 700,000 per pond (180 PL/m²). However, this is still impressive by industry standards.

Economic returns

Culture period varies from 95 to 120 days after which shrimp average 50 pcs/kg (20g) and are sold for about RMB 14.0 per catty or USD 3.5/kg (one catty =0.5kg) while the production cost is RMB 8.5 per catty or USD 2.1/kg. The major cost input is the feed and energy cost which accounts for up to 80% of total costs. As the produce is exported, the company has in 2004 established its own feed mill which is able to produce 600 tonnes per month.

The establishment of an in-house feed mill has allowed the farm to control the quality of the shrimp which is exported all over the world. It also allows the farm to comply with the traceability requirements of importing countries. The feed conversion ratio (FCR) range from 1.3 to 1.5 and the cost of the feed is about RMB 4,900/tonne or USD 612/tonne. Four grades are produced with protein content ranging from 38% to 42%.

Plastic pond liners

The ponds have been in operation for more than 5 years and the liners are still in use. The liners are produced by the Foshan Plastic Group in Guangzhou and in addition to local sales, they export their products all



Mr Ou with feed produced from his own mill. The reason for controlling feed production in-house is to be assured of quality and also to comply with the traceability requirements of shrimp importing countries.



Ponds in another farm with concrete walls. New ponds are lined with plastic to lower development costs.

over the world. The liners come in various grades and for the shrimp ponds, it has a bulk density of 190 gms/m².

The cost of lining a pond is very feasible as it allows farmers to have faster turnover rates while at the same time having reduced risks of disease. At the rate of expansion seen in South China, it will be little wonder that China will again dominate the production of farmed shrimp.



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Better market for white shrimp PL in 2006

by Zuridah Merican

In 2004, Phuket's Sarin Hatchery became one of the selected local hatcheries to import SPF *P. vannamei* broodstock. As more farmers switched to white shrimp culture, demand for postlarvae increased. However, in mid 2005, the domino effect of the requirement for bonds by the US Customs led to lower prices as processors stopped purchases. Farmers stopped culture reducing the demand for postlarvae. In 2006, Managing Director, Mr Attapol Suriyawonghae is looking forward to better times as the grow out industry in Thailand picks up again.



Mr Attapol Suriyawonghae

Thailand's farmed shrimp industry now comprises 80-90% (depending on industry sources) of the white shrimp *Penaeus vannamei*. To provide for a supply of postlarvae (PL), the Department of Fisheries started a controlled importation of SPF broodstock from accredited suppliers in Hawaii and Florida by local hatcheries. To qualify, they had to be CoC (Code of Conduct) approved by DOF, have biosecurity measures in place, located near

shore and finally demonstrate their commitment for future shrimp domestication programs in Thailand.

One of them is the Sarin Hatchery Group, already an industry leader in Thailand's shrimp hatchery business. The group was certified to the DOF's good hatchery practices to produce disease free postlarvae since 2002. Set up in 1997, the hatchery with nine satellite facilities, all located along Chalong Bay in Phuket, has already developed quality standards for the production of disease free postlarvae of the black tiger shrimp. Back in 2003, their black tiger PL was well known and sold at higher prices. This was all due to the strict production protocols. Today, these protocols are being applied for the production of the white shrimp. The annual production is 500 million PL15.

The transition to the white shrimp production is not difficult, according to Attapol. "One of the main advantages of producing postlarvae of the white shrimp is the fact that there is a supply of broodstock of known quantity and specific pathogen free (SPF) ie from WSSV, IHNV, YHV and TSV. Earlier with *P. monodon*, we had to search for spawners off the Andaman and one was never sure that these would be free of some of the diseases including MBV. With *P. monodon*, even if diseases were not detected in the spawners, we could not be 100% sure that some diseases will show up and we then had to discard the whole stock".

The broodstock imported from Hawaii costs USD18 – USD 32 each, FOB to Phuket. These are SPF broodstock. Higher prices are paid for those termed as TVR™ (see box). Lately, farmers have started to demand PL from these broodstock.

"It may cost me more for the *vannamei* broodstock but I am always assured of the disease free status and I can use the broodstock for 5-6 months before I replenish the stock. My Hawaiian suppliers also provide technical assistance, when required. If we prepare well, we can be assured of a supply. In the case of the wild black tiger spawners, whatever the price I pay, I have to destroy infected ones", said Attapol.

Sarin Hatchery buys these broodstock for its centralised breeding centre where there are 137 tanks of 16m² tanks. Water temperatures are adjusted for 28°C and nauplii are nursed to the postlarval at its 8 farms. At the central breeding station, male and female broodstock (average weight 40g) are kept in separate tanks. They are fed diets

containing 48% protein, prepared in house and which contains 12% spirulina. The formulation for the broodstock feed was developed by Dr Somchai Veanrum.

Attapol added that the spawning and larval rearing process of the white shrimp is more stable in comparison to that for *P. monodon*. In the case of the white shrimp, the biggest challenge is during the first 4 days during the zoea to mysis stages. If this goes well, an overall survival rate of 70% is easily achieved. In the case of *P. monodon*, mortality can occur even at PL₁₀. The fact that white shrimp PL are more resistant to *vibrio* also makes its production less problematic.

Better times ahead

In the second quarter of the 2005, the industry in Thailand was hit by a slide of 30% in the shrimp prices. Prices declined to almost 75 baht/kg, below costs of production. This was a domino effect of the new custom bond requirement by the US Customs. Independent



From left (standing) Charnkiet Angsuwan, Chean Cheng Kiak and Thomas Liew, visitors from Singapore. Seated, Dr Somchai Veanrum and Attapol.



Broodstock in tanks



Cultures of algae at the Biotech shop in Phuket



The broodstock feed is prepared on site and based on a formula containing spirulina.

processors stopped purchasing. With this decline in demand, farmers delayed or stopped operations. Prices for PL went down to as low as 0.08 baht/PL, from the normal 0.10-0.12 baht/PL. Sarin's operations was affected. However, Attapol said that they can now put this behind them and look forward to better times in the new year (2006).

"Prices are now up as processing plants have resumed operations and are buying shrimp. The Government has developed solutions to comfort the farmers and the industry is back on track".

Key success factors

Water management and biosecurity

One of the key success factors is water management in the hatcheries of the group. Water is drawn from an undersea sand filter and is chlorinated in tanks. This water is then passed to another tank for dechlorination tank and then through a diatomaceous cartridge filter and a one micron filter before being channeled to all tanks in the farms. Affluent water is collected in tanks and passed through three sedimentation tanks before being released into discharge canals. Following their CoC certification, all of the hatcheries under the group have to adhere to biosecurity procedures.

Disease checks

Although only SPF broodstock are used and hatchery production systems are biosecure, it does not mean that diseases may not appear. Attapol and his assistant manager Charnkiet Angsuwan checks that the PL have uniform sizes. According to them, size is uniform at PL 11. A large size variation at PL12 may indicate a problem with the broodstock. They are always vigilant as there have been reports of YHV (yellow head virus) and IHHNV (Infectious hypodermal and hematopoietic necrosis) infections in ponds culturing SPF shrimp. Occurrences of TSV (Taura Syndrome Virus) depend on season. Checks for diseases using a nested PCR – polymerase chain reaction method start at PL8 to PL10.

A system of points is used to determine the quality of the PL. According to Dr Gunnawit Ruchirawat, who runs the Biotec Lab in Phuket, one of the tests is the hepatopancreas where pale organs are assigned 0 points and dark ones, 20 points. Feed and lipid bubbles in the gut are assigned 10 or 5 points respectively. Checks are done at the zoea and mysis but these are not included in the final score. Finally, only PL that have a score of more than 80 are sold.

Changing trends

This requirement that hatcheries only use certified SPF broodstock and install biosecurity measures has led to a consolidation of the hatchery business in Thailand. Smaller hatcheries have closed. Another change is the upstream integration of feed companies to supply postlarvae to customers. Thus, hatcheries such as Sarin have formed partnership with feed companies to supply postlarvae as well as in the free market. Prices for PL10-PL12 range from 0.10-0.12 baht each when demand is high. During low demand, prices declines to 0.08 baht. In the case of Sarin Hatchery, all purchases carry a 15 day guarantee.

Hatcheries in Phuket use the expert services at the Biotech Lab. The laboratory services 4 hatcheries in Phuket, accounting for 50% of the total production. Besides monitoring the quality of PL, the laboratory produces single cell bacteria and algal cultures such as *Skeletonema* and *Chaetoceros* for the hatcheries. Regular checks for vibrio in fry and water are carried out. Other services include routine water quality monitoring.

Attapol has also taken the initial steps to develop broodstock for the future. He has collected the fast growers and separated them into tanks for future use. The fast growers from each batch are selected based on their average daily growth (ADG).

In due course, the bottomline for Attapol is to continue to be ahead in the production of good quality PL of the white shrimp, just as he has built up a reputation with the black tiger shrimp. With this, he can assure his customers of his commitment to them and to the industry in Thailand.

What is TVR

TVR™ is short for Taura Virus Resistant *P. vannamei*. These shrimp are certified SPF (i.e. pathogen free) and have been bred for fast growth and TSV resistance over 8 generations of selection at HHA in Kona. We've seen stepwise improvements each generation going from 20% survival at the beginning up to 95% now. In recent tests, we challenged TVR shrimp with TSV isolated from Thailand and averaged 96% survival. TVR™ is HHA's trademark. Shrimp farmers in Thailand, Indonesia, Vietnam and China using TVR shrimp are setting record production levels in nauplii and PL in hatcheries and growout production in ponds. - James Wyban, High Health Aquaculture Inc, December, 2005.

Multispecies research in Phuket



Various substrates are tested for the culture of the worms

There are several ongoing projects at the Phuket Coastal Fisheries Research and development Centre (PCFRD), located in Ban Para, Talang. Research ranges from the breeding of the seabass, red snapper, grouper, trevally, marine shrimp and cobia to that on the production of annelid worms as feed for the shrimp broodstock. The centre also has ponds and cages.



Mr Vaiyapoch Kruesanae

The centre, part of the Coastal Fisheries Development Bureau, Thailand, Mr Vaiyapoch Kruesanae, leads a team of 7 biologists. Their role is assist the mariculture industry in Phuket and South Thailand to develop appropriate technologies which include work in live feed, supplementary diets and hatchery management to improve efficiency. The various aspects of research for a particular species are shared between the centre and others all along the coastal areas such as the one in Songkhla and Trad.

The hatchery at the centre is CoC (Code of Conduct) certified and it produces white shrimp postlarvae for farmers. They work on methods to improve survival rates and the target is to produce a larger percentage of larger postlarvae. It also provides supporting services for the private sector hatcheries in Phuket. They conduct checks on the consignments of broodstock and send samples for disease diagnosis to the centre in Songkhla. They also have facilities for the quarantine of these consignments for two weeks.

Work on the genetic improvement of *P. monodon* is a major project at the centre. Together with other centres in Songkhla, Krabi and Rayong, PCFRD is selecting and maturing broodstock of *P. monodon* as part of the national project on the domestication of the black tiger shrimp. In Phuket, the selection is based on growth whereas in Songkhla, the selection includes disease resistance.

Another significant research for the industry in Phuket is that on the production of polychaete annelids (sand worm). They are excellent live food for broodstock shrimp as they contain 45.32% protein. The work is on the *Perinereis* spp. Ms Nantawan Santisathitkul is using several culture medium in her trials. She keeps the male and female populations at a ratio of 20:30. Feeding starts with the rotifer and followed by the algae *Chaetoceros*, *Skeletonema*, *Tetraselmis* and *Chorella* after a month. This is then followed by artificial feed. The



Ms Nantawan Santisathitkul (left) and Mr Wittaya Rathana who works on the marine shrimp

polychaetes are sold at 4 months. Nantawan also maintains stocks of algal for use by the centre and for sale to private hatcheries.

In the seed production of the cobia *Rachycentron canadum*, the centre has broodstocks of cobia reared in cages. These are then transferred to large tanks (10m ø, 2m deep and 150 tonnes capacity) for spawning. Broodstock are 15kg each. Cobia is a targeted species as it is a fast growing species and can reach 7-8kg in a year and the market price is 60-80baht/kg or USD 1.5-2.05/kg for fresh whole fish and 110 baht/kg or USD 2.82/kg for fillet. New projects include the breeding of some common marine aquarium species.



Picture shows a male (top) and the larger female *Perinereis* sp.

Probiotics and premixes in aquaculture

– a solution for antibiotic free feeding in shrimp hatcheries in South East Asia

By Christian Lückstädt

A growing awareness from consumers and producers of aquaculture species has resulted in calls for responsible and sustainable aquaculture. This is particularly so in the much debated shrimp production industry of South East Asia (Feedinfo, 2005). Public opinion and regulation authorities in most export countries now focus on the misuse of antibiotics in aquaculture. Henceforth, public attention has shifted towards production methods (Lückstädt, 2005).

Modern shrimp feed currently contains around 38-42% crude protein. Essential amino acids for shrimps are arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, valine, threonine, and tryptophan. The crude lipid content range from 5-6% and is best with high amounts of n-3 series highly unsaturated fatty acids (HUFAs), while carbohydrates make up around 20% of the diet, mostly to satisfy energy requirements, but also used for feed binding. The energy content of such diets should be around 2850 – 3700 kcal/kg.

However, in order to withstand the high stocking densities in shrimp production (hatcheries and grow-out ponds) and stress situations, directly fed probiotics can be a promising additive to stimulate shrimp growth and secure a low disease response. For shrimp grow-out, Massam (2005) found that directly fed probiotics can be an effective tool to boost survival. Decamp et al. (2005) also studied the effect of probiotics on one Asian shrimp hatchery. However large scale field data are still missing.

Trials with probiotics

In 2005, several trials in South Vietnam in a number of hatcheries using DynaGain products (DynaGain is a trademark of Mangrove Coast Ltd.) containing a single-strain fermented probiotic feed additive (with 3 different strains of *Bacillus* sp., *Enterococcus* sp. and *Lactobacillus* sp.) were performed. These have been designed to improve bioavailability in shrimp larvae used from early zoea to late post larvae stages and a micronized amino acid and vitamin premix blend for shrimp larvae. The trials were done in 4 provinces in 56 hatcheries from nauplii to post larvae (PL 12). The average results from all farms are shown below. All results are based on triplicates in each farm.

Table 1. Length differentiation in control and treatment (micronized amino acid/ vitamin premix blend) in PL12 of *Penaeus monodon*

| Hatcheries | Control | Treatment group ¹ |
|----------------------------|----------|------------------------------|
| 1. province, 15 hatcheries | 10.80 mm | 11.04 mm |
| 2. province, 12 hatcheries | 10.60 mm | 10.80 mm |
| 3. province, 9 hatcheries | 10.80 mm | 11.17 mm |
| 4. province, 20 hatcheries | 10.60 mm | 10.95 mm |

¹ containing DynaGain(r) NUTRA-ZM 3x

Table 2. Survival in hatcheries using the probiotic blend in diets until PL 12 in *Penaeus monodon*

| Hatcheries | Control containing antibiotics | Treatment group ¹ |
|----------------------------|--------------------------------|------------------------------|
| 1. province, 15 hatcheries | 50.0% | 53.3% |
| 2. province, 12 hatcheries | 45.0% | 45.8% |
| 3. province, 9 hatcheries | 55.0% | 58.3% |
| 4. province, 20 hatcheries | 50.0% | 51.3% |

¹ containing DynaGain(r) LARVAEbiotic

Based on these results it can be concluded that the chosen additives can be an alternative for an antibiotic-free hatchery operation under the circumstances in Vietnam.

Acknowledgement: Thanks to Andrew Bryan from Mangrove Coast Ltd. for delivering the data.

References are available on request.

Mode of action of probiotics in aquaculture

- *Production of inhibitory compounds*

Here probiotic bacteria release chemicals which have a bactericidal or bacteriostatic effect. Some of these chemicals are: bacteriosins, lysozyme, proteases, organic acids (pH-change)

- *Competition for available energy (nutrients)*

Microbial competition for organic substrates (carbon and energy sources) in the intestinal tract of shrimp means that by increasing the relative numbers of probiotic bacteria, nutrients are consumed which would otherwise be available for the growth of pathogenic bacteria.

- *Competition for adhesion sites*

Bacteria also compete for gut adhesion sites. Adhesion is a prerequisite to colonisation in the intestinal tract. By applying a high number (10¹²) of beneficial bacteria (probiotics), harmful bacteria (pathogens) are not able to adhere and thus cannot proliferate.

- *Enhancement of immune response*

There are many publications available on immune stimulating substances. Most of these are derived from the cell walls of various microorganisms, such as β -glucans, lipopolysaccharides (LPS) and peptidoglycan (PG). These substances are a first challenge that approaches the shrimp's immune system in response to invading microorganisms.

- *Improvement of water quality*

This is usually associated with *Bacillus* species. In comparison to gram negative, bacteria gram positive strains (e.g. *Bacillus subtilis*) are better converters of organic matter thus producing CO₂. This results in lower levels of residues in the pond, so the BOD (biological oxygen demand) and the COD (chemical oxygen demand) are reduced.

- *Enzymatic contribution of digestion*

Certain bacterial species (*Bacillus subtilis*) are known to produce and release enzymes (e.g. amylase, protease) that are able to improve the digestive process in shrimp.



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Managing gut flora naturally with prebiotics in aquaculture

By Nicolas Robert and Florence Rudeau

In animal husbandry, the prebiotics concept is already well developed and is used to manage the gut flora of the animal for good feed conversion. In this article, the authors explain the application of this concept to aquatic species. Trials with trout and marine shrimp showed improved growth.

In animal husbandry, good feed quality is crucial for good feed conversion for growth. The good health of the animal is also essential. Feed transformation to growth process starts in the digestive tract of the animal containing bacteria ie the gut flora.

It is the management of this gut flora that is key to good feed conversion and animal health. This management means the selection of beneficial strains, control of their number and reduction to the smallest number of "negative" or potentially pathogenic strains.

Beneficial strains means bacteria not pathogenic for the animal and which interacts in a positive way with the animal immune system gut associated lymphoid tissue (GALT). It is also the community of strains that interact in a balanced microbial ecosystem and that work together or interact for the production/ transformation of volatile fatty acids. In contrast, negative or potentially pathogenic strains means those that produce compounds toxic to the animal, excess gas and excess osmotic by-products in the gut lumen. These compete with the animal host for nutrients as digestible protein.

Beneficial strains are defined as "antagonistic to potentially pathogenic strains" and help in the proper development of gut mucosa: immunity, secretion, absorption. In the past, in terrestrial animal farming, this management was frequently based on addition of antibiotic growth promoters for controlling potentially pathogenic strains. Fortunately for aquaculture, this has never been the case in Europe.

Our knowledge of science has shown that beneficial and negatives strains were more or less in exclusive competition. Beneficial strains in terrestrial animals are commonly *Lactobacillus* and *Bifidobacterium* spp. These bacteria produce volatile fatty acids (VFA) which then inhibits the pathogenic bacteria or feed other bacteria genus of the beneficial community.

Currently we manage this gut flora by applying probiotics (beneficial strains). Going a step further, we can supply prebiotics, that is by supplying nutrients for promotion of the beneficial strains development. This would be a more natural way.

Briefly, prObiotics are bacteria, prEbiotics are feed for bacteria.

Using prebiotics in aquatic species

Previous scientific research on aquatic species tends to show that the interaction "gut flora – host" was measurable only for animal raised at high temperatures, which means having sufficient bacterial number per gram of digestive tract and with high metabolic rate. But more recent studies show that even for aquatic animals living in cold temperature (< 20°C), the gut flora can interact with positive or negative effects on growth.

The increase of probiotic products (pond treatment) sold for some species (e.g. shrimp) in some parts of the world have shown the interest of farmers for management of microbial ecology in the farming environment in general. Additionally, the aquatic environment allows

for easy growth, dissemination, selection of bacteria as soon as they leave the gut.

Research on gut flora has shown that there is a very variable flora in transit through gut (named "transit flora") and this is very dependent on the aquatic surrounding flora. The dominant flora was shown to be variable in quality and quantity. In animals with moderately short digestive tracts, bacteria are most frequently aero-anaerobic type.

Recent methods of molecular biology are being applied to study gut flora in aquatic organisms. However, the "actual" dominant flora in aquatic animals are probably still to be discovered. In this context, the management of gut flora in aquatic organism is of prime importance. A supply of useful and efficient probiotics require the selection of new strains.

However, feeding existing beneficial flora in the gut allows it to take advantage of bacteria already naturally selected as beneficial for the organism and which has been adapted and is efficient for the animal. These nutrients for gut flora are called prebiotics.

General properties of prebiotics are that they feed preferably on the beneficial flora, but are of low or no value for pathogenic flora. They are un-digestible for the animal host: thus fully available for the target bacterial strains.

Trials with prebiotics

This concept of prebiotics in aquaculture was applied to rainbow trout and marine shrimp. Fish and shrimp were fed complete feeds

Figure 1. Growth performance of various sizes of trout fed the prebiotic at 11°C – 17°C.

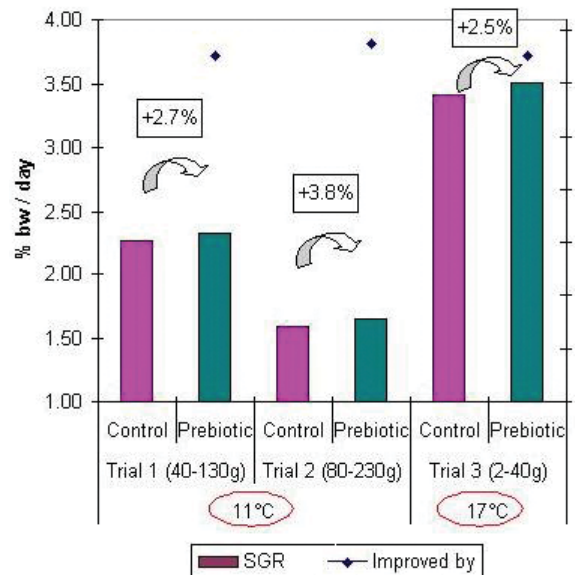
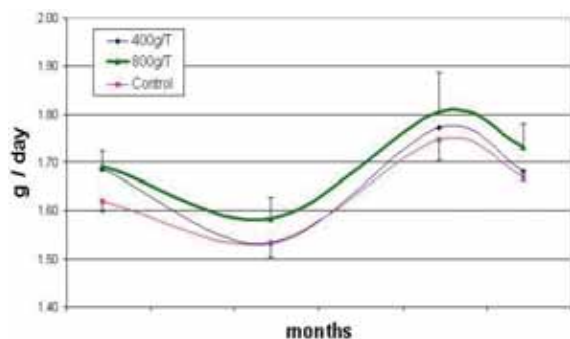


Figure 2. Growth performance of trout at different doses of the prebiotic at 11°C



supplemented with a prebiotic called Profeed. This is a raw material extracted from sugar beet manufactured by Beghin Meiji, France. It has been shown to have interesting effects in terrestrial animals. In trout, four tests were carried out separately on fry at first feeding and during growing stage (40 to 250g) and at two temperatures (11 and 17°C). These are the main temperature ranges for trout farming (Figure 1 and Figure 2).

During the trials, we observed an improvement in specific growth rate (SGR) from 2.7 to 4% according to dose and temperature. The final body weight improved from 4% (in fry) to 7% (in 40g fish at 17°C). In trials with fry, an antibiotic treatment probably limited the effect of the prebiotic on growth. However, the final weight improved by 4% with the addition of the prebiotic. This confirmed that the interaction between the prebiotics and “gut flora - host performance” does actually exist.

Similarly, in terrestrial animals, supplying the prebiotic at the early stage, at first feeding, was shown to have effect on the selection of flora in the young animal, eliciting preferably the beneficial strains which became dominant.

Feeding animals weighing from a few mg to a few kg and having different metabolic rates and gut volumes implies that care must be taken in dose application. In our trials with aquatic species, various doses were tested. It is then possible to calculate the optimal dose taking into account the temperature and the feed intake level.

In the shrimp *Litopenaeus vannamei*, trials were run in concrete tanks in several replicates. Although temperatures during trials were suboptimal, the groups fed with the prebiotic showed that feed conversion rate (FCR) improved on average by 7%. All groups fed the prebiotic had better survival than the control during feeding trial. Survival improved by 11% on average. Figure 3 and Figure 4 show a dose dependent relationship for growth.

At the end of the growth trial, shrimp were challenged with *Vibrio parahaemolyticus*. Doses of 400g of the prebiotic per tonne of feed reduced shrimp mortality by 40%

Figure 3. In feed prebiotic effect on shrimp growth.

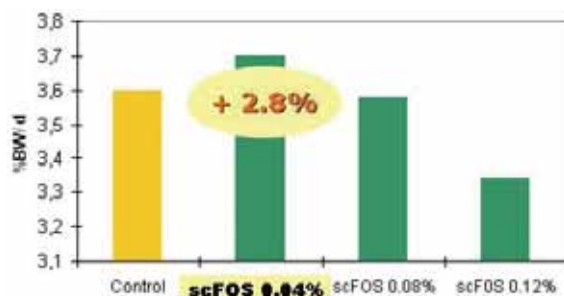
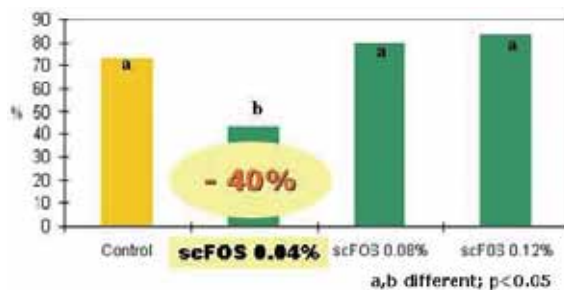


Figure 4. Survival of shrimp after challenge with *Vibrio parahaemolyticus*. Animals were previously fed with feed containing various doses of the prebiotic Profeed



Conclusion

These very promising results show the importance of supplying nutrients favourable for the beneficial host gut flora. They show that the prebiotic in feed concept, well developed in terrestrial animals, is also beneficial in aquatic organisms, even if they live at low ambient temperatures (10°C), and with a gut flora (as measured with classical microbiological methods) quantitatively very inferior to those observed in homeothermic animals.

In aquatic species farming, numerous cases of non acute enteritis are observed. Although not obviously serious, they lead to decline in growth performance and can be the basis for chronic low mortality. These observations are the results of an unstabilised or unbalanced gut flora ecosystem. The prebiotics Profeed could help in stabilising the beneficial flora.

The hatchery environment often have varying bacterial communities. A supply of a prebiotic can help the gut media of young animals to select “local” beneficial strains and favour the competitiveness against pathogenic bacteria.

Thus a wide area for applications of prebiotic is possible and the natural prebiotic Profeed® is already available and approved for application in aquatic animals in EEC and worldwide.



Nicolas Robert



Florence Rudeaux

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An evaluation of full and partial replacement of fishmeal with DDGs in red tilapia diets

By Hanan Mohd. Yusof, Chuah Hean Peng and S. Pathmasothy*

The search for low cost quality ingredients for formulating cost-effective diets has been a continuous agenda for many fish nutritionists worldwide. Full or partial substitution of expensive fishmeal as a source of protein in feed formulation has been achieved using plant ingredients such as soybean, groundnut, cottonseed and rapeseed (Richter et al., 2003). However, these same ingredients are always in high demand for human consumption, the livestock industry and other industrial uses. A continuous increase in prices for these raw materials has gradually put these ingredients far beyond the reach of aquafeeds producers (Fasakin et al., 1999). At present, this has become more critical as the profit margin from feed production is being reduced.

Therefore, new alternative sources of plant-based ingredients have to be investigated in order to reduce costs in fish production. A new product for the aquaculture industry is Distiller's Dried Grains with Solubles (DDGs). It is already successfully used in feeds for cattle, swine and poultry. However, will DDGs be a suitable ingredient for the culture of freshwater fish?

DDGs in aquafeeds

DDGs is one of three co-products from dry milling in the process of the ethanol distillery industry. It is the dried residue product from a fermentation process with the help of selected yeasts and enzymes on corn starch fraction in the production of ethanol (Buchheit, 2002). With a rapid change in the US ethanol scene over the last two decades, its production has increased from virtually zero to more than 7 million tonnes in 2004. It is expected that the output will reach 9 million tonnes in the 2005 (NRA, 2005).

There is good possibility that it has a promising future in aquafeed production because of its abundance, consistent quality and low and stable price. Generally, DDGs contains 25 to 30% crude protein and 8 to 12% fat, which makes it nutritionally suitable as a feed ingredient. Not all DDGs are the same. The quality depends on the type of processes that go into making DDGs. In general, those with a golden color and possess a sweet fermented aroma have better nutrient profiles and palatability.

The use of DDGs as a protein source in aquaculture has been studied. There are a few attempts at formulating aquafeeds for channel catfish (Kohler and Killian, 1987; Webster et al., 1991), Tilapia (Wu et al., 1996), rainbow trout (Cheng and Hardy, 2004) and freshwater prawn (Coyle and Tidwell, 2000). In a study by Tidwell et al. (2000), tilapia fed totally on loose and pelleted forms of DDGs did not give any encouraging result compared to those fed commercial catfish feeds. This may be attributed to the lack of several essential amino acids (EAA) for fish such as lysine and methionine. The inclusion of synthetic EAA or fishmeal in fish diet is advisable (Cheng and Hardy, 2004). They also suggested that besides reducing the cost of aquafeeds by replacing some portion of fishmeal in the diet, it can actually reduce the discharge of phosphorus, a cause of eutrophication, from fish farms into the aquatic environment.

In a series of trials, we tested the use of BPX Dakota Gold, a product of Dakota Gold Research Association (DGRA, USA) and distributed by Delstasia Sdn. Bhd. Its nutrient composition is compared against corn, a regular commodity (Table 1). Two experimental diets were compared in this study: a formulated diet comprising 50% inclusion of DDGs and a commercial diet. Diets were isonitrogenous. The diets were pelleted by using the 'Mini Pelleting Plant' developed by the Freshwater Fisheries Research Center (FFRC), Batu Berendam, Malacca, Malaysia. The composition and proximate analysis of both diets are shown in Table

Table 1. A comparison of nutrient composition of BPX Dakota Gold™ DDGs and corn

| | Corn | DDGs |
|----------------------|--------------|-------------------|
| Dry matter | 87%90% | |
| Metabolisable energy | 3250 kcal/kg | 2750-3350 kcal/kg |
| Crude protein | 7.8% | 25.5% |
| Crude fat | 2.1% | 10.4% |
| Crude fibre | 11.2% | 6.3% |
| Lysine | 0.24% | 0.93% |
| Methionine | 0.16% | 0.45% |
| Tryptophan | 0.05% | 0.19% |
| Threonine | 0.29% | 0.72% |
| Calcium | 0.02% | 0.03% |
| Available Phosphorus | 0.09% | 0.61-0.64% |
| Sodium | 0.02% | 0.17% |

Table 2: Composition (%) and proximate analysis of the diets

| Ingredients | Test diet | Commercial diet (control) |
|---------------------------------|-----------|---------------------------|
| Danish fishmeal | 6.21 | Not available |
| Soybean meal | 10.00 | |
| BPX Dakota Gold™ DDGS | 51.99 | |
| Copra cake | 15.00 | |
| Cassava flour | 15.00 | |
| Dicalcium phosphate (DCP) | 1.0 | |
| Vitamin premix | 0.5 | |
| Mineral premix | 0.3 | |
| Proximate analysis (% dm basis) | | |
| Dry matter | 85.77 | 92.07 |
| Moisture | 14.23 | 7.84 |
| Protein | 27.38 | 28.31 |
| Lipid | 8.15 | 3.66 |
| Ash | 6.96 | 10.88 |

2. The ingredient was also tested in a variety of diet formulations for ornamental fish.

Feeding trials

In the first experiment, a total of 120 red tilapia (*Oreochromis* spp.) juveniles with an initial average weight of 14.9 ± 1.11 g were used in the experiment. Twenty fish each were assigned to six 0.2 tonne capacity tanks. Water was filtered and recycled. The fish were fed twice daily at 9% and



Formulated pellets



Various diets for ornamental fish were also formulated to include DDGs. This will give an idea on how well ornamental fishes react to the test diets.

7% body weight (BW). The experiment ended after 28 days. In the second experiment, two 1.5 tonne capacity indoor concrete tanks were each stocked with nine individual fish. Partial water exchange was carried out from time to time. Fish were individually tagged with passive integrated transponder (PIT) tags. After a 10-day period of acclimatization to the test diet, the fish were fed rations based on estimates obtained using the thermal growth coefficient (TGC) for 26 days.

Growth performance and survival rate

For the first experiment, comparisons of mean final weight gain, feed conversion ratio (FCR), specific growth rate (SGR) and survival rate (%) of fish were as in Table 3. Juveniles that were fed the commercial diet recorded better FCR and SGR ($P < 0.05$). In second experiment, there was no significant difference in individual weight gain, FCR, and survival rate (Table 4). However, fish fed the commercial diet registered a better SGR.

In the second experiment, there was no significant difference in individual weight gain, FCR, and survival rate (Table 4). However, fish fed the commercial diet showed improved SGR.

Palatability

The test diet containing 51.99% of the ingredient was well-accepted by the tilapia after an initial period of acclimatization. Incidentally, when the same diet was given to Ikan Tengas (*Acrossocheilus hexagonolepis*), and the Malayan Mahseer (*Tor tambroides*), two species that are considered 'choosy eaters', there was a feeding frenzy. This is a rather exciting observation because commercial diets tested so far on these fishes had only lukewarm responses indicating that the "sweet fermented aroma" of BPX Dakota Gold™ DDGs may be preferred by certain species. In preliminary tests on a variety of ornamental fish, DDGs was successfully incorporated into formulated diets which were well-accepted.

Effects on colour and flesh quality

A slight enhancement of body colouration was detected in the second experiment on Tilapia fed with the test diet for 36 days. Ornamentals such as the discus (*Symphysodon* sp.) and the guppy (*Poecilia reticulata*) also showed an apparent improvement in body coloration. In the case of the red tilapia, the color enhancement may make it more presentable despite the current preference for pale whitish fish. Color enhancement may be attributed to the high content of xanthophylls (35ppm) in the DDGs (Buccheit, 2002).

Conclusion

The effects of this 60% inclusion of the DDGs in a formulated test diet on the red tilapia indicated little difference in growth when compared

Table 3. Comparison of growth performance, feed conversion and survival rate (\pm SD) of red tilapia juveniles at 27°C.

| Parameters | Diets | |
|-----------------------------|-----------------|---------------------------|
| | Test diet | Commercial diet (control) |
| Initial weight (g/fish) | 14.9 \pm 1.11 | 14.9 \pm 1.11 |
| Final weight (g/fish) | 34.7 \pm 4.78 | 37.6 \pm 4.52 |
| Specific growth rate (SGR)% | 2.91 \pm 0.11 | 3.40 \pm 0.08 |
| Feed conversion ratio (FCR) | 2.24 \pm 0.11 | 1.83 \pm 0.06 |
| Survival rate (%) | 100 | 98.3 |

Table 4. Comparison of growth performance, feed conversion and survival rate of individually tagged red tilapia over a 26-day period at 25°C

| Parameters | Diets | |
|--------------------------------|-------------------|-------------------|
| | Test | Commercial |
| Initial weight (g/fish) | 186.6 \pm 24.3 | 189.3 \pm 24.2 |
| Final weight (g/fish) | 219.2 \pm 26.9 | 229.4 \pm 32.5 |
| Specific growth rate (SGR) (%) | 0.735 \pm 0.317 | 0.625 \pm 0.237 |
| Individual weight change (g) | 32.7 \pm 13.1 | 40.1 \pm 18.1 |
| Feed conversion ratio (FCR) | 1.44 | 1.25 |
| Survival rate (%) | 100 | 100 |

to a commercial diet. The inclusion rate in the test diet is considered to be on the higher side for accepted growth effects. Although it was anticipated that the lack of starch in DDGs could be a problem in the binding ability of the formulated diet, the inclusion of 15% cassava flour resulted in pellets with good water stability. Even then, the inclusion rate in feed should be less than 50%.

Fish did not decline the test diet which showed that the ingredient was palatable to tilapia and even some 'difficult-to-feed' species such as the Malayan Mahseer and the tengas responded very well. Good colour enhancement was obtained for both the red tilapia and ornamental fishes. DDGs could be preferred over artificial or synthetic color enhancers.

These preliminary trials show that in general, DDGs can be used for aquaculture because of its palatability, acceptable nutrient profile and digestibility. However, the question is the level of inclusion in feeds for the various species. More research needs to be done to fine-tune the inclusion rate in various diets for the various species. Further studies are being planned by the FFRC regarding the prospects and effects of DDGs inclusion in feed for both food-fish and ornamentals.

References are available on request.

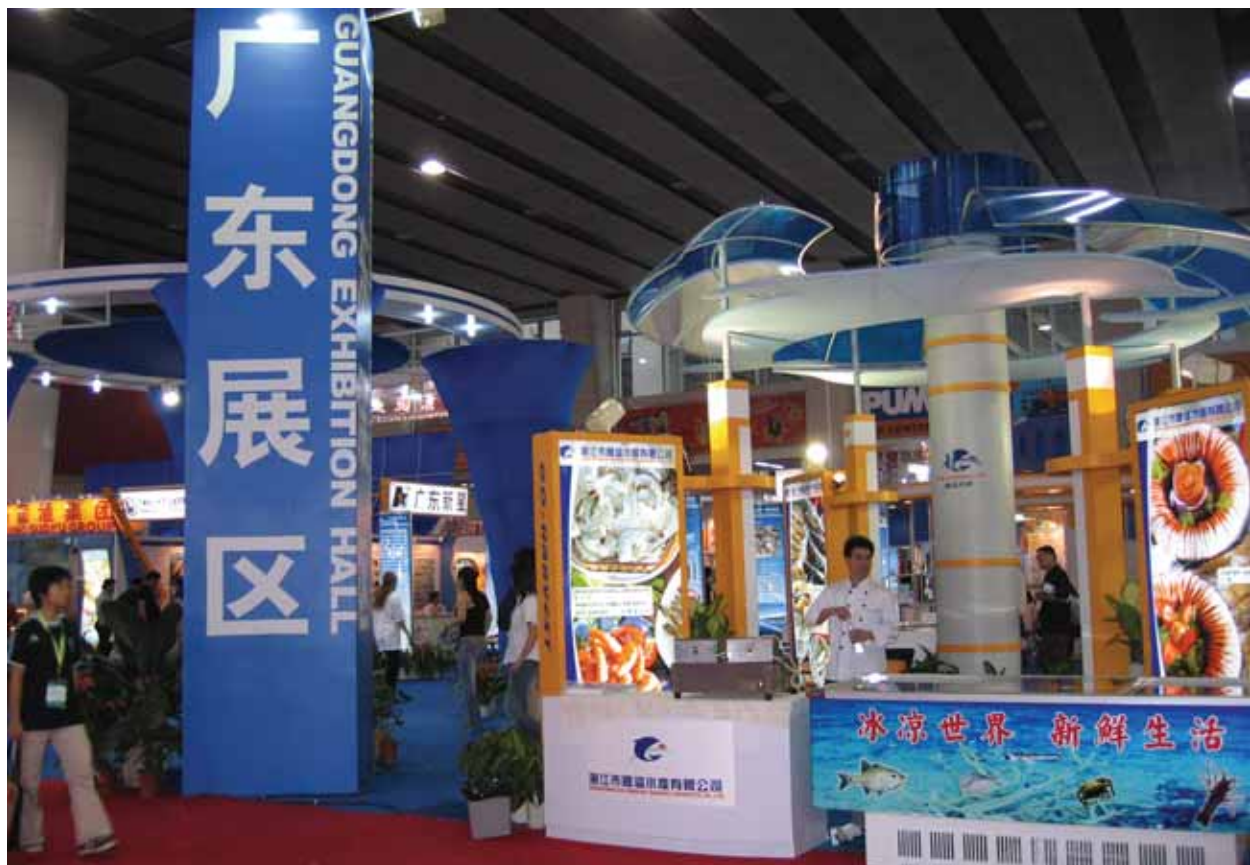


Chuah heah Peng (left) and Hanan Mohd. Yusof S. Pathmasothy

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At China Aquaculture 2005

The vastness of the China's seafood industry was on display at the China Fisheries and Seafood and China Aquaculture exhibition held in Guangzhou from November 10-12. The organizers, Seafare Expositions said that it attracted more than 15,000 visitors and 700 exhibitors from 35 countries. New to the show were companies from Spain, Korea, Indonesia and Namibia.



Three River Seafood

This was the first time that the show was held in South China. Guangzhou was chosen as the venue as the organizers consider it as the most promising aquaculture centre in the world with products worth USD 7 billion. The show was started ten years ago in Qingdao, North China.

According to Peter Redmayne, president of Seafare Expositions, "China is well on its way to be a dominant player in the seafood production industry, much of which is focused on aquaculture production".

Guangdong Province in South China is the aquaculture hub in China. In 2003, it produced about 41% of the total farmed marine shrimp with 2-3 harvest per year. In marine cage culture, it produced 37% of national production of 518,000 tonnes in 2003. Together, the southern provinces of Guangdong, Hainan, Fujian and Guangxi produced more than 47% of the country's output (Wang, 2005). Thus, it is around Guangzhou, that most of the large aquaculture and seafood producers are located. More than 100 of them were present at the Guangdong pavilion.

China is also a large market for seafood such as salmon from Chile and Norway and live fish from the region. China imported US\$1.6 billion of fishery products in 2002 and it is expected that Chinese seafood imports will continue to increase at a healthy rate. This is largely because of the increasing interest by foreign companies to have the



Chris Zhou (left) at the booth of Luye Fisheries



Chen Guo Qiang (right) showed feed products and the culture technology for *P. stylostris* at the Haimao booth.

processing done in China where costs are much lower and a higher recovery rate can be achieved. (Canada Agri-Food trade services, 2003).

Globally there is a trend for aquaculture to supply a large part of the demand for seafood products. China, itself has announced that it will target 70% of the demand from aquaculture production in the next five years and begin to downsize the fishing activities (chinadaily.com.cn). The current ratio is already 67%. At the show, most of the large processing establishments already have production bases for the supply of raw material for further processing or depend on contract farms. For many this is the way to ensure the quality of products and that the production process follow strict guidelines on sanitary conditions and traceability.

South China's top integrators

Zhanjiang Evergreen Aquatic Product Science and Technology Co Ltd is one of the larger fully integrated companies at the show. It is a subsidiary of the Guangdong Evergreen Group which has complete integration from feed manufacturing to hatchery and seafood processing. The processing facility has a capacity of 50,000 tonnes per year of seafood. Products include several valued added fresh and cooked shrimp *P. vannamei* and *P. japonicus*. Fish products include deep skinned and shallow skinned tilapia fillet and whole frozen tilapia.

There was also the **Luye Fisheries Co Ltd** which has three subsidiary companies in Guangdong, Hainan and Fujian counties. They produce tilapia fry and products. Guangdong Luye, the largest tilapia producer in China has 140 ha of nursery ponds and produces 600 million tilapia fry. Hainan Luye has 30ha of ponds and produces 100 million fry. The advantage of locating a hatchery here is that the production can be 1-2 months ahead of other producers. Production will increase to 500 million in 2006. At Xiamen Luye, the ponds utilise water from a hot spring allowing it to produce and market fry during the off season. Production is 100 million fry.

Through its selective breeding programs, the company produces three brands of tilapia under the Luye brand. The Wuguo fish has features such as high male ratio of 98-100%, high growth and strong disease and cold resistance. The fish has a high adaptability to pH ranges from 5 to 10 and optimal salinities of 8 ppt and to temperatures as low as 13°C. The meat ratio is 5-8% higher than the common tilapia types. The red tilapia has purity of 96% and with high growth rates of 6g per day and at 30ppt. As the colour is better, the company said that there is price premium. Their production technology has been certified by the Aquatic Breeding and Quality Supervision and Examination Center of the Ministry of Agriculture. Fry are exported to countries such as Malaysia and Vietnam.



Madam Tang Ai Qin, General Manager of China Qingdao Jianhao Aquatic Foods

The group has a fish processing plant which was set up in 2005 with a 30,000 tonnes per year capacity. The fish is from its own farms and from the 35,000 ha of ponds culturing tilapia in the province. The company said that the plant will propagate South China as a tilapia processing centre. The plant also processes channel catfish and marine shrimp.

Hainan Sky Blue Ocean Foods, located on Hainan Island is a processing arm of the Grobest Group. It was established in 2003 and has annual production of 16,000 tonnes. Products include whole and gutted tilapia and various value added products of *P. vannamei*. These have been produced from the vertically integrated supply chain from hatchery, feed and farms of the group. The Grobest Group, a fully integrated aquaculture company, is a leading brand in the industry in Asia. The company said that quality products are assured as they are farmed using feed produced by the company and the aquaculture technology developed through their R&D process. Production follows the highest hygiene and traceability standards. In recent years, the company has been setting up processing facilities in the region.

Also at the show was the processing arm of Taiwan's Hanaqua group, **Three River Seafood (ZJ) Corp** based in Guangdong. The company processes tilapia cultured in its intensive ponds. Products are sashimi grade fillet and frozen fillet and blocks. Sushi Ebi is produced from live farmed shrimp. The Hanaqua group has expanded from its core business of feed manufacturing into shrimp/fish farming and cage culture,



Using Cryovac for tilapia fillets

processing and marketing. It has also developed a hatchery, a grow out farm and a processing plant in Thailand and is currently developing a feed mill in Vietnam. At the show, the company was also promoting its red drum and cobia products.

Another large scale aquaculture company is Guangdong's **Foshan Gaoming Sunshine Agriculture Technology Development Co Ltd**. It has 11 culture farms. Some 3,800 net cages are located in a 620,000 m² reservoir. Species cultured include the sturgeon, channel catfish, tilapia and basa. The annual production of tilapia is 4,000 tonnes.

The Chinese and foreign owned enterprise **Zhangjiang Run Hai Food Co Ltd** depends on the resources in the west of Guangdong and Hainan provinces as raw material for its 6,000 tonnes per year processing plant. Farmed shrimp are *P. vannamei* and black tiger shrimp which are processed as frozen headless, butterfly and tail on products.

Shenzen Xulian Sea Life is a company established with Chinese and foreign investments and is engaged in hatchery, production and processing of fish, shrimp and other crustaceans. Products are sold in Hong Kong, Japan and South East Asia. At the show, the company was promoting its yellowtail *Seriola dumerili* cultured in offshore deep sea cages.

Shantou Jiazhou Foods Industry Co Ltd is involved in aquaculture and fisheries and integrated with production, processing, trading and R&D. Raw material are from its 1.3 million m² of shrimp ponds as well as from a large fishing fleet. It also produces the bull frog. The capacity

is 90 tonnes per day and products are exported to America, Canada and South East Asia countries.

International entry into the Chinese markets

The Indonesian group was marketing live fish (see page 37) and Malaysian producers, through the Fisheries Development Authority and INFOFISH were seeking markets for chilled and live fish products into the Chinese markets. According to India's MPEDA (Marine Products and Export Development Authority), they were there to assist buyers for Indian products, renew contracts and to update on new machinery for the industry in India. They also promoted the forthcoming Indian Seafood Show to be held in Kolkata in February 2006.

Nha Trang, Pearls Limited, Vietnam's largest cobia farm was at this show as part of its marketing efforts to encourage the consumption of this new species in the Chinese and international markets. The Norwegian group promoted seafood safety. One of the approaches was to work together to provide accurate information in an open manner to achieve consumer's trust. Besides, marketing salmon and trout products to the Chinese market, EPF Nutrition was promoting feed ingredients at the Chilean booth. The world's leading aquaculture producer of salmon and trout, Marine Harvest presented its salmon and trout as well as barramundi, halibut, sturgeon and yellowtail which are produced in several locations in Europe, Australia and Asia. It has been in the Chinese market since 1996. Branch offices are in Hong Kong, Beijing and Taiwan.

Next show

The organizers have also announced that the next China Seafood Expo will move back to Qingdao in North China. It is scheduled for November 1-3, 2006 at the Qingdao International Convention Center. The press release said that, "Qingdao and the surrounding Shandong Province import more than half of all the seafood coming into China," according to Wan Baorui, Chairman of the China Council for the Promotion of International Trade (sub-Council Agriculture), which co-organizes China Fisheries & Seafood Expo with Sea Fare Expositions, Inc. of Seattle.

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Indonesian producers tap Chinese live fish market

At the China Fisheries and Seafood Exposition 2005, a group of producers combined forces to market live marine fish. The exhibition was held in Guangzhou from November 10-12.

In marketing the products, the producers were supported by established cold storage companies in their area, working together to tap the emerging market in South China. Six companies participated in the show. They were from the Bali Grouper Group; PT Tirthamas, PT Tirtalini Perdana and PT Samawa Alam Lestari. The Sumatra Grouper group was represented by PT Indonesia Mariculture Industries, PT Sumatra Budi Daya Marine and PT Trimina Dinasti Agung

The Bali Grouper Group was marketing groupers such as the giant, mouse and tiger groupers farmed in cages off Bali and Sumbawa Islands. The large PT Sumatera Budidaya Marine (SBM) has farms located in ten locations, from the islands of Nias to Flores and from Aceh to Lampung. The Indonesian Agency for Export Development (NAFED) helped to fund their participation at the Indonesian pavilion.

The focus is the export of live fish and frozen products. Their aim is to penetrate new markets directly. Currently, exports of live fish are limited and their entry into China's markets has been through Hong Kong. Other markets are Japan, USA, EU and Korea for frozen products.



Khoo Eng Wah, Malaysia with Wayan Sudja, PT Tirtalini Perdana and Wira Cahyadi Wangsa from Singaraja, Bali at the AquaCulture Asia Pacific booth.

The group expects to increase production from the current 2,500-3,000 tonnes per year with the opening of new markets.

Wajan Sudja of PT Tirtalini Perdana said, "Our current production has been constrained by limited markets, such as Singapore and Hong Kong. We are able to increase volumes as we do not foresee any problems in production.

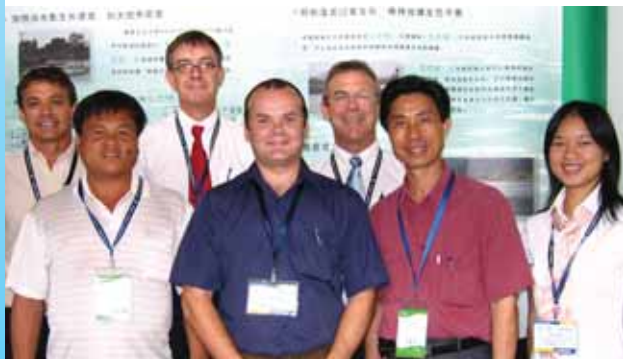
We have government support, perfect environmental conditions, steady supply of seedstock and large potential of coastal areas for further expansion. We may have competition from marine cage farming in South East Asia but we have the lead. Each country will have their own advantage. Ours is the government support and infrastructure. In our production systems, we use probiotics and immunostimulants in feed and avoid antibiotics. Our strong belief is that fish is healthy food. The market is a dynamic one and each country will be able to fit into it." He added, "At the show, we were inundated with enquiries on our fish products. We have 15 representatives of companies present, and the enquiries came not only from Chinese importers but also those from the US and Russia".



Representatives at the Indonesian pavilion.

China import licence for Australian company

On October 27th 2005, Australia Aqua Biotech (Foshan) was granted an import licence from the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China, Beijing. This was for the Ecogreen Aqua and Aquaclean range of bacterial water cleaners. Ecogreen Aqua is a microbial water cleaner to manage water quality in ponds. These products have been developed by Environmental Products (Australia).



The Australia Aqua Biotech team and customers at Aquaculture China 2005
 Front row from left: He Jian Bo (Shrimp Farmer, Panyu, Guangdong), Gordon Motherwell (Environmental Products, Pty Ltd), Wu Rui Rong (Ronyu Fisheries Bureau) and Lillian Liang (Australia Aqua Biotech).
 Back Row, from left to right: Robert Stewart, James Mills and Martin Kain (Australia Aqua Biotech).

With the import licence approved, the company's booth at Aquaculture China 2005, received several queries from Chinese producers.

According to Gordon Motherwell, Bioscientist at Australia Aqua Biotech's parent company, Environmental Products (Australia), "The response was phenomenal; producers expressed concern over falling productivity in the industry, citing poor water quality in farm ponds as the key stumbling block to higher yields. Our cost effective probiotics, Ecogreen Aqua and Aquaclean, improve water quality and thus profits for producers."

In pond trials conducted in Kasetsart University, Thailand, the density of tilapia stocked in the ponds treated with the Ecogreen range could be increased to much higher levels than the industry average. This was because of reductions in pond BOD and ammonia levels.

Gordon Motherwell qualified from Glasgow University in 1999 with a BSc (Hons) in Aquatic Bioscience. He was formerly a manager with Beermullah Marron Farm, Gingin, Western Australia, where he supervised the culture of both marron *Cherax tenuimanus*, a very large freshwater lobster native to Western Australia and barramundi *Lates calcarifer*, a giant perch native to Australia. Prior to this, he worked for Scotprime Seafoods in the UK, where he managed a lobster hatchery and a research project on lobster cultivation.

For information: Web: www.aquabiotech.cn; Email: info@aquabiotech.cn

Biotechnology creates new functional feed that works for marine shrimp

Researchers at Japan's Kyushu Medical Co., Ltd. have spent ten years developing "ShrimpGuard, a feed supplement which will support immunity of the marine shrimp.

This is produced from the marine bacterium *Pseudoalteromonas sp* and contains culture nutrients. A Japanese patent has been obtained for the product.

The company has indicated that this is not a curative nor preventive medication for WSSV. This does not work in shrimp and postlarvae shrimp in ponds already infected with the virus. The recommended dosage is 0.02% of shrimp feed and should be used at the beginning of culture until harvest.

The product should be ingested by the shrimp, and spreading it over the pond surface will not be produce any effects.

Kyushu Medical Co. Ltd., based in Kitakyushu, Fukuoka is a mainly pharmaceutical company, which made a decision to venture into the biotechnology business several years ago. Marketing for the ShrimpGuard began last year. Current markets are Vietnam, Korea, Taiwan, Indonesia and Japan. The company has conducted



Mr Chiaki Kuma and colleague at the Kyushu Medical's booth.

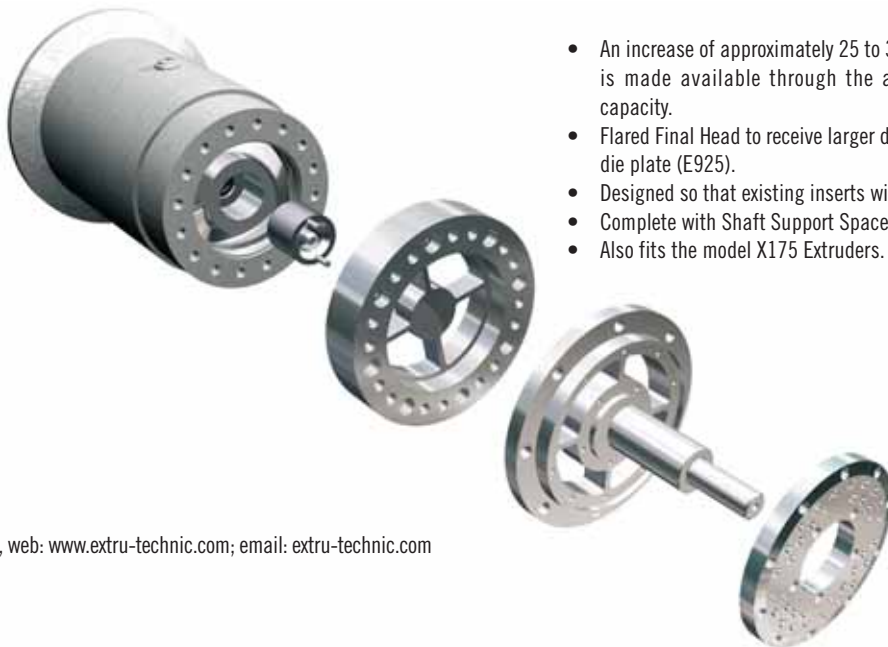
trials in Indonesia, Japan and China. Tests are also being carried out in Brazil.

At the China Aquaculture 2005 show, there were interest from producers in the region. Mr. Chiaki Kuma, General Manager and Technical Advisor, said, "We have queries from customers culturing black tiger and kuruma shrimp. The vannamei shrimp is also susceptible, though to a lesser extent. We have trials ongoing in Brazil too."

He explained that in the trials in Indonesia, the ponds cultured black tiger shrimp. Survival rates of shrimp in ponds fed with diet supplemented with the products improved to 53 to 73% compared to the previous 0-20% when survival rates were affected by infections of WSSV. The size of shrimp at harvest was 19-21g. Stocking rates were low at 3.5 to 17/m². For more information email: kbio@kmed.co.jp; Web: www.kmed.co.jp

New from Extru-Tech

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- Flared Final Head to receive larger diameter standard die plate (E925).
- Designed so that existing inserts will fit this new die.
- Complete with Shaft Support Spacer & Extrusion Die.
- Also fits the model X175 Extruders.

More information, web: www.extru-technic.com; email: extru-technic.com

New phospholipid product reduces deformity in fish larvae

After launching Omegalec™ for cod farming earlier this year, Norwegian biotechnology company Natural ASA will now introduce the product for seabream farming in 2006. In a recently concluded study, this phospholipid was shown to reduce the degree of deformity in farmed seabream. Previous studies have shown reduction in deformities in cod larvae and fry.

Study results show that the phospholipid also increases growth rate and reduces the degree of deformity in Gilthead Seabream (*Sparus aurata*) larvae and fry. The study was carried out in Malta where the phospholipid was added as enrichment for rotifiers for fish larvae over a period of 55 days. Deformity analysis was by x-ray scanning. In August, Omegalec™ was nominated for Nor-Fishing's innovation award, based on a full scale study that documented a similar deformity reduction in cod larvae and fry.

More information; Jostein Dalland, CEO Natural ASA, Tel: phone +47 996 49 038; Hogne Hallaråker, Tel: +47 481 20 388

FDA approves aquaculture drug

In November, the US Food and Drug Administration gave approval for the Animal Health Division of Schering-Plough to begin marketing Aquaflo (florfenicol) in the US. This is for the control of mortality in catfish due to enteric septicemia from *Edwardsiella ictaluri*. This is the first in feed antibiotic to be approved by the FDA in more than 20 years.

The product has been used to treat fish species since the 1990s. In Japan, it is used in yellowtail and other species. Additional approvals have been granted or are anticipated over the next several months in Latin America and parts of Asia for shrimp and fish such as tilapia.

More information: www.SPAQUACULTURE.com

VICTAM ASIA 2006

More updates on the exhibitors



In the November/December 2005 issue (page 38), we had a list of exhibitors showing products directly related to aquafeed production. More details on some of the exhibitors are given below. You can also consult the show's catalogue or visit their stands for more details. And if you show up at the Aquaculture Asia Pacific booth No 603, you can obtain a free copy of the preview edition.

Wenger Manufacturing, Inc.
714 Main Street, Sabetha, Kansas 66534, USA
Web: www.wenger.com
Booth No: 81



Contacts: Doug Baldwin, Email: dbaldwin@wenger.com; Tel: +1 816 891 9272
Rock Chen, Email: rockchen@wenger.com; Tel: +886 42 3223302

Wenger, USA will introduce the new X-185 and its External Density Management System, or EDMS which gives customers precise control of final product densities and is capable of increasing capacity over vented configurations by as much as 25 to 50%. The EDMS is a particularly important advancement for the aquafeed industry, as it allows processors to make both floating and sinking feeds with a wide range of properties – without the need for extruder configuration changes.

As part of the patent, Wenger developed a back pressure valve that allows the operator to adjust specific mechanical energy (SME) online for control of critical product properties. And as the second part of the equation, the EDMS includes a new external density chamber. Officially patented as a “super atmospheric post-extrusion product treatment assembly”, it utilizes compressed air to control pressure in the chamber. This turns allows the operator to better control density and other critical properties of the final product.

Paul Chen, Wenger Asia, said, “Wenger has many clients over the world, especially here in the Pacific Rim area where the aquaculture is prosperous. The show will enable us to have a chance to speak personally with clients. We will also use this opportunity, to introduce our new technology in the field of extrusion to them”.

“It has been an opportunity for us to join Victam Asia as this is one of the biggest shows for aquaculture here in Asia. We have a chance to see all our competitors and their new technology as well. Last, but not least, the seminar will educate us with the new development of the aquatic industry”.

EXTRU-TECH Inc.
100 Airport Road, P.O. Box 8, Sabetha, Kansas 66534 USA
Web: extru-technic.com
Booth No: 81



Contact: Tom Nease, Email: tomn@extru-technic.com

Extru-Tech is a worldwide supplier of extrusion/cooking systems for aquatic/fish feed and pet food industries. E.T.I. equipment is being utilized for the production of a wide range of items in over 60 countries. E.T.I. equipment provides the most efficient, economical and highest capacity production capabilities for single screw extrusion processes and products.

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Geelen Counterflow USA Inc.
7380 Sand Lake Road, Suite 500,
32819-5257 Orlando U.S.A.
Web: geelencounterflow.com
Booth no: 313



Contact: Peter Schreursweg 38, 6081 NX Haalen, The Netherlands
E-mail: info@geelencounterflow.com
Tel: +31 475 592 315 Fax: +31 475 592 767

Geelen Counterflow is specialized exclusively in the development and manufacturing of counterflow coolers and dryers for granular products. It first invented its vertical counterflow cooler for animal feed in the 1980s, and the company has since applied energy-efficient counterflow principles for drying and cooling.

Exports to Asia started in the late 80's and since then sales progressed with the rapid development of the animal & fish feed market. First, only coolers but soon after Geelen entered the market for shrimp and fish feed. The dryers and coolers prove to be most suitable to manufacture feed for: tilapia, milk fish, cat fish, yellow tail and local carp species. Geelen especially developed the vertical holding bin to improve the water stability of pelleted shrimp feed. Many South East Asian shrimp feed lines contain Geelen equipment. The Asian market is still of importance for Geelen Counterflow today.

New product lines

Counterflow MkII Dryer - This new generation vertical dryer includes a compact air circulation box. This total insulated air circulation system improves energy efficiency and decreases foot print and required building space. Most of these dryers are used in the premium segment of the pet and fish feed industry.

Large Capacity coolers - These KL type coolers expand the cooling capacity of production lines. These lines enable feed mills to produce more efficiently at lower production costs. Large capacity coolers are mainly used by poultry integrators, oil crushing plants, salmon feed producers in Asia, South America and the US.

INTEQC Feed Co Ltd, Thailand
77/12 Moo 2 Nakhok Muangsamutsakhorn
Samutsakhorn Thailand 74000
Booth No: 5



Contact: Dhanapong Sangsue, Technical Manager
Email: dhanapong@inteqc.com, labinter@ksc9.th.com
Fax: + 66-34-851197

INTEQC Feed Co Ltd is one of the top aquafeed manufacturers in Thailand with a factory in Samutsakhorn, south-west of Bangkok. Currently the product range includes feeds such as the “Inteqc” “Diamond” and “Shrimp First” for *Penaeus monodon* shrimp. The brands “Wave” and “Starteqc” are formulated for the *Penaeus vannamei* shrimp. Other lines are “Neofeed” and “Vanamax” which form supplemental feed for the marine shrimp. Additionally, it also produces and markets “Fresh” for the culture of the freshwater prawn.

New product lines

“FISH FIRST” are sinking & floating pellets fish feed for herbivorous fish and tilapia.

CLEXTRAL Europa

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**Nice Garden Industrial Co., Ltd.**

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www.datastorsystems.com
 Booth No: 605
 Contact: Fiona Joanne Lee, Sales & Marketing Asst. Manager,
 Aquaculture Division, Email: aqua@nicegarden.com.tw
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CLEXTRAL provides turnkey production lines for the aquaculture industry, based on twin screw extruders. Twin screw extrusion technology was developed 35 years ago by the company for the manufacture of fish feed granules, from 0.8 mm up to 30 mm in diameter. Feeds were produced for the marine fish (salmon, turbot, sea bass, yellow tail), the marine shrimp, fresh water fish (trout, carp) and ornamentals.

Due to its specific features which include a good mixer, positive pump action, perfect control of all parameters (i.e: temperatures, shear, screw speed), the Clextral extruders can process any kind of recipe and produce high quality, well calibrated pellets which are nutritionally adapted to the animal. Two pilot plants are available in Europe and USA. These have capacities ranging 10 kg/h up to 20 000 kg/h .

The new developments apply to the EVOLUM range of machines with advanced cooling systems and perfect control of the bulk density, a new laboratory extruder EV 25 and a new cutting device. Clextral invites you to share the experience and its knowledge in fish feed processing at their booth.

Nice Garden of Taiwan deals specifically in livestock, aquaculture and related biotechnology products such as Elisa test kits for drug residues in seafood, honey, milk and meat. Founded in 1984, the company has a professional and dynamic team consisting of veterinarians, animal sciences and aquaculture experts.

The company also celebrated its grand opening of the new feed premix plant on 22 January 2006 at Tainan Technology Industrial Park, Southern Taiwan. The plant is implementing the sophisticated DataStor system and DSM, guidelines to ensure a high standard of quality and traceability in their productions.

DataStor Systems Limited, a leading supplier of Integrated Process Control Solutions, has 25 years experience in controlling the manufacture of animal feeds, food and drink and a wide range of other industrial control applications. The products allow customers to comply with a range of regulatory requirements including the EU Food Supplements directive. Nice Garden is its agent in Asia-pacific region for food and feed industries.

Nice Garden invites you to visit their booth and learn about the DataStor system in the food and feed industries.

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From Dr Joachim Hertrampf, Malaysia

As a former “feed antibiotic man” I read with great interest all the publications on probiotics. Unfortunately, in most cases, after studying those articles, I am just as knowledgeable as before. Very important facts are missing. This refers also to the article “Probiotics in aquaculture in Volume 5, 2005, p14-16 of the magazine that challenges me to write this letter to the editor.

Among others, the article stressed that *Bacillus* is the true probiotic for shrimp culture, in particular *Bacillus subtilis* and *B. licheniformis*. However, as we know, the antibiotics “bacitracin” (better known as zinc bacitracin) is a polypeptide, produced by *B. licheniformis*. The question therefore arises as to whether probiotics based on *Bacillus* contain antibacterial activities.

For a better understanding of the cited trial results, it would have been an advantage to add information pertaining to the inclusion rate of the probiotics used (e.g. whether the probiotics was mixed into the feed or sprayed onto the pelletised feed). In this context, it would show how the added probiotics are analyzed in the compound feed.

The production results of treating pond water with probiotics are very impressive. However, facts are missing with regard to:

- the application rate of probiotics per pond treatment
- the number of treatments per culture period
- the total biomass produced per ha
- the statistical significance of the improved FCR of 6.3%
- the return of investment on applied probiotics

In summary, the economical value of all kinds of feed additives, not only of probiotics, can only be estimated if comprehensive and complete information is available.

Dear Editor,

We would like to make the following comments on the letter by Dr. Hertrampf.

It is obvious to both aquaculturists and producers of feed additives or water conditioners that the economical value of an innovative product can only be estimated if adequate information is available. This is part of the R&D development of any product. Our paper was written as a brief discussion paper, not as a detailed scientific paper, as it would not be appropriate for this magazine. So, it is not possible to include all the information relating to such complex product development! Nevertheless, some of the scientific data to back up our statements were published in other magazines and journals, and some were presented at scientific conferences and farmers workshops, and others will be published in the future.

For further information on experimental design, performance or return on investment, we refer Dr. Hertrampf to the references given in our article and to the following:

- Decamp *et al.*, 2005. Use of *Bacillus* probiotics as feed additives. International Aquafeed Sept/Oct 2005. pages 10-12.
- Decamp & Moriarty. 2005. Probiotics as alternative to antimicrobials: limitations and potential. Proceedings of the Workshop on Antibiotic Resistance in Asian Aquaculture Environment, Chiang Mai, Thailand. February 2005. Track 3.1 at www.medinfo.dist.unige.it/asiaresist/workshop.htm

His comment on “antibacterial activities” of bacteria suggests he might not be fully informed of some important matters in microbial ecology:

- Successful microorganisms adapt to an environment either by outgrowing competitors (faster growth rate), by using nutrients more efficiently than others, and by producing compounds that inhibit competitors. Such compounds include the chemicals we know as antibiotics. Many groups of microorganisms (if not all) produce chemicals that are antagonistic to others. Not only bacteria, but also fungi, yeasts and algae produce antibiotics. Of the more than 8,000 different known antibiotics, only a few are produced and used commercially. When antibiotics are used therapeutically or prophylactically in humans or animals the concentrations applied are far greater than those of any antibiotics that are produced by the natural or probiotic bacteria in the intestinal tract or ponds or hatchery tanks. Any antimicrobial compound produced naturally works on a small scale close to the microbe that makes it.
- The ability of our *Bacillus* strains to control *Vibrio* is due to several factors, not just the possible production of antimicrobial compounds. These factors include their ability to grow in the conditions prevailing in shrimp ponds and compete with potential pathogens for nutrients.
- The benefit of our *Bacillus* strains is not restricted to their direct or indirect effect on pathogens, but also their ability to occupy the environment and produce enzymes to degrade waste products (thus improving the water quality).

Yours sincerely,

Dr. Olivier Decamp and Prof. David Moriarty

From S. Chandrasekar, India

I was surprised to read the article in the Nov/Dec'05 issue on 'Improving water quality with clinoptilolites'. Most of us are aware that the normal zeolites (commercially available) are not effective in removing ammonia from high saline and brackish water shrimp ponds. This particular article directly contradicts the findings made by Dr. Claude E. Boyd in his article on "Zeolite-Ineffective as pond treatment" published in Global Aquaculture Advocate, December 2003 issue. Even in our own experience, we have seen no impact with zeolites in shrimp culture ponds with salinities more than 20 ppt. I have also discussed this with some of the leading aquaculture professionals in India who share the same opinion. In general the products that work well in fresh water need not perform well in salt water.

Dear Editor,

It is pleasing to note that the article on "Improving water quality with clinoptilolites" has found much interest with heated debate on the internet. There was more criticism than appreciation. Most of the debaters refer to the article by Prof. Boyd which appeared in the Global Aquaculture Advocate. He concluded that zeolite has little value as a pond treatment. However, his considerations are based merely on theoretical nature, supported only by a small laboratory test. In addition, the kind of zeolite which has been used for the laboratory test has not been named.

However, not all zeolites are the same. In fact, this is a large group of chiefly hydrous aluminum silicate minerals belonging to "clays". Each zeolite, therefore, has different physical properties, depending on the origin. Clinoptilolites are processed and are one of the largest group of zeolites.

It is scientifically well known that under identical environmental conditions (feed, feeding frequency, water management, etc.) differences between two groups have to be referred to the kind of treatment of one of the two groups. This is the case in the published article. The only difference between both groups was the treatment of the pond water with clinoptilolite in one group. The differences of this pond trial in water quality as well as performances of the animals are statistically significant. The conclusion, therefore, is that this has been achieved by the treatment of the pond water with clinoptilolite. In this context it is unimportant that physical-wise zeolites are not useful in saltwater. The facts and figures from this study give a different picture.

Yours sincerely,

Dr. Joachim W. Hertrampf, Kuala Lumpur, Malaysia

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The Second International Symposium on Cage Aquaculture in Asia (CAA2)

This is second in the series for the cage culture industry. The main organisers are the Asian Fisheries Society (AFS) together with the Zhejiang University (ZJU), the China Society of Fisheries, the Department of Science and Technology and the Bureau of Ocean and Fisheries, Zhejiang Province, China. The symposium is scheduled from 3 to 8 July, 2006 in the new Zijiangang Campus, ZJU, Hangzhou, China.

In conjunction with the symposium, there will be an international trade exhibition to show case the latest cage culture innovations, equipment, net cages, feed and feeding technologies to the participants of CAA2 and the key Chinese stakeholders interested in developing

modern cage aquaculture. There will also be post symposium tours such as a 2 day tour to off-shore cage culture in Zhujiajian and a day tour to fisheries/aquaculture in Lake Taihu, Zhejiang Institute of Freshwater Fisheries and pearl culture sites.

Producer session in AQUA2006

This is part of the program for the annual World Aquaculture meeting to be held at the Fortezza da Basso Convention Centre in Firenze (Florence), Italy from May 9-13, 2006.

The 'Producer Session' on May 12th will focus on quality for the consumer. This will provide an overview of all aspects of quality provision for the consumer, as well as insights into consumer perception of farmed fish and shellfish. Taking place just after the 2006 European Seafood Exhibition (ESE) in Brussels, it will allow participants at that event, after a short 90 minute trip to Florence, Italy, to benefit from both the ESE and AQUA2006.

More than 3,000 participants are expected for the conference and trade show. To date more than 50 exhibitors from 25 countries will be promoting their products and services. "The combination of these producer oriented events within the exhibition area and linked to such a well-attended meeting will surely be a win-win for aquaculture producers and trade exhibitors alike", said Mario Stael, European exhibition sales manager for AQUA2006.

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