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AQUA Culture AsiaPacific

Focus on Food Safety in Asian Aquaculture

Impact of EU Food Safety Rules

Traceability in Thailand

Industry Review on Catfish and Tilapia in Vietnam

Sustainable Aquaculture in Guangdong Province

Marketing Quality White Shrimp to Europe

Peas in Tilapia Feed Formulations

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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@aquaasiapac.com

Letters may be edited prior to publication

From the editor

Costs, Consequences and Opportunities

Crude oil prices have escalated beyond USD 70 per barrel. The aquaculture industry has been affected. In Vietnam, shrimp farmers say that the increase in the cost of production is small but the impact of high oil prices is a 5% increase in transport costs for harvested shrimp. Indonesian shrimp farmers cited an average 16% increase in the cost of production.

However, the impact is more significant in capture fisheries. In a news report, the President of the Thai Shrimp Association, Somsak Paneetathayasai said that the total shrimp output for this year may not be as high as anticipated as boats have refused to go out fishing because they cannot manage the rising costs of fuel. This fall in supply is creating opportunities for aquaculture to fill the gaps and it should be used well. The opportunities have spread to support industries. In Indonesia, grouper farmers who depend on trash fish, have indicated that fishing has declined and trash fish is less available. Feed companies should take the opportunity to move towards feed production for the grouper and other marine species.

However, amidst these opportunities, there are threats and the crucial task for the industry is how to mitigate them. Aquaculture has an image problem. Shrimp farming is facing accusations of environmental destruction and that marine fish culture is not sustainable. This is also reflected in an article by Chen Wen (see page 24) on the aquaculture industry in Guangdong and the measures to safeguard its future.

Aquaculture is also making gains from declines in poultry consumption because of fears with Avian flu. At the same time, BirdLife International, a UK based partnership of bird-protection groups from more than 100 nations, made an attack on the integrated livestock-fish farming method, common in Asia and producing tilapia and carp. It said that this method is more likely to spread avian flu than flocks of wild, migratory birds. Aquaculture representatives counter that there is no risk of that happening. On suggestions that the virus can remain in the water, George Chamberlain, president of the Global Aquaculture Alliance said there is no record of viruses from warm-blooded animals being found in fish, shrimp or other cold-blooded aquatic species.

Asian aquaculture producers also constantly face non tariff barriers because of the quality of products and this is not without reason. To emphasise the seriousness of this, the EU's Rapid Alert System has recorded 9 cases of contaminations during the 17 weeks of 2006. These are of chloramphenicol and nitrofuran in vannamei and black tiger shrimp, nitrofuran in freshwater prawn, leucomalachite green in frozen anguilla eels and in catfish and residues above MRL of ciprofloxacin and enrofloxacin in frozen catfish. In 2004, the total was 8 notifications on malachite green in catfish and tilapia and 30 on nitrofuran in crustaceans and its products from South East Asian countries. However, this was a significant decrease from that in 2003 (RASFF, Annual report for 2004).

It is obvious that Asian producers must work harder not to use antibiotics as growth promoters or for therapeutic purposes. This requires the concerted effort of all parties. In Vietnam, authorities have announced measures to eradicate the use of these chemicals and the industry has started to self regulate. The issue of food safety and traceability has been mentioned often enough. It has been the focus of meetings in Asia such as the DSM conference in November 2005 and Aquafeeds in Asia in March 2006. In this issue, we have a focus on this too.

All of these are precursors toward a Responsible and Sustainable Aquaculture (RSA). The bottom line is that for Asian producers to be a major aquatic food supplier, consumers should not have any doubt on the safety and health aspects of the product.

Zuridah Merican

What it should have been

We thank Dr. Toshiaki Itami, Professor, Miyazaki University, Japan who pointed out an error in the use of the word 'proprionic' acid as an anti-mold chemical in the article "Some FAQs on myxotoxins in aquafeeds", (pp28-30). We stand corrected and it should be 'propionic acid'.

In another article on 'Better sales of shrimp feeds and expansion to fish feeds' (p14), the caption for production in India, 180,000 mt was missing. In the table 2 (p32) in the article on "Nucleotides: the performance promoter', the salinity in the treatment column should be 38 ppt. We apologise for these errors.

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SHRIMP HEALTH MANAGEMENT TRAINING WORKSHOP

July 24-29, 2006, Bangkok, Thailand

Black and white in Malaysia

Malaysia's farmed shrimp industry has always positioned itself as a major supplier of quality and large sized black tiger shrimp for niche markets; that is, until 2002 when production declined as farmers faced diseases problems. Thus, in May, 2005, the DOF agreed to industry's demands to remove the ban on the culture of *Penaeus vannamei*. Since then the industry has moved quickly with the culture of this species.

However, the ban still remains for producers in Sabah where besides the black tiger shrimp, the culture of only *P.merguensis* and *P. indicus* are allowed. In Sabah production of the black tiger shrimp declined to 3,000 tonnes in 2005, mainly due to diseases. In Sarawak, the lifting of the ban is under consideration.

In West Malaysia, industry has estimated that in 2006, 60 to 70% of production will comprise *P. vannamei*, up from the 1:1 ratio calculated in 2005. A projection for production of shrimp in the country shows an increase to 40,000 tonnes as compared to 34,200 tonnes in 2005 and 30,800 tonnes in 2004.

Work on the domestication of the black tiger began in 2004. Specific pathogen free (SPF) PL is being produced but volume is small. These are being used in the integrated farm itself and also sold to some farms in the area. This farm and others in this southern eastern part of the Peninsula are culturing 100% black tiger shrimp, according to an industry source. In the case of the other farms, the reasons for culturing this shrimp are that they get better value for the shrimp, have contracts with processing plants, are willing to pay the relatively high price for SPF monodon postlarvae and have the facilities to test for PL quality. With producers in Sabah and Sarawak, they remain the country's suppliers for the high end niche markets.

After the ban, the Department of Fisheries licensed two companies to import of SPF broodstock from the US. White shrimp postlarvae from these certified local hatcheries are available but insufficient to meet demands. There are also illegal imports of postlarvae which are much cheaper. In Sitiawan District in the northern part of the Peninsula, almost all farms have switched to the white shrimp. For many years, these farmers with ponds older than 7 years have been grappling with White spot syndrome virus (WSSV) infections. Long before the ban was lifted, farmers in this area were already culturing the white shrimp, albeit illegally and using postlarvae from neigbouring countries. In other parts of the country, some of the larger farms in the country are farming *vannamei* and *monodon* shrimp at a ratio of 50:50 to 70:30.

Tan Kim Tee at his new farm

According to industry sources, the average production with the *vannamei* shrimp is 10 tonnes/ha of 60-70 pcs/kg. Stocking density ranges from 80 to 100 PL/m^2. Postlarvae (PL8-10) costs MYR 0.014. Farmers now practice 2 partial harvests or one total harvest. The current ex farm price range from MYR10-11.50/kg (USD 2.7-3.1) and the costs of production was quoted at MYR 8-9/ kg (USD 2.16-2.43) at an average survival rate of 70%. Generally formulated feeds for the vannamei shrimp are used.

A new farm for white shrimp

In Sanglang, Pontian, Johor, EMT Marine Farms Sdn. Bhd has recently constructed a new farm designed specifically for the culture of the white shrimp *P. vannamei*. The farm has 13 ponds of 0.8ha to 1ha and depths of 1.5m. There is also a 2.4 ha reservoir pond.

The target size after 100-140 days of culture will be about 15g-20g which can be sold at around MYR11.50-15.00/kg (USD 3.1-4). Tan Kim Tee, Managing Director, said that this first cycle with the *vannamei* shrimp at this new farm is a challenge.

"There are differences between the two species. The *vannamei* postlarvae at PL10 is much stronger than *monodon* PL15. Culture techniques are quite similar, but I still need to monitor closely the culture and learn. One advantage is that in vannamei culture, the pond bottom remains relatively clean".

Tan has been in the industry since the early 1980s. He saw how the industry developed with the culture of the black tiger shrimp with Taiwanese technology. At his farm and hatchery in Sungai Chupak, Pasir Gudang, he produces *P. monodon* and *P. vannamei* postlarvae as well as marine fish fingerlings such as the red snapper, golden snapper, tiger grouper, seabass, big eyed trevally, golden trevally and threadfin. His experiences were gained in the culture of the black tiger shrimp. In one cycle of *P. vannamei* in the ponds in Pasir Gudang, he achieved a production of 15 tonnes/ha. However, the stocking density was much higher than the current one at this new farm.

Tan said that with such low shrimp prices, integration is the best way to increase profit margins, although this is not in his immediate plans. At the moment, he has to look at other means to reduce costs.

"My production costs have increased 15% from feed and energy costs. To increase production, we will need to increase stocking density. In turn, this will require more aeration. We are seeking some rebates with our electricity costs as it will help us reduce costs".

Besides ponds, areas for feed storage and staff housing, the company has some residential training facilities, currently under construction. When completed, Tan will conduct apprenticeships programs for university students and courses on shrimp culture technology for others.

Thailand goes to WTO

On warnings that exports could fall by one third in the first half of 2006, Thai shrimp farmers have asked their government to press ahead with plans to file a complaint with the World Trade Organisation (WTO) over US antidumping tariffs on shrimp exports.

On March 16, the Commerce Ministry instructed the Thai mission in Geneva to file the complaint. The Thai delegation has already hired a law firm which is now gathering information from Thai exporters to strengthen their case. In the complaint, Thailand is charging that the US is collecting both antidumping duties and demanding bond payments as export guarantees, known as a C-Bond, on shrimp from Thailand.

The US imposes an average 5.95% duty on Thai shrimp. To guarantee payment, it also requires exporters to pay for a continuous bond. According to figures from the Thai Frozen Food Association, to date, Thai exporters have posted USD 50 million worth of such bonds and the same amount is expected this year. This is a cost burden for Thai exporters. Under this, the US will only return the amount of the bond three years after the transaction and the Commerce Ministry is asking the Export-Import Bank of Thailand to find ways to help exporters.

Somsak Paneethatyasai, Thai Shrimp Association's President, praised the government's decision in lodging the complaint to WTO. Poj Aramwattananont, president of the Thai Frozen Food Association, agreed, but he also wondered whether the US would revoke the bond requirement if the WTO ruled in favour of Thailand because it was put up by the private sector, not the government.

Thailand is the world's biggest shrimp exporter with 280,000 tonnes worth Baht 70 billion (USD 1.9 billion) in 2005. About 150,000 tonnes of this was shipped to the US, its largest shrimp market. In 2004, the volume was 130,000 tonnes. During January and February 2006, the total export was 38,762 tonnes of shrimp. This was a 17% increase in volume compared with the same period in 2005. Of this, 20,757 tonnes went to the US, which was a 25% increase as compared with the same period in 2005. The Commerce Ministry has estimated that the country should be able to export up to 350,000 tonnes of shrimp in 2006 versus 280,000 tonnes in 2005.

Brief news

Thai Fish Expo 2006

In 2006, Thailand's Department of Fisheries will celebrate its 80th anniversary. In collaboration with the private sector, it will organise the 'Thai Fish Expo 2006'. The aim of this is to disseminate its vision to the worlds' businessmen and industrialists in fisheries technology, aquaculture and fish processing. It will be held from 24-27 June, 2006 in Bangkok.

In addition to the exposition, there will be technical seminars in the various areas and the introduction of the Q mark, which is the symbol of international quality for Thai fisheries products. The exposition will feature exhibits from government, international organisations and industry. It will also cover ornamental fish and plants. (More information: www.fisheries.go.th/EXPO2006) (Also see related article on page 23)

Import of KHV vaccine

Indonesia is considering importing a vaccine against Koi Herpes Virus (KHV) from Israel through a third country, according to an Indonesian fishery official in Antara News. KHV was detected for the first time in 2003 when it infected carps in West Java. This led to an 80% decline in the country's carp production in West Java, the country's main fresh water fish farming region. It was also reported that KHV had recently infected carps in the Cirata dam in January and inflicted USD 400,000 in losses.

Mozambique to give tax incentives for shrimp farming

In 2005, three shrimp farms in Mozambique produced 1,200 tonnes of whole shrimp (*Penaeus monodon* and *P. vannamei*) from about 10,000 ha of ponds. Two new projects were recently approved, both smaller than the existing projects. The Aquaculture Department, Fisheries Ministry said that new tax incentives for shrimp farming may be announced before September 2006. This may also include reducing fuel taxes and import duties on shrimp feeds.

In related news, it was reported that the Chinese group Weihai International Economic and Technical Cooperation (WIETC) will sell all or part of its shrimp farming operations covering 174 ha of ponds with 100 ha of reservoirs and other facilities. The Export-Import Bank of China, invested about USD 12 million in the farm and currently it produces about 450 tonnes of tiger shrimp/year. (More information: www.shrimpnews.com)

Korean seafood consumption creates opportunities

The high consumption of seafood in Korea makes it an emerging market for Norwegian seafood exporters according to a review and analysis of the Korean aquaculture industry made by Innovation Norway Korea in 2005. The per capita consumption of 49 kg is possibly the highest in the world. In 2004, total production from aquaculture totalled 933,000 tonnes. Total seafood imports in 2005 was 1.1 million tonnes valued at USD 2 billion, mainly from China, Russia, Japan, USA, Vietnam and Thailand. Norway, the 9th largest exporter of fishery products, exported 14,100 tonnes in 2005.

Marine finfish farming is growing with increasing demand. The research sector is looking at diversification to more high value marine fish species. Currently, the flounder, black rockfish, seabream, sea bass and yellow tail are the most important species farmed. The report listed opportunities as offshore cage, automated systems, processing systems & equipment, traceability systems, grow-out feeds, high value species and aquaculture consulting services. (source: www.eksportaktuelt.no)

Indonesia to reduce imports of shrimp broodstock

The Indonesian government wants to reduce its dependence on shrimp brood stock imports. Antara News reported that Hatchery Director of the Fish Breeding Directorate General, Agus Budhiman said that many breeding stock centres are being developed in South Sulawesi and in Situbondo and Jepara, Java. In 2004, Indonesia imported 35,000 pieces of *vannamei* shrimp broodstock. The annual requirement is 108,000 pieces. There are 17 broodstock importers.

New area for shrimp culture in Brunei

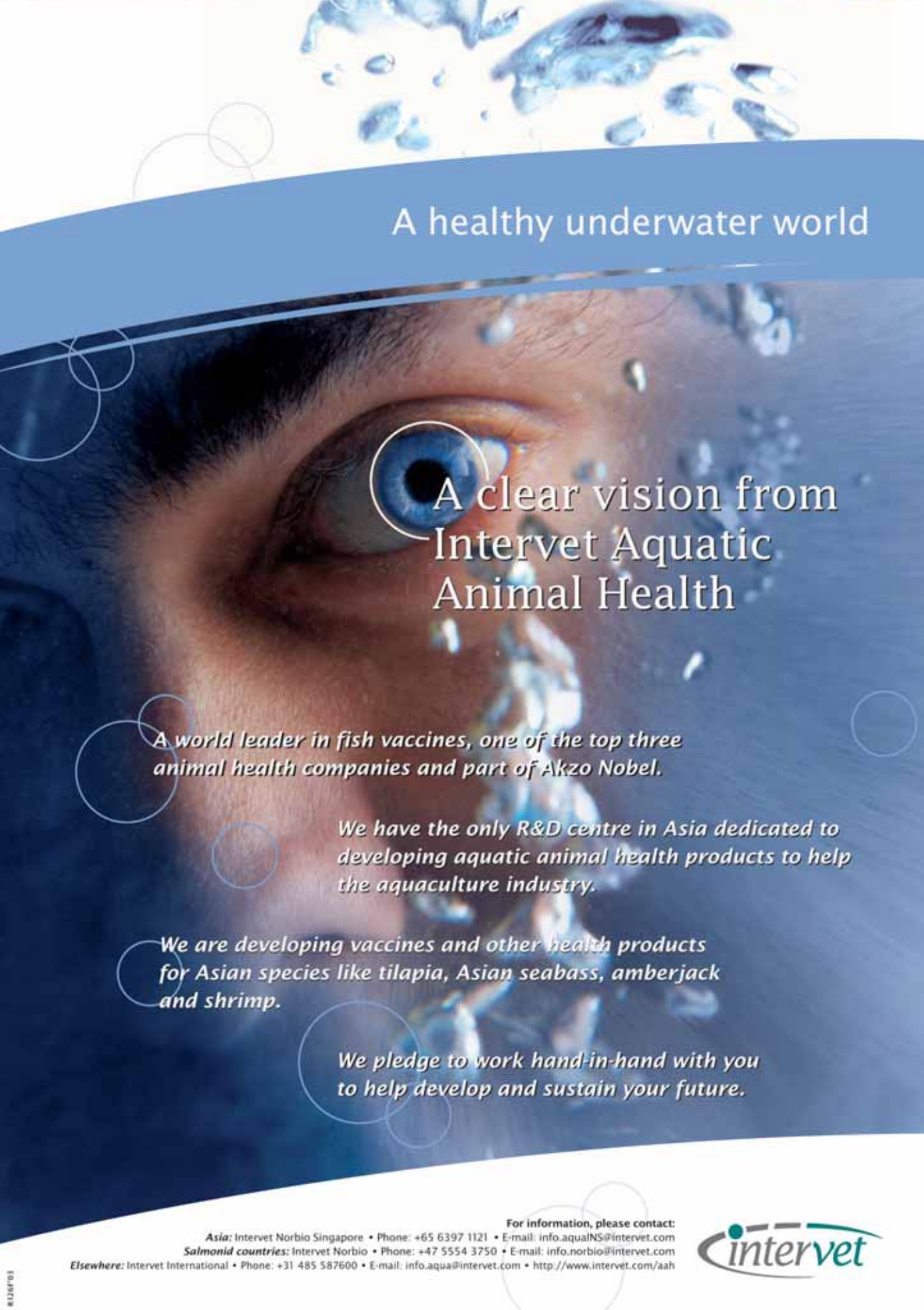
With a growing demand for shrimp in the global market, the Fisheries Department will increase efforts to develop shrimp farming in Brunei, reported the Borneo Bulletin. Shrimp farming was introduced in 1994. Thirteen entrepreneurs are already involved in the culture of *Penaeus stylirostris* and *P. monodon* in 230 ha. In 2005, shrimp production was 394 tonnes with a total value of about USD 1.8 million, which were sold in the local market as well as exported to the USA, Taiwan, Japan, Malaysia and Singapore. The Department said that they have identified a new land area of 459 ha to be developed into shrimp farms as part of the ongoing effort to upgrade the industry. Open tenders have been issued and closed in April.

Resistance against iridovirus with fermented seaweed

Researchers at Japan's Fisheries Research Agency (FRA), in collaboration with Nippon Suisan Kaisha (Nissui) has added seaweed *ecklonia* fermented with lactic acid bacteria in feed and fed this to seabream infected with iridovirus. They have confirmed that survival of the red seabream group fed with the fermented seaweed was significantly better than the control group. The scientists have concluded that the mixed meal gave resistance against iridovirus. Details of this research were presented at the Meeting of the Japanese Society for Fisheries Science in March. Following this, FRA will experiment with marine silo, a device for fermenting seaweed with three partners. The aim is to develop a key technology for the effective utilisation of unused seaweed such as sea lettuce and apply them to feeds and fertilisers. (Source: JCN Network)

Shrimp genetic center in Venezuela

The Government has set aside USD 2 million for the creation of the Shrimp Genetic Reference Centre by mid 2007, according to the Panorama Digital. This idea was promoted by the Western Association of Shrimp Producers (ASOPROCO), after the crisis faced by the farmed shrimp industry in 2005 due to the presence of the Taura syndrome virus in their farms. The aim of the centre is to develop a species that is completely resistant to the virus, with genetic material ensured for some 30 years, said its president Fernando Villamizar. After detecting the presence of the Taura virus in the country in 2005, Venezuelan producers were forced to acquire broodstock that was pathogen-free and resistant to this viral agent from the United States. The Centre will use 6ha for the installation of 1,000-square-meter pools using French technology. (Source: fis.com)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First with grouper feeds in Vietnam

After years of conducting R&D on the use of extruded pelleted feed for the culture of the Malabar grouper (*Epinephelus malabaricus*) and Brown-marbled grouper (*E. fuscoguttatus*) in ponds and cage culture, Uni President Vietnam will soon begin marketing the feeds in Vietnam. The company expects to obtain the license to produce the feeds locally in May 2006.

Mr Jeff Jie-Cheng Chuang, Vice President, said, "Grouper culture in Vietnam is developing fast. It is a high value fish and in Vietnam, prices have remained high. Grouper is not only consumed in local markets but also exported to Hong Kong and China. As it has a high economic value, farmers culture grouper especially when there are high risks in culturing the marine shrimp. Many shrimp ponds are being used to culture marine fish".

Currently, the main feed in grouper culture is trash fish but the supply of good quality trash fish is decreasing fast in Vietnam. Prices are also increasing and the quality is unstable. The usage of trash fish is not sustainable. With trash fish as feeds, survival is low. More chemicals for disease treatment are used for longer periods. Thus, there is a need for formulated feeds.

Table 1: The proximate composition of pelleted feed for the grouper

Pond no	No.1-3	No. 4-5	No. 6-7
Moisture (%) max	10	10	10
Crude protein (%) min	47	46	44
Crude lipid (%) min	10	9	9
Ash (%) max	15	14	14
Fibre (%) max	1	1	1

The company began feed trials on the efficacy of its feed formulation under culture conditions in Vietnam in March 2005. The extruded sinking feeds with 44 to 47% crude protein (Table 1) used in the trials were produced in Vietnam. Trials were carried out in ponds in the Binh Dai District in the Mekong Delta. The ponds were separated into 1,950 m^2 sections with netting material. In each section, 1,300 fingerlings were stocked. Fish were initially fed at 8-10% body weight/day for 1 month. The feeding rate was then decreased from 6% to 2% as the fish grew from 15g to 800g. The marketable size of fish is over 600 g and this was achieved in about 9-10 months.

In these trials, growth performance of fish fed with the artificial diets was compared against fish fed with trash fish (Table 1). There is no significant difference in growth rate of fish fed the pelleted feed and trash fish. The feed conversion ratio of trash fish was higher than that of pelleted feed. On the other hand, the quality and quantity of trash fish was not stable. This had an effect on pond pollution. Fish fed with trash fish was easily infected by bacterial or virus. For example, some red spots were found on fish skin. The important criteria was that the pelleted feed was cheaper than trash feed in terms of total cost of feeding (table 3)

Grouper trial ponds were also carried out in the Cadet - Agriculture Extention Centre in Binh Dai , Ben Tre province. Here fish were stocked in 4 sections, each of 2000m^2 and the stocking rate of 1500 pieces/section)

Table 2: The growth of fish by using pelleted feed and trash fish

	Pelleted feed			Trash fish
Pond no	1	2	3	4
Pond size (m^2)	1,950	1,950	1,950	1,950
Numbers of fingerlings	1,304	1,437	1,304	1,503
Fingeling size (g)	27	22	19	16
Feed consumption (kg)	956.2	895.4	818.8	3,205
Harvest yields (kg)	498.4	410.6	360.5	434
Size of individual fish at harvest (g)	530	470	510	610
FCR	1.91	2.18	2.27	7.38
Survival rate (%)	72.0	60.7	54.1	54.5
Average FCR	2.12			7.38
Average Survival rate (%)	62.2			54.5

Table 3: The feeding cost/kg of fish with pelleted feed compared with trash fish

	Pelleted feed			Trash fish
FCR	1.91	2.18	2.27	7.38
Price of feed or trash fish	USD 1/kg			USD 0.35/kg
Cost(US$/kg)	1.91	2.18	2.27	2.58

According Lin Chen Lung, Director of Aquatic Feed Division, Uni-President VN, fingerlings of 3 cm were imported from Taiwan for these trials. Local supply of the fingerlings will soon be possible when a Taiwanese company starts production from its hatchery in the central region of Vietnam.

Feeding trays are used to monitor feed rate after each feeding time

A smiling researcher with the grouper after a successful harvest

Farmers netting grouper for monthly sampling

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Project announcement

EXPRESSION OF INTEREST IN TILAPIA FARMING

The Rajiv Gandhi Centre for Aquaculture (RGCA), an autonomous society under the Marine Products Export Development Authority, Ministry of Commerce and Industry, Government of India desires to take up the aquaculture of *Oreochromis niloticus* as well as a best available strain of Red Tilapia on an experimental basis in a totally bio-secure environment using recirculation systems.

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Competent firms with experience in hatchery production and grow out of these desired varieties of tilapia in a bio-secure environment and ready to provide package of technology on turn key basis may send their expression of interest to the following address with all relevant details on their experience and expertise on or before **20 June 2006**.

The RGCA, after short-listing the firms will call for their financial bids later.

Challenges ahead for aquaculture in India

A debate on the culture of *P. vannamei* in India to new culture species at AQUA INDIA 2006

Aqua India 2006 was a two-day annual gathering for the Society of Aquaculture Professionals and was held from March 3 to 4 in Chennai. Following the theme "Challenges Ahead", fifteen invited speakers presented data and analysis pertaining to the current status of the sector and critical questions on its future. One hundred and sixty participants attended the meeting.

In his welcome address, S Santhanakrishnan, the outgoing President of the Society outlined the challenges facing the industry. A major challenge was to objectively evaluate whether the black tiger shrimp has a sustainable future in India's shrimp culture industry. In his assessment of the tiger shrimp as the culture species of India, he said that the key is to increase the production of large size shrimp. There is also a need for India to boost its image as a producer of quality shrimp by implementing best aquaculture practices and food safety programs. On the introduction of *P. vannamei* culture in India, Dr Matthew Briggs from Epicore BioNetworks said that based on lessons learnt by other Asian countries it is possible to manage the introduction of this shrimp by taking adequate safeguards (see box)

Other presentations were on aspects of feed and culture management in shrimp farming. Dr Pornlerd Chanratchakool, Novozymes spoke on the prevailing practices of shrimp farming in South East Asia and why soil and water quality management is vital in sustaining the future of shrimp farming worldwide. He emphasized the importance of proper soil and water management in shrimp farming and recommended that feed use in the ponds be an indicator of pond bottom quality. In poorly managed ponds, feed intake stagnates and becomes highly unstable after 70-80 days of culture whereas in well-managed ponds, feed intake keeps steadily increasing until harvest. Relating stocking density to pond bottom conditions, he said that it is advisable to limit density to less than 20/m^2 to produce large-size tiger shrimp.

Dr Victor Suresh, Bentoli, discussed feed cost reduction opportunities in shrimp farming. It is important as feed, processing and distribution costs are 65, 10 and 25% respectively of the total production cost. Since ingredients contribute the bulk of feed costs, efforts should be made to appraise the current feed formulation for shrimp. Shrimp feeds produced in Asia still have the vestiges of tiger shrimp feeds produced in the 1980's by the Taiwanese even though there has been a shift to vannamei shrimp and the nutrient requirements of both tiger and vannamei shrimp are now better understood.

Three speakers, D. Ramraj, Udaya Ram Jothy, and S. Chandrasekar, reviewed the hatchery production, shrimp farm production and freshwater prawn production sectors, respectively. In a special session on alternative species and systems for saltwater culture, presentations were on cage culture of finfish (Dr P. Nammalvar Rajan), seabass farming (Dr M. Kailasam), crab farming technology (Dr C.P. Balasubramaniam) and lobster and other marine aquatic species Australia and South East Asia (Dr Ravi Fotedar).

Speakers agreed that the sector had stagnated in 2005 due to a number of production and market related problems. But, they also pointed out the solutions available to overcome current problems and how to bring the shrimp farming sector back on a path of sustained growth and expansion. P.K. Ramachandran, The Waterbase, told the gathering that indications from the world shrimp supply situation are that procurement prices will fall for farmed shrimp and that Indian farmers should aim to produce large shrimp that can fetch higher prices. India is only losing market share in the world market because of trade barriers but the limited ability to produce value added products.

Presentations in CD-rom format are available for purchase. Contact SAP's coordinator Ms Pramila Rajan at Tel: +91-44-4310 8745 or +91 98842 03445; Email: prami_rajan@yahoo.com.in

Should *P. vannamei* shrimp culture be allowed in India?

The role of the black tiger shrimp as a culture species.

On this, **S Santhanakrishnan**, Marine Technologies said that worldwide the culture of this species will continue to depend on captive, wild broodstock until perhaps 2010 as most domestication programs have not made any significant progress. On production technology, Mr Santhanakrishnan said that the key would be to increase production efficiency. The lack of progress in understanding the cause and lowering the incidence of specific shrimp disease problems such as like loose shell is a cause for great concern as it reduces the competitiveness of Indian shrimp farmers.

Tiger shrimp farmers should aim to produce medium and large size shrimps. The country also needs to boost its image as a producer of quality shrimp by implementing best aquaculture practices and food safety programs. Clearly, he said there is lack of vision, either short-term or long-term, for the shrimp farming sector despite the fact that the country has a vast pool of well-trained aquaculture and seafood professionals.

P. vannamei as a culture species

According to **Dr Matthew Briggs,** Epicore BioNetworks, the advantages of this species are that they are cheaper to produce and amenable to more intensive culture. However, competitiveness in production could also be a problem as intensive culture is energy-intensive.

The introduction of vannamei shrimp presents the risks of introducing unknown disease agents but then this can be managed by allowing only certified pathogen-free stocks into the country for a period of time and implementing well-established quarantine procedures for the importation of exotic species. This is a high cost to the government and/or the shrimp farming sector in introducing vannamei in a proper manner, but a complete ban deprives farmers of advantages of the species. It would also be difficult and costly to implement a complete ban if there is an economic benefit to culturing vannamei shrimp.

Indian shrimp production and changing market demands

In his review on the shrimp production in India in 2005, **Udaya Ram Jothy**, AA Biotech said that farmed shrimp production fell from 136,393 tonnes in 2004 to 112,042 tonnes in 2005. Production declined in all states except Tamil Nadu, Maharashtra and Gujarat. Production rose from 1,500 tonnes in 2004 to 3,500 tonnes in Gujarat in 2005. Most of the decline in national production was explained by the 7% decline in farming area in 2005.

Average annual farm yield also declined from 921 to 892 kg/ha. Feed sales in 2005 were estimated to be 137,870 tonnes. Sales of health care products also declined. Farm-gate prices of 30-count shrimp (av. weight, 33g) varied between INR 220 and 260/kg. This is about INR 50 below the price in 2004.

Returns on investment in shrimp farming fell from 70% in 2004 to 40% in 2005. However, the sector suffered from variations in the results of post-larval quality testing, recurrence of WSSV and loose shell problems, slower purchase of shrimp, low prices and delayed payments for purchased shrimp.

The positive trends in the farming sector were: (a) increased awareness among farmers to form cooperative organizations such as aqua clubs, (b) selecting only tested, quality postlarvae from hatcheries; (c) stocking only when conditions are favourable for farming; and (d) reducing the use of chemicals in production systems.

PK Ramachandran, the Waterbase Limited, presented the global shrimp demand and supply situation. He pointed out that the world supply of farmed shrimp has nearly doubled to about 1.9 million tonnes in the last five years despite the various challenges faced by the farming sector. The vigorous growth in shrimp production is due to the introduction of *P. vannamei*, into Asia. India, as one of the few countries in Asia that decided against commercial-scale introduction of the species, remained stagnant in shrimp production for nearly five years. However, India, has become one of the few producers of large shrimp (> 25 g in size).

Due to the changing market conditions in Japan, India's portion of the market has steadily declined. The Japanese market also favours value-added forms of shrimp, rather than block-frozen raw shrimp, a product form that was popular years ago. The shrimp market in the US is a vigorously growing one. Yet, Indian exports to the US market have been affected due to the antidumping duty and the associated customs bond requirements. The growing demand for regulatory compliances and increasing sophistication in market requirements by all major buyers, present challenges to the Indian seafood exporters. As prices of shrimp have fallen over the past year and will continue to fall, P.K Ramachandran called on exporters to identify and target a niche for Indian products in world markets, preferably the large shrimp produced in India. Farmers on the other hand were asked to understand to market conditions, adopt best farming practices and become more efficient in their production.

'Optimize for Profit' aquafeed workshop

A look at formulations and ingredients

This one-day workshop was held in conjunction with Victam Asia 2006 on March 8 in Bangkok. The organizers, aquafeed.com gathered prominent players in the industry to assist participants in their aqua feed production operations. Sessions dealt with ingredients, feed formulation and processing technology. Some 150 participants, mainly from the Asian region, attended.

In her welcome speech, Dr. Juadee Pongmaneerat, Senior Expert Aquatic Animal Nutrition, Department of Fisheries, Thailand, said the focus the aquaculture in Thailand is the safety of food products throughout the production line. This has enabled the country to keep the lead in marine shrimp production with 340,000 tonnes in 2005 and 330,000 tonnes of shrimp is expected for 2006. The government has established a policy not only to promote research and development but also to control the production quality of all processes from farm to table (see box).

In his presentation, Dan Fegan, Alltech Inc., discussed the 'Nutritional approaches to aquatic animal health and performance improvements: What can we learn from terrestrial nutrition?' The current concept in terrestrial nutrition is nutrigenomics, the use of functional foods with health benefits that goes beyond basic nutrition. Some of these are nucleotides and functional carbohydrates in probiotics and probiotics. He followed by presenting how such strategies can be used in feeds for fish and shrimp.

Peter Coutteau, Inve Aquaculture Nutrition said that reducing the feed cost by using cheaper feed is a strategy. However, cheaper feeds, obtained by eliminating the most expensive ingredients in the formulation, do not always result in improved cost efficiency. He presented some data obtained from farms in Latin America which showed that cheaper feeds may cost more money to the shrimp farmer than what is saved on the feed formula at the feed mill.

Lars Andersen Hamlet Protein A/S said that there are positive and negative aspects of soy protein but its usage can be increased by improving product quality. These improved products offer a reduced CHO content and as a result, increased protein content. With the escalating prices of fish meal in the past year, demand for alternatives will increase everywhere. Soy protein concentrates and enzyme treated products are the most used in feeds today. Most known harmful anti nutrients have been reduced or eliminated in these types of product.

In his presentation on improving nutrient delivery in aqua feeds, **Victor Suresh**, Bentoli said that aquaculture nutritionists and feed formulators recognize that nutrient losses, through leaching in water, occur before and during feed intake by aquatic animals. As much as 15% of crude protein in the diet may be lost from shrimp feeds before the shrimp gets to eat it. He went on to discuss the strategies available to minimize losses such as decreasing feed search and consumption time by using feeding effectors (attractants and stimulants), using appropriate feed size, coating the raw materials or feeds with materials that will reduce the rate of leaching and choosing appropriate feed processing technologies.

In her presentation on handling variability, **Merryl Webster**, Format International said that variability present in the feed manufacturing process arises from a number of sources, from the raw materials used to the manufacturing process itself. This can have a significant effect on the costs of production. To improve on planning and thus realise improvements in quality and profitability, she explained the techniques and tools which are available for the user of formulation software to assess and manage this variability.

More information on this workshop as well as the complete proceedings is available at www.aquafeed.com

Juandee (right) with Dan Fegan (left) and Bunleusak Sorajjakit, Thai Union Feedmill, Thailand

The role of feed industry in food safety

Thailand as a food exporting country and regarded as the World's Kitchen, must inevitably develop and enhance its competitive capability.

Feed and materials must be qualified and safe for consumption. Therefore feed should be manufactured according to established hygiene and quality standards.

The Department of Fisheries supervises the feed for aquatic animals. The quality is inspected from manufacturing factory to farm to ensure that the feed is standard and safe for all consumers. As of this year, there are 64 complete feed manufacturing plants: 31 shrimp feed mills, 15 fish feed mills and 18 mills that produce both fish and shrimp feed. It is a good sign that the numbers of feed mills has increased by 21 from 2002: 8 shrimp feed mills, 8 fish feed mills and 5 shrimp/fish feed mills.

This increase in aquatic feed manufacturing is driven by the Avian flu epidemic, which has raised demand for aquatic animals. In addition, because of drug and chemical residue problems, farmers who culture freshwater shrimp have turned to using more commercial feed instead of farm made feed.

The Department of Fisheries has accredited six aquatic feed mills according to GMP and three aquatic feed mills according to HACCP standards, while six aquatic feed mills are pending in the accreditation process (three factories according to GMP and three factories according to HACCP standards). In the near future, CODEX will establish a Code of Practice for Good Animal Feeding and encourage Thailand to use the same standards.

Meryl Webster

Lars Sangill Andersen

Peter Coutteau

Disease updates at CAA2

The recent advances, potentials, challenges and problems of cage aquaculture in Asia will be discussed at the 2nd International Cage Culture Symposium (CAA2) in Hangzhou, China, to be held from July 3 – 8, 2006.

As a supporting organization to the CAA2, staff from Intervet Norbio Pte. Ltd. in Singapore and Intervet International B.V will play an active role in the symposia where they will share their research, field findings and experience in fish health in Asia and Europe. At Booth 5 in the International Trade Exhibition, held in conjunction with CAA2, Intervet staff will also be available for discussions and questions from industry.

At the symposium, the team will be lead by Dr Zilong Tan, Manager of Technical Services, Intervet Norbio Singapore Pte. Ltd. He will be one of the keynote speakers, presenting "Health management practices for cage aquaculture in Asia – a key component for sustainability" (see box for summary).

Leong Tak Seng

In another presentation based on work conducted with Intervet, fish health expert Dr Leong Tak Seng will discuss the 'Impact of infection with capsalid monogeneans in marine fish cultured in Asia'. Dr Leong will discuss the susceptibility of fish to monogenean infestations as they relate to grow-out stage and water conditions. Newly-stocked juveniles under unfavourable environmental conditions are most vulnerable to infection. *Benedenia lutjani* shows greater host specificity than the other species, mainly causing mortality (up to 70%) in golden snapper. The main symptoms of infected fish are loss of scales around the forehead region, lesions on the body surface and sluggish swimming behaviour close to the water surface.

Neobenedenia girellae infects most cultured marine fish species in China and causes large economic losses. The mortality in amberjack due to *N. girellae* infection can be as high as 50%. In Malaysia, common grouper are affected more severely than are tiger and red grouper. Since 2000, *N. girellae* infection in red snappers has become common, with mortality as high as 60-80%.

The high density of monogenean populations in the cage culture ecosystem is the direct cause of the parasitic disease outbreaks. Improved farming practices and control measures must be used to tackle the problem. Reduction in stocking density, frequent cleaning of cage nets, application of antifouling paint and use of pelleted feed can decrease the incidence of parasitic infection. Furthermore, safe and effective anti-parasitic products, preferably given by the oral route, are needed for the control of monogenean infections in cage-cultured marine fish.

Alistair Brown

Mr. Alistair Brown will be serving on the Expert Panel during CAA2 for an open forum that will involve the business sector, farmers, government officers, scientists, NGOs and other stakeholders, to tackle practical issues related to cage culture. He will also speak on the success achieved in salmon farming with the help of vaccination technology: 'A global success story of cage-based aquaculture – salmon farming and the technology of vaccination, key to sustainability'. The first commercial vaccine was developed for the salmon farming industry in Norway about two decades ago. Over the years, vaccines have had an enormous effect on the Norwegian fish farming industry. In 1985, only 2 kg of salmon were harvested for each smolt (salmon fingerling) transferred to seawater and this was mainly due to losses through diseases. In 2004, it was estimated that, for every fish transferred to sea, 3.8 kg were harvested. Norway has produced 5.6 million tonnes of salmon between 1986 and 2005; without vaccines, this figure would probably only have been about 3.6 million tonnes. The value of these extra 2 million tonnes, based on today's prices, is approximately USD 8 billion.

Two additional presentations will be given by Chinese researchers in collaboration with Intervet. They are:

- Dr. Li Anxing of Sun Yat-sen University on "Disease surveillance in marine fish farmed in Guangdong, China"
- Mrs. Yu Xiaoli of Guangxi Research Institute of Fisheries on "Field trial vaccination of Channel catfish *Ictalurus punctatus* with a live attenuated vaccine against enteric septicemia of catfish in China"

For details on the Symposium, please visit website www.caa2.org

Health management practices for cage aquaculture in Asia – a key component for sustainability

by Zilong Tan, Cedric Komar and William Enright, Intervet Aquatic Animal Health Division

Zilong Tan

The intensification of aquaculture activities in Asia has led to deterioration in environmental and health conditions. Aquaculture is plagued by frequent disease outbreaks caused by viral, bacterial, fungal and parasitic pathogens. The associated mortality and morbidity have caused substantial economic losses.

In Asia, some disease-causing agents have been described but comparative studies between isolates from different geographical locations and fish species are generally not available. The enormous diversity of species, with several dozen marine species being farmed means that more resources are needed to understand the basic epidemiology of diseases in the various species. Epidemiology data are scarce, as are basic data on the immune systems of Asian fish species. This hampers development of effective strategies for disease control. Also, as most farms are small scale, technical support, including disease diagnosis and training, is often lacking at farm level.

Several factors attribute to the spread of diseases. Among them are the increased trade of live aquatic animals and the introduction of new species for farming, without proper quarantine and risk analysis in place. In Asia, most individual fish farms produce several species of fish. Trash fish are widely used as feed. Fry are often wild caught or derived from wild caught broodstock. Legislation and implementation of farming licenses and zoning policies are not in place in most Asian countries. This often results in too many fish and too many farms in a concentrated area, which in turn promotes disease transmission.

At present, many farmers focus more on treatment than prevention. In Asia, with the exception of Japan, few fish vaccines are yet commercially available. The major advantages of prophylactic vaccination over therapeutic treatment are that vaccines provide long-lasting protection and leave no problematic residues in the (seafood) product or environment.

As Asian aquaculture will continue to grow at a fast pace due to both area expansion and production intensification, the prevalence and spread of infectious diseases will unavoidably increase. Accordingly, the effective control of infectious diseases has become more critical. Good health management is the "silver bullet" for disease control. Collectively, this includes the use of healthy fry, quarantine measures, good feeding and husbandry techniques, disease monitoring, sanitation, vaccination, proper control and biosecurity measures. Overall, the emphasis must be on prevention rather than treatment.

Freshwater fish culture in Vietnam for the global white fish market

by Le Thanh Hung and Zuridah Merican

Tra and basa catfish generated USD 232 million of exports in 2004. Next is to develop a market presence with tilapia. Current issues arising from the rapid expansion of catfish farming since 2000 are declining prices, food safety and market barriers.

Vietnam's aquaculture development was recently recognized as one of the fastest in Asia. In freshwater aquaculture, the network of rivers, canals, irrigation systems and reservoirs amount to 1,700,000 ha and offer potential for culture activities. Through a rapid use of these resources, freshwater fish and prawn production was 620,000 tonnes in 2004. This accounted for 56.4% of national aquaculture production of 1.15 million tonnes in 2004 (MOFI, 2004). Freshwater aquaculture will continue to expand to reach a target of 946,000 tonnes by 2010.

Fish in freshwater systems are diverse and include that of the chinese and indian carps, tilapia (*Oreochromis sp*), hybrid catfish (*Clarias spp.*), snakehead (*Channa micropeltes*), red tilapia and gouramy (*Helostoma temminckii*) and Mekong catfish (*Pangasius spp*). All these species are either cultured for local consumption or export markets. The focus is on the culture of species with export potential. Tra and basa catfish generated USD 232 million exports in 2004 and the target for tilapia is USD 160 million by 2010.

Catfish

Vietnam is the world's largest producer of the pangasiid catfish with common species of tra (*P. hypophthalmus*) and basa catfish (*P. bocourti*) and hu catfish (*P. concophilus*). The main producing area is the Mekong River Delta. A rapid expansion of its culture began in 2000 with demand from markets in the US. By 2004, production reached 260,000-300,000 tonnes, mainly from cage culture. Other systems are pond and fence culture. In 2005, the national production of *Pangasius* catfish rose to 350,000-400,000 tonnes (Vietfish, 2006).

Production trends are changing. Cage culture has declined 17% from 2,271units in 2003 to 1,871 units in 2004. In contrast, pond culture increased by 13% in 2004 to nearly 3,000 ha. The stocking density is high at 20-30 pcs/m^2 resulting in yields on 200-300 tonnes/ha in 4-6 months. Fish are harvested at 0.9 to 2.2 kg (Hung et al, 2005).

The reasons for these changes are the advantages with pond culture in terms of production cost, investment and management. An economic evaluation conducted in 2005 on culture in ponds and cages in the Mekong Delta indicated that production/kg costs are 8-12% lower with pond culture as compared to cage culture (Hung, *et al*., 2005).

Black and Red Tilapia for export. Courtesy of Cuulong Fish.

Basa catfish. Pictures, courtesy of Cuulong Fish

Cage Culture of tilapia

Feed constitutes the highest proportion of total production costs in both systems (78 to 90%) and followed by seed costs (4.8 to 9.84%). Generally the average production cost is higher if fish are fed with pellet feeds. Costs of production range from VND 8,000 to VND 11,000/kg for fish fed pellets in pond systems. With on farm feeds, costs are reduced by VND 400 to 1,000 VND/kg. In cage culture, production cost range from VND 8,153 to 11,619/kg with farm feeds. Seed costs are lower in pond culture as smaller fingerlings are used as compared to cage culture. Seed costs are VND 200-600 per piece in pond culture and VND 1,000 to 1,500 per piece for stocking in cages (Hung, *et al*., 2005).

On farm feeds which comprise mainly of trash fish is still widely used in the more traditional and older farms in the Mekong delta, despite the availability of commercial pellets. Its use is driven by the need to reduce costs, particularly with declines in farm prices when demand from processing plants is low. Previously a glut in production brought down prices to as low as VND 9,500-10,200/kg. At present, the lowest price is 13,000 VND/kg. (April, 2006).

However, pellet feed can only be applied if farmers perceive benefits. Nevertheless, pellet feeds are commonly used in pond culture. Most use the combination of farm made feeds and pellets regime. The reason for feeding fish with pellets in the initial months is because of the nutritional benefits of the pellets and perception that young fish cannot feed well on farm made feeds and mortality is lower. In the latter months, the purpose is to obtain quality flesh such as white colouration.

The use of commercially produced pellet feed is being encouraged not only because of its advantages in terms of feed efficiency and environmental management but also in the production of 'clean' fish. Previously, using fresh trash fish which was abundant in the wetlands area of Mekong Delta did not raise any problem. However, resources are now depleted with over fishing. Farmers then use poor quality (7-10 day old) marine trash fish and by products of fish processing factories. This is a cause of concern for the industry which is working towards better hygiene in the production process.

Feeding catfish with farm made feeds

Tilapia

Since 1999, red tilapia is being cultured in cages in the Mekong Delta, sub-urban areas of Ho Chi Minh (HCMC) and other cities to supply live fish for restaurants and city markets. An investigation conducted by Nong Lam University showed that red tilapia production in sub-urban areas of HCMC has increased from 300 tonnes in 2,000 to 4,200 tonnes in 2004. By 2010, the country will produce 100,000 tonnes of tilapia half of which will be exported. The target areas are in the southeast, the Mekong and the Red river deltas. Currently, the annual production is 50,000 tonnes of which 15,000-20,000 tonnes consist of red tilapia.

Farmers culture fingerlings in earthen ponds until the size of 20-50g and then fish are transferred to cages. Commercially formulated feeds are completely used. The protein level in the feed is in the range of 35-40% for fingerlings and 25-26% for grow-out. In cages, the fish is cultured for 4.0-4.5 months to marketable size of 0.5-0.6 kg. The use of farm-made feed for red tilapia is rare (Hung *et al.*, unpublished data). The average production is 50-60 kg/m^3 for a culture cycle. The average farm price is VND 23,000/kg for a 0.5-0.6 kg fish and the lowest reported was 19,000 VND/kg in November 2004. Farm prices for fish cultured in cages are 3,000 to 5,000 VND/kg higher than those in ponds (Hung *et al.*, 2004).

Table 1. Technical parameters for red tilapia cultured in cages

Parameters	Description
Unit size (m^3)	60 – 120
Species cultured	Red tilapia
Feed used	Pellet feed, FCR 2.2 – 2.5
Feeding strategy	2 – 3 times/day, amount of feed directed by feed manufacturers
Fish yield (kg/m^3/year)	100-150

Supporting industry

Seed production

In catfish farming, hatchery produced fingerlings are used. Large integrated companies supply fingerlings, credit and sometimes feed to their farmers. Cuulong Fish started a hatchery five years ago. Other farms obtain fingerlings from small scale hatcheries. The seed production is specialized with hatcheries producing larvae and larval rearing farmers who purchase larvae from hatcheries to produce fingerlings. Catfish seed production is well established to supply enough seed for the country's catfish industry. All hatcheries are located in three provinces of Mekong delta: An Giang, Dong Thap and Vinh Long.

Red tilapia hatcheries are mostly located in the sub urban parts of Ho Chi Minh City and Mekong delta. Each hatchery only produces 20,000 to 3 million fingerlings annually. In a survey conducted in 2003, most breeders produce fingerlings from 6g in small hatcheries (Huy *et al.*, 2003). Similarly to catfish seed production, larval rearing farmers purchase small fingerlings to raise to 20-50g fingerlings for cage culture.

Wholesalers and retailers are important players in the trading of fish seed in South Vietnam and thus, there is often no interaction between farmers and hatchery operators. The farmers understand little about the source of bloodstock fish and conditions the seed are produced. Seed quality is not an issue as any feedback does not result in changes at the hatchery level (Huy *et al.*, 2003).

Investments are underway by the private sector and the government to scale up the production of fingerlings to meet the ambitious production targets. In a NORAD sponsored project, genetically improved tilapia (GIFT) tilapia imported from the Philippines is being selected for faster growth and cold tolerance in North Vietnam.

Fish feed production

Catfish feed is produced by 33 of the 36 aqua feed mills. The top catfish producers at present are Proconco, Cargill, Uni President and Green Feed. Collectively, these companies have an installed capacity of 80,000-100,000 tpy (Hung, 2005). Local companies such as Afiex, Cataco and Vinh Tuong also manufacture significant volumes of catfish feeds. These companies have an installed capacity of 30,000-50,000 tpy. Although no official data for commercial catfish feed production is available, an estimation can be made based on the catfish production. A sum of 300,000-400,000 tpy of commercial catfish feed was produced in 2004.

There is no official data for tilapia feed but based on the red tilapia production in Vietnam, It is estimated that 50,000-60,000 tonnes of feed is needed for tilapia. Like catfish production, multinational and joint venture companies are the main producers. Local companies are also involved in the production but have low capacity.

Manufactured feeds for the catfish have to meet the feed quality standard that is assigned by the Ministry of Fisheries (28 TCN 188:2004). Crude protein (CP) should be at least 18% for grow out (500g) and up to 40% for fingerling stage (1g) of catfish. The standard for tilapia feed (28 TCN 189: 2004) requires feed mills to produce feed with CP levels of 20% for grow-out (500g fish size) to 40% in crumble feed for fingerling stage (5g). Gross energy should be at least 2,700 kcal/kg for growth out and up to 3,200 kcal/kg for fingerling feed.

Processing

There are 405 processing units in Vietnam. Of this, 171 companies are allowed to export to the EU and 300 apply HACCP. The centre of the processing industry is in the south where 70% of companies are based. In recent years, considerable investments have been made to modernize facilities (Tan, F., 2006)

These processing plants buy catfish and tilapia as well as several other types of freshwater fish and prawn species. These process tra and basa catfish into several product forms such as fresh and frozen, skinless and boneless fillets and value added products as basa skewer, pie, sausage, dried basa, basa chip. To promote the growth of Vietnam's seafood industry, the Vietnam Association of Seafood Exporter and Producers (VASEP) connects producers to customers. It is omnipresent in international seafood shows.

Market Issues

Food Safety and hygiene

In 2004, alerts in the EU and Canada, on catfish from Vietnam contaminated with malachite green, highlighted the risks of an embargo in these markets (Nguyen & Nguyen, 2005). In 2005, the discovery of

banned antibiotics in samples resulted in import alerts of the products in some southern US states. The response from the government emphasised an earlier ban on the use of 17 antibiotics, including malachite green. Nevertheless, these incidences created the awareness throughout the supply chain on the importance of food safety and hygiene. As farmers expand production quickly, they overstock ponds and use too many chemicals in fish feed and for disease control.

As markets for tra and basa in the US, EU and Japan have imposed stringent requirements on hygiene, the attention is on increasing quality in all stages from 'pond to table' (Pham, 2006). Vietnam is yet to apply GAP (Good Aquaculture Practices) and some of the GAP criteria such as ponds for affluent treatment may be impossible for small farms with 1-2 ponds. In 2005, a program on controlling and monitoring harmful chemical residues in aquaculture was implemented. NAFIQAVED (National Fisheries Quality Assurance and Veterinary Directorate) has set up agencies for the quality management and hygiene as well as training courses to improve skills in the field. Accordingly, the number of seafood processors meeting international standards and requirements is increasing. The Ministry of Fisheries now checks all seafood shipments of Pangasius and shrimp to the US (Vietfish, 2006).

The industry itself is self regulating. In order to cover the needs of processing plants, collectors who buy fish from farms undertake analysis of the products for chemicals using modern equipment. In An Giang, the largest catfish farming province in the Mekong Delta, a model was developed whereby groups of farmers are trained to produce "clean" tra and basa catfish that would meet international food safety standards. Cuulong has a group. Agifish has 19 catfish farmers to provide it with about 50,000 tonnes of fish annually, reported ThanhNien News. Another group comprising of 25 farmers producing 70,000 to 90,000 tonnes annually is linked with Nam Viet company which exports 80% of its products to the EU. The company also signed agreements for the supply of feed and fry.

Shifting markets

In 2003, the US Department of Commerce (DoC) imposed tariffs of 37% to 63.8% on catfish imports into the US from Vietnam. The impact on the industry was huge as 70% of exports went to the US markets. However, following this, the market structure altered as producers shifted to markets in Europe, Japan and Australia. Exports to the US declined to 11% of export volume in 2005, 37 % went to the EU market and 30% to Asian countries, according to VASEP (Eurofish, 2005).

Since then, the industry has made strong efforts in promotion and market expansion. They have success in new markets in the Middle East, Africa and Eastern Europe (Saigon Times, 2005). But current interest remains the EU markets where processors market themselves as service oriented. The European market was flooded with Vietnamese catfish, mostly in fillet form since 2005, competing with tilapia and Nile perch. According to Eurostat, freshwater fish fillet from Vietnam has a share of 37% in Germany. It also a major share of the market in Spain and Italy. The unit price for Vietnamese products was much lower at 60% of the average price.

US tilapia market

In the US, the ban of Vietnamese catfish has boosted US imports of tilapia. This increased 135,000 tonnes in 2005 from 113,000 tonnes in 2004 with the major increase in frozen fillets The tilapia market in the EU totalled 433,7 tonnes in 2003. The main suppliers for the frozen market are Taiwan and China followed by Jamaica, Brazil and Ecuador. The total market was estimated at 10,000 tonnes but this changed completely in 2004 with the entry of cheap and good quality catfish from Vietnam (Eurofish, 2005). The US will still remain attractive for tilapia exports.

Competitive advantage

Vietnam's processors have gained market share in the freshwater fish fillet segment in several EU markets because of the competitive advantage based on price. This is a condition which may not be feasible in the long term as it means marginal profits. This in turn may not encourage expansion (Eurofish, 2005). It was reported that as ex farm prices declined to below costs of production, some 30-50% of catfish farming households in the Mekong region stopped operations or switched to other fish species.

Creating more competitive advantages other than price such as meeting the strict EU requirements on quality, hygiene and safety and value addition should be a focus to maintain market share (Eurofish, 2005)

Conclusion

S	Strong government support Fast reactions and attention to market issues by all stakeholders Sufficient feed production capacity
W	Marginal profits Weak control on production volumes and production methods
O	Expanding EU markets and new markets in Middle East and Africa Expanding US tilapia market Value addition in processing
T	Trade and market barriers Competition in US tilapia markets

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New challenges and frontiers of the Philippine shrimp industry

5th Shrimp Congress, Philippines, 21-23 June 2006 Bacolod Pavilion Hotel Bacolod City, Philippines

The organisers have planned for an extensive coverage of current issues ranging from technical information to industry experiences and marketing to prepare the industry for the eventual culture of *Litopenaeus vannamei* in the Philippines. The sessions will start with updates and forecast on the local shrimp industry by Philip S. Cruz , Cruz Aquaculture Corp followed by that of the global industry by Dr. Pinij Kungvanji, Charoen Pokphand Foods Public Co., Ltd. (CPF), Thailand. There will be technical presentations on farming technology and health management practices. Dan Fegan, Alltech Inc.Thailand will discuss recent advances in shrimp farming in the Asia-Pacific Region and Dr Pornlerd Charatchakool, Novozyme Biologicals will discuss "Surviving Thailand's Price Crisis. There will be four company presentations in the session on probiotics and bioremediation.

Five prominent industry members will also discuss their experiences in the local shrimp industry.

- probiotics- the basic approach - Dr. Fides Tamblao, BMEG
- an evaluation of the aquaculture practices, the Intaq experiences - Gina Regalado, INTAQ
- field experiences in shrimp health and water management - William Kramer, Hoc Po Feeds Corporation
- CP proven technology - Ronald L. Gatilao, CPF - Visayas
- Feeding management of *L. vannamei* - the Luzon Experience - Roy Ortiga, Santeh Feeds Corp.

The third day will be dedicated to issues on the introduction, hatchery technology, culture and marketing of the white shrimp. Dr. Juan D. Albaladejo from the Bureau of Fisheries and Aquatic Resources (BFAR) will discuss the Philippine Regulations on importation, accreditation for hatchery grow-out and amendments to FAO 207. Organisers said that all four major suppliers of SPF broodstock in Hawaii and Florida will be present. Dr Jim Wyban will talk on the key success factors of *L. vannamei* culture in Thailand. In marketing issues, Amado Emaguin Division Chief – Marine Products, Board of Investments will present information on the DTI Programs to Support White Shrimp Industry. Chingling Tanco, Chariman, Fisheries and Aquaculture Board (FAB) will give her views on the export of shrimp and Tak Matsushima, Director, Japan External Trade Organization (JETRO) will discuss regulations in Japan.

There will be a trade show. A field trip to shrimp farms will be on the last day of the congress. More information: Email: jalbaladejo@bfar.da.gov.ph; jalbaladejo99@yahoo.com or mariaabegail11@yahoo.com. Web: www.bfar.da.gov.ph; For registration details: Tel: +63 34 4332131/4342559. Fax: +63 34 4332131 Email: nppmci@mactan.ph

Producing 'clean' catfish profitably

Ever since the imposition of antidumping tariffs on catfish exports, Vietnamese farmers are exposed to uncertainties and the consequences of world markets. Culturing mainly for processing industry and for export markets, farmers have seen the fluctuations of ex farm prices as the industry goes through frequent boom and bust cycles. Producers and associations have worked hard at developing markets other than the EU and US, but for the farmer, the main concern is the production of 'clean fish' and good prices. By Zuridah Merican

Long Xuyen in the An Giang Province of the Mekong Delta is the second most important centre for catfish farming. In a survey by Nong Lam University, carried out in July 2005, Hung, et al (2005) said that in general, catfish farmers have experiences ranging from 3-5 years and this determines their culture practices. Some 50% of pond farmers use farm made feeds and of this 43% use pelleted feeds in combination with farm made feeds. Seven percent use only farm made feeds for the duration of the culture cycle. Some 87% use pelleted feeds during the first month of culture.

Mr Pho Van Lieu, a pond farmer and also a feed distributor, started fish culture five years ago. He said that currently (April 2006) some 30% of farmers are still using farm made feeds. Whether a farmer uses farm made feeds depends on his or her financial standing. The cost of farm made feeds is 3,500 VND/kg versus 5,500 VND/kg for floating feeds. He said that all farmers use pelleted starter feeds which are marketed by 4 companies. Farm made feeds are prepared using trash fish, fish meal, rice bran and by products from the seafood processing plants. Usually vitamins are also added.

He added that the farmers also consider the total cost to his production (COP) when deciding on using pelleted feeds or farm made feeds. His main interest is the COP and the profit level. However, there are other considerations such as effectiveness of the feeds, cost of additive and timing of the culture. In using farm made feeds, the duration of culture is 6-7 months whereas with pelleted feeds it is 4-5 months. As the selling price is always changing, the timing of harvest is critical for the farmer. If the harvest is delayed, the farmers will lose all his profits.

At present, farmers are faced with several challenges. Lieu said that it is the fluctuations in selling prices for catfish that makes its culture very difficult. Currently, the ex farm prices are good and range from 13,000 to 14,500VND/kg for fish. Demand is high for fish with white flesh. Prices are lower for fish with yellowish meat. However, even at these prices, margins remain low, as their costs of production are 9,500 VND/kg at survival rates of 90%.

Added to this, there is a requirement to demonstrate that the catfish is produced under hygienic culture conditions and according to the quality standards of the processor. Buyers check on the materials used in the production chain, such as feed, feed additives and other chemicals. Processing plants record every purchase and if fish is found to be contaminated with residues, the products are destroyed and the farmer will not be paid. The Government also monitors farms on the use of chemicals during the production process.

Lieu has one pond of 0.5ha, stocked with 250,000 fingerlings each of 110g. The duration of culture is 5 months and the harvest from this pond will be in June. Lieu uses floating feeds from Uni President Vietnam. Pelleted feeds are used throughout the culture cycle. FCR is 1.65 to 1.7. In changing feed sizes, Lieu will replace 50% of the last feed size on day 1 with the new size feed and increasing this by 10% on each consecutive day until 100% of the new feed is achieved.

Lieu said, "Even if we have all the technology to produce clean fish, in the end, it is the consumer market which will affect us. Our main concern is how we can have better prices for the catfish. In such a situation, we worry whether we should continue to invest in the business. It is actually we, the farmers who are being burdened with the antidumping duties have been imposed on exporters in the US antidumping case".

Despite these setbacks, Lieu is determined to stay in the catfish farming business. He does not plan to shift to the culture of tilapia as he feels that the market for tilapia from Vietnam is still uncertain at the moment.

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Lieu (right) with Le Dinh Thanh Nha, Manager for the Fish Feed Business, Uni President

Floating pellets in a catfish pond. If more than 3% of pellets sink, farmers will reject the feeds.

The impact of EU food safety rules on the future of Asian aquaculture

By John Sweetman

A central aspect of many EU decisions is a shift in focus to preventing disease occurrence at each point in the production chain rather than dealing with it when an outbreak occurs. Natural micro-ingredients like yeast and its derivates are promising alternatives to the use of antibiotics and chemicals in aquaculture.

During the last decades, the increasing demands for aquaculture products were resolved by the intensification of the industry, with the largest increase in production and trade of farmed fish and shrimp taking place in Asia. Intensification of a production sector is often, if not always, accompanied by undesired increased disease pressure.

In order to mitigate the spread of disease among the cultured fish or shrimp, and the resulting economic losses, prohibited chemicals and antibiotics are easily used, especially if financial resources do not allow for sustainable alternatives. The subsequent food safety problems have had significant economic and political impacts both in the exporting Asian countries and in the EU. The use of antibiotics and the attention it received in the European media influenced consumer perception and affected trade potential in a negative way.

Possible alternatives to the use of antibiotics are investigated on different levels all over the world. Outcomes of the projects, as well as recent EU trends and European legislation proposals all point to the same directive of disease prevention. Treatment by chemicals or antibiotics should only be applied in the scarce cases that no sustainable husbandry technique could be used and when significant recovery is expected.

Trials were conducted with common carp in Bulgaria.

Detection of residues in aquaculture products

The discovery of antibiotics has probably not been the result of any rapid increase in antibiotic use, but is, at least in part, due to the improvement of analytical methods. In addition, discovery of the presence of antibiotic residues commonly results in intensification of control measures, which also increases the discovery rate. A number of factors appeared to have played a role in the development of this case.

'Zero tolerance' and naturally occurring antibiotics

The lack of data on toxic effects of certain antibiotics prevented formulation of internationally harmonized acceptable daily intake or maximum residue level (ADI/MRL). Therefore, some nations, including the European Union, initially showed "zero tolerance" to these compounds.

Antibiotics are usually present in background levels in natural resources and this can be the result of the usage of antibiotics for human medicinal purposes, but also of their production by naturally occurring bacteria in seawater and sediment. In addition, the improvement of detection methods will result in lower detection limits, which in turn may result in the detection of "commonly" occurring residue levels of, for example, antibiotics in shrimp. This does not necessarily mean human interference, but may very well be a result of natural occurrence, and thus zero tolerance is not always achievable during production.

Lack of internationally harmonized legislation, quality assurance and control

The absence of harmonized legislation and a lack of synergy within the industries have lead to cases where the use of antibiotics may be allowed in the exporting nation, while being prohibited by importing nations. There was even no harmonization among Western countries that imposed different levels of detection for the same antibiotic in the initial phases of the incidents prior to EU-harmonized measures. In addition, many production locations produce shrimp for multiple costumers or sell their products to wholesalers where different lots are mixed. Due to the lack of a quality assurance system and communication, wholesalers have difficulties in controlling the usage of compounds.

There have also been accounts of illegal use, which is facilitated by the lack of control on the use of antibiotics in primary production. Developing countries where aquaculture is widespread have less legislation and the availability of antibiotics and disease-preventing chemicals are usually seen as a cheap and very effective tool to increase production. Moreover, some Asian countries are also important producers of medicinal compounds and farmers have easy access to antibiotics. This means that the production and distribution of these medicines is relatively cheap and easy.

Development of EU border controls

Following the detection of antibiotics in shrimp, the EU intensified its border controls or, in some cases, barred imports of shrimp from various Asian countries. These measures were suspended after a period in which the exporting nations had established appropriate controls on consignments of shrimp destined for export and quality systems to ensure that no antibiotics were used in aquaculture.

In addition, the "zero tolerance" approach was replaced by the definition of "minimally required performance levels (MRPL)" for control laboratories. Consignments of products with levels of these compounds

exceeding the MRPL should either be destroyed (possibly after recall) or shipped to a third country outside Europe after approval by the latter. For example, MRPL in aquaculture products are 0.3 ppb for chloramphenicol and 1 ppb for nitrofuran and at this point in time there are no indications of illegal use of chloramphenicol or nitrofuran. The risk of illegal usage being detected becomes very high, especially since costs for the controls, shipment etc. need to be paid by the exporting country or industry.

A combination of measures is needed

Regulations, quality control and education

The supply of antibiotics in Asia and other parts of the world can be regulated more stringently. The provision of for example, a registration system for antibiotics would at least provide insight into the distribution and uses of these antibiotics. In addition, the formulation of MRPL has helped to avoid problems arising from a "zero tolerance" policy, although MRPL may be stringent too.

The regulatory requirements of Hazard Analysis and Critical Control Point (HACCP) in aquaculture and certification of consignments for export have proven beneficial. The principles of quality systems like HACCP should be implemented, since these enable a better control of the use of antibiotics. The introduction of HACCP-based systems can be stimulated by global shrimp importers and governments.

Maintaining a healthy stock

On-farm disease control is of vital importance. An effective health management programme must cover all levels of aquaculture activity, from the production unit (pond, tank, cage, etc.), farm, local or zone level, to the national and international level. The use of high quality broodstock or stocking high quality fry, elevated biosecurity levels, appropriate water quality management program and potentials of using probiotics and natural alternatives should all be taken into account to reduce the risks of disease. Further development of new feeding, management and healthcare strategies should be encouraged.

Benefits of dietary MOS* on health and performance in aquaculture

Trials with fish

Trials were conducted with rainbow trout and common carp on different fish farms (See photos). Feed contained either no supplement (Control) or 0.2% MOS and trials lasted for 42-90 days. Factors investigated included growth performance, survival and the activity of the non-specific (innate) immune system (Staykov et al., 2005).

Supplementation of trout and carp diets with 0.2% MOS significantly improved FCR, growth rate, weight gain, total biomass production and survival of reared fish (Table 1). Furthermore, adding 0.2% MOS to the feed significantly improved the immune capacity of rainbow trout and common carp as indicated by serum lysozyme concentration and complement activity (triggered both through alternative and classical pathways) (Figure 1). Results obtained in this study were consistent with earlier studies with other fish species.

Table 1. Effect of MOS* supplementation (2 g/kg) on weight gain, mortality, FCR and total biomass of different trial groups of fish.

Dietary treatment	Parameter	Control	MOS*
Trout (net cages)	Weight gain (g)	56.37[a]	68.36[b]
	Mortality (%)	1.68[a]	0.58[b]
	FCR	0.91[a]	0.83[b]
	Total biomass (kg)	611.44[a]	703.16[b]
Trout (raceway)	Weight gain (g)	193.31[a]	223.27[b]
	Mortality (%)	4.97[a]	2.94[b]
	FCR	1.19[a]	1.09[b]
	Total biomass (kg)	6200[a]	5550[b]
Common carp	Weight gain (g)	292.62[a]	341.10[b]
	Mortality (%)	3.52[a]	1.92[b]
	FCR	1.99[a]	1.69[b]
	Total biomass (kg)	5550[a]	6200[b]

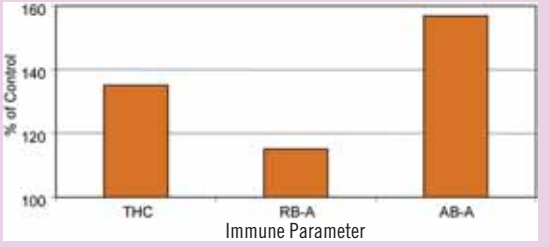
Trials with shrimp

Field trials were conducted with amrin shrimp *Penaeus vannamei* and showed that the MOS at 0.1% and 0.2% resulted in increased immune response under commercial culture conditions in different locations. All measurements of haemocyte count, haemocyte respiratory burst and antibacterial activity of the haemolymph showed a significant enhancement in shrimp fed with MOS (Figure 2).

** Bio-MOS® manufactured by Alltech Biotechnology*

Figure 1. Effect of MOS* on serum lysozyme and complement activity in trout reared in net cages.

Figure 2. Effect of 0.2% MOS* concentration in the diet of *P. vannamei*. THC, Total Haemocyte Count; RB-A, Respiratory Burst Activity; AB-A, Antibacterial Activity.



Harvested shrimp after using Bio-MOS-supplemented feed.

Education

In order to obtain farmer's commitment it is important to provide appropriate back up and skills for the local industries. Farmers should get practical training and technical assistance in (health) management (regular health surveillance, disease control and prevention) by professional experts. Large-scale practical education programs for individual farmers are being implemented (e.g. NACA, 2002), but to reach the majority of the farmers requires an enormous organisation. Farmers should be educated on the long-term (economic) benefits of disease prevention and be made aware of the issues surrounding the use of antibiotics, such as antibiotic resistance and bacterial virulence increase.

The importance of dietary nutrients

In recent years, considerable research has focused on meeting the nutritional requirements of aquatic animals and the benefits of supplementing feed with "pro-nutrients" (Spring, 1999). Pro-nutrients are dietary items that are not essential but which can benefit animal health and performance in a variety of ways. Even though a great amount of research is still required to understand the exact mode(s) of action of many products, evidence is mounting of the benefits that can be derived from their use.

Instant responses to the use of prebiotics, probiotics or immune stimulants can never be seen in contrast to the use of antibiotics. However, the use of pro-nutrients often appears to improve production parameters the longer the product is utilized in the aquatic production system. This can be achieved through improving the availability or utilization of nutrients, as well as maintaining health and survival whilst reducing reliance on antibiotics.

One of the natural products, which is well studied and has scientifically proven health and performance benefits in different animal species, including in fish and shrimp, is Bio-Mos® (Alltech, Inc.). This product is a natural sugar (mannan-oligosaccharide) derived from the outer cell wall of a selected strain of the yeast *Saccaromyces cerevisiae*. The mode of action is two fold; it specifically blocks colonisation of pathogens and it modulates the animal's immune system.

The specific structure of the mannan-oligosaccharide (MOS) molecules serves as a decoy, strongly binding to particular parts of certain types of fimbriae which are mainly present on gram-negative pathogenic bacteria. Once attached to the MOS, binding to the intestinal surface of the host is prevented and the trapped bacteria lose their pathogenicity. In addition, the nature and degree of phosphorylation of the MOS triggers immune modulation and health and performance are increased, this is especially seen at times of pathogen invasion.

Bio-Mos® is an all-natural product which is specially developed for food animal production and has shown positive results as alternatives for the therapeutic and prophylactic use of antibiotics (see box).

In conclusion, the recommended measures are listed below.

- Certification testing and regulation in the exporting country.
- More practical training and technical assistance in (health) management for farmers, including explanation of the risks of antibiotic usage.
- Explanation and demonstration of the long-term (economic) benefits of disease prevention for the farmers.
- Regular health surveillance, disease control and prevention by professional experts.
- Practical and acceptable legislation (international and national) for implementation of aquatic animal health management.
- Further development of new feeding, management and healthcare strategies.
- Application of natural micro-ingredients like yeast and its derivates since they are promising alternatives to the use antibiotics and chemicals in aquaculture.

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John Sweetman is with Ecomarine Ltd, Greece. John has over 25 years worldwide experience in aquaculture. His consultancy company Ecomarine Ltd is involved in all aspects of aquaculture production, product use and marketing, research and development and management.

Thailand's road map from quality to traceability

Since June 4, 2004, the Department of Fisheries, Thailand has the responsibility to ensure food safety standards for tuna and shrimp products in the country. Soon, traceability will be through RFID and this is the lead that shrimp from Thailand has over that of other countries in Asia. This will be presented at the Belgium Seafood show in May.

Year 2004 was the Food Safety Year in Thailand and the launch of a public relations campaign to improve the quality and standard of Thai agriculture and food both in the domestic and world markets. Mr Niwat Sutemechaikul, Deputy Director General, DoF, said "With this transfer of jurisdiction to the DoF, it has to inspect products for the local and export markets and issue health certificates. Here we have to look at the production of raw materials, make sure that all inputs for feed and food are safe from residues and take samples for every shipment for export."

Together with other agencies involved in the inspection and certification for other agricultural products in this road map for food safety, the objectives are to maintain the Baht 600,000 million/year (USD 15 billion) of exports and reduce problems and losses incurred when products are quarantined or destroyed. This has been valued at THB20,000 to 30,000 million (USD 500-750 million) per year.

Mr Niwat said that there are 4 steps in this process. At the farm level, the DoF registers and certifies shrimp and inland aquaculture farms. This starts with the GAP (Good Aquaculture Practices) and CoC (Code of Conduct) at the production level. These programs were introduced some years ago and include the movement documents (MD) as identification for shrimp from hatchery to processing in Thailand. (see AquaCulture Asia Pacific, Vol 1 (1), p20-22).

Farms have to follow the several steps in the accreditation process. Aside from this, through rapid tests, they check that inputs do not contain any residues or hidden chemicals and all chemicals used in the farming process must be registered. He said that it is relatively easy for large shrimp farms to comply and meet the requirements for the accreditation process as operators are well educated and have the financial resources. In contrast, this is more difficult to achieve for small farms and those culturing freshwater fish. In inland aquaculture, their focus is on freshwater prawn *Macrobrachium* and tilapia culture farms.

In the second part, the department ensures compliance to environmental aspects. At the farm, this includes the storage of water prior to release and location of toilets etc. The objective is to ensure that the quality of affluent is monitored and that levels of *E. coli* and *Salmonella* in the water is controlled.

The third part sets standards for the distribution process. Here the responsibility of the DoF is to inspect and certify manufacturing facilities for processed foods for export. This also includes checks on raw material, aqua feeds and feed producing facilities and inspection of ports. The final step here is compliance to GMP and HACCP. The aim is for DoF to be able to assure that risks are minimal to the food chain.

"In food safety, we can say that we are doing a good job with this program. We have also considered the small producers. There are different standards for the different levels of industry. These are clearly explained in the guidelines for Food Safety in Thailand which is written in the Thai language. It lists the levels of industry as industry, small scale and communities, primary processing plants and central auction markets. Small scale producers promise to use feed from registered producers and only registered chemicals", said Niwat.

The DoF is well equipped to undertake the total process to GAP certification. There are centres in the southern and eastern provinces and 26 laboratories with more than 200 staff to check on the problems of farmers. The country has 17 LC/MS/MS for the analysis of residues in the products.

On registration with the DoF, farmers receive training on the GAP. Advisors are sent to help farmers and they undertake to follow these for 6 months to a year. An audit inspection from another province follows and the farmer is left with a checklist to follow. The farmers benefit as they receive better prices for their shrimp.

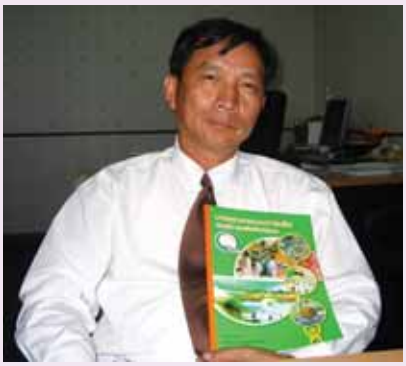
"In the end, this means that we test for raw material quality and cooked meat quality and is confident that 99% of the food produced is free from any hazards. Companies that meet this are given the Q mark and they are then eligible to apply for traceability audits", said Niwat.

Traceability with RFID

With the above, the traceability is partial from farm to package. Further down the road is the traceability of production process. Today, there are MOUs (Memorandum of Understanding) between the farmer and factory on the application of traceability. This comes with a 30% premium in prices for the farmer. An example is the agreement between 140 farms and a large processing company. Many other companies are following this model. The processor will set the criteria and species for culture.

Producers which follow this will have in addition to the Q mark, a traceability number. So far, four companies, mainly shrimp processing companies are in the program. In the second phase of the traceability program, DoF will use RFID (radio frequency identification) technology. This is in collaboration with the Ministry of Science. In the program, RFID chips in the shrimp trays will help record
the origin of shrimp back through all the processing to the farm.

"Next, we should work towards a federation of seafood producers with India, Vietnam and Indonesia to exchange information and create standards for primary products to processed products", said Niwat.



Mr Niwat Sutemechaikul, Deputy Director General with the book on quality and traceability regulations for food safety in Thailand. Mr Niwat's interest in shrimp farming spans 25 years. After finishing university, he worked with DoF and was one of the first to do the artificial insemination in shrimp and set up shrimp R&D programs.

HACCP for feed plants

Two Cargill Animal Nutrition feed mills in Vietnam became the first in the industry to receive the HACCP certification. The mills are located in Bien Hoa and Hung Yen Provinces.

In April, at a gathering of staff in Ho Chi Minh City, Scott Ainslie, General Director, Cargill Vietnam proudly led celebrations to thank Cargill staff for this achievement.

"Although, we are not required in Vietnam to get HACCP certification for our feed mills, we want to lead the industry towards better systems in food safety. This is an important part of Cargill's global strategy.

Cargill Vietnam has animal and aqua feed plants in Dong Nai, Hung Yen, Long An and Cantho. In 1998, they started to produce fish feed at their plant in Dong Nai. Their newest plant in Cantho is designed to produce 60,000 tpy of fish feeds, and will focus mainly on tilapia, tra and basa catfish. Cargill recently broke ground on another new feed mill located in Long An province and will start operations there in the middle of 2007. This plant will initially focus on livestock feed, but could add aquaculture capabilities in the future.

On the new aqua feed mill in Cantho, Scott said, "We have started the process of getting this facility HACCP certified and plan on completing it later this year. Once we do this, and complete our new mill in Long An, all of our products in Vietnam will be produced under systems that are HACCP certified."

"By being HACCP certified, Cargill Animal Nutrition can demonstrate that we have the processes and systems to provide the safest feeds to Vietnamese livestock and aqua farmers. We take pride in partnering with livestock growers, and when they succeed, we succeed. This is one way we believe we can help them succeed, whether they produce for the local or international markets. HACCP certification is another way to demonstrate Cargill Animal Nutrition's commitment to creating high quality products for our customers."

The company started the process of certification from SGS a year ago. HACCP (Hazard Analysis Critical Control Point) is a food safety program designed to reduce or eliminate potential food safety hazards. HACCP is not required in the animal feed industry, but it is mandated in four areas of food for human consumption. These are in fish and seafood, juice processing, poultry and meat. Scott said that HACCP also supports Cargill's position as the leader in developing nutritional technology.

In aquaculture, Le Minh Man, Aquafeed Sales Manager said, "It is the growing sector in Vietnam and contributing to world food production. It is also being monitored closely such that products are safe for human health and is environmentally friendly. Food labelling laws are getting stricter. There are also new measures such as traceability and the prevention of usage of drugs and antibiotics in the local industry. Organic aquaculture is being promoted to cover concerns on the effects of aquaculture on the environment and prevent diseases. As feed goes into fish, our role is to ensure that the feed production meets international standards of hygiene and quality".

Scott Ainslie with Le Minh Man (right) and Truong Dai Viet

Cargill USA's entry into Vietnam began in 1995 soon after relations between the US and Vietnam were normalized. Cargill Vietnam is one of the fastest growing subsidiaries of the company with an annual sales growth of 20%. Today the company has five feed plants, a breeder farm and hatchery.

Its commitment to Vietnam also extends to community development, in particular, education. Under the company's 'Cargill Cares' program it has built classrooms in the rural areas of several provinces in the country. It has built a total of fourteen schools from North to South of Vietnam. Funding for the program is contributed by staff, suppliers, dealers, customers and the mother company matches dollar for dollar these contributions. The total amount has reached USD450,000.

Challenges for sustainability in aquaculture for China's Guangdong Province

By Chen Wen

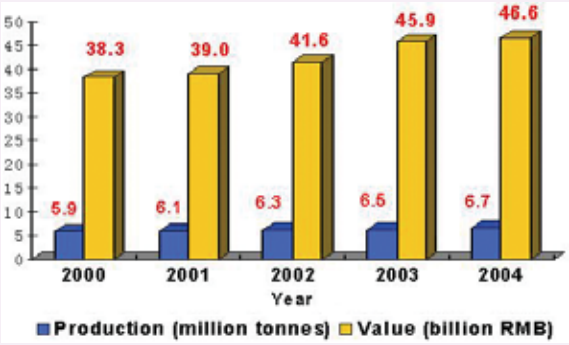
The rapid growth of aquaculture in Guangdong Province, driven by a high demand for seafood, has resulted in negative consequences for the environment, product quality and, ultimately, sustainability of the industry. The government and private sector have realized the problems and measures are being taken to keep the industry sustainable.

Aquaculture in Guangdong Province

China is leading the world in aquaculture production (see article "Recent trends in China's aquaculture industry" in issue Vol. 1 (5) p18-20). Guangdong, a southern province of the People's Republic of China with a subtropical climate and rich resources, is one of the major aquatic production areas in the country.

The total production (capture fisheries and aquaculture) was 6.7 million tonnes in 2004, equivalent to RMB 46.6 billion (US$5.68 billion) and accounting for 21.6% of the total agriculture production in Guangdong (Figure 1). Seventy-two percent of the total production (4.8 million tonnes) is derived from aquaculture. People (Cantonese) in Guangdong traditionally love seafood. The per capita consumption of aquatic products is about 81 kg which is among the highest, not only in China but also in the world.

Figure 1. Guangdong aquatic production through capture fisheries and aquaculture



Source: Guangdong Ocean and Fishery Administration, Annual Statistics Information, 2000-2004. 1 RMB = approx US$0.12

Aquatic species cultured in Guangdong are diverse. In freshwater, the main species are silver carp, bighead carp, common carp, crucian carp, tilapia, wuchang bream, mud carp, Japanese eel, mandarin fish, large mouth bass, giant river prawn and soft-shell turtles. The main marine fish species are Japanese seabass, red drum, cobia, puffer fish, groupers, red snapper, black see bream and ovate pompano. The primary species of cultured shrimp are currently *Penaeus vannamei* and *P. monodon*.

However, despite the achievements in aquaculture in terms of production volume and the number of species, the industry is facing problems with sustainability. Outbreaks of disease are increasing as a result of intensification of culture and deterioration of environmental and health conditions. The government and industry are very much aware of these sustainability issues and are putting more emphasis on product quality, production efficiency, profitability, environmental protection and disease control.

Challenges for sustainability

According to China's Fishery Law that went into effect on December 1, 2000, the growth in capture fisheries for both freshwater and marine products should be kept at zero growth. Therefore, increased production will be from aquaculture. Unfortunately, the rapid growth and intensification of aquaculture have already brought a number of problems. Some of the critical issues are discussed here.

Disease monitoring in a laboratory in Guangdong

Inadequate quarantine and biosecurity measures

Similar to the livestock sector, infected farmed aquatic animals can spread disease and release pathogens into the environment. Irresponsible movement of animals can introduce new diseases to native fish or shrimp populations. In the past, the introduction of new aquatic species into Guangdong from other countries or regions without risk analysis and proper quarantine has led to disease epidemics and heavy economic losses.

Resource and environmental deterioration

Unplanned development of aquaculture has a negative impact on the environment. Mangrove forests along the coastline play a significant role in prevention of soil erosion and maintenance of water quality. From 1950 to 1998, the mangrove forest area decreased from 8,000 ha to 280 hectares in the east coast, and from 54,000 ha to 14,000 ha in the west coast of Guangdong. Some of the losses of the mangrove areas are certainly due to shrimp farming activities.

Eutrophication and pollution have direct impact on the aquatic environment and fish stocks. For instance, there was a widespread red tide (toxic algae bloom) in the coastal areas of Guangdong and Hong Kong from 1997 to 1998. More than 2,000 tonnes of fish were killed, resulting in economic losses of more than USD 60 million. Zoning, mangrove usage, effluence discharge and use of chemicals must therefore be strictly regulated.

Lack of hatchery technology

To a great extent, supplies of marine fish and shrimp broodstocks and fry are dependant on imports. In recent years, Guangdong imported more than 20 species of fish broodstock, fry and fingerlings from other countries and from other regions in China. For some species, farmers still use wildcaught fingerlings. As a result, fry are often infected with pathogens. For hatchery-produced fry, the quality of broodstock is often doubtful. Inbreeding has led to degradation in fry quality, resulting in poor growth and high susceptibility to diseases.

Current methods of fish/shrimp farming must change to more sustainable farming methods such as large offshore cage culture and well managed earthern shrimp ponds.

Poor health management and improper use of medicines

Poor husbandry and health management practices are common, for example, the use of trash fish as feed. Also, more often than not, farmers pay more attention to treatment than to control. Irresponsible use of antibiotics or chemicals in aquaculture can lead to residue and environmental problems. With the exception of a vaccine for grass carp hemorrhagic disease (caused by aquareovirus), there are no commercial vaccines for disease control for other species cultured in China.

Recommendations

A number of issues must be addressed to keep the aquaculture industry sustainable in Guangdong. The aquaculture industry in Guangdong must shift from its old practice of utilisation of resources to a new practice of management of resources. New policies and measures must be put in place to avoid environmental degradation while maintaining growth of the industry. In aquaculture, these policies and measures may include the control of water pollution and epidemics of disease. There is a need to make a scientific assessment on the environmental carrying capacity for aquaculture and do not over-exploit the resources.

Fisheries Information Technology (FIT)

In the future, Guangdong will use FIT to manage its aquaculture resources, develop advanced techniques, improve the aquatic habitats and promote environmentally friendly aquaculture. It is necessary to establish the FIT systems for data collection, monitoring and evaluation of domestic fisheries, and streamlining of decision making. The system will also enhance the competitive strength of the aquaculture industry for both the domestic and international markets. As part of the programme, websites will also be set up for e-commerce activities.

Build up capacity and disease control

The Guangdong government is determined to build the infrastructure necessary to provide technical support to the industry. The facilities and systems may include an artificial reef, an oceanic and fisheries hi-tech park, research centres, an aquatic animal diseases control programme, breeding and extension services.

In order to tackle disease epidemics in aquaculture and to develop an effective strategy for disease control, the Guangdong Provincial Fishery Technological Extension Center launched an aquatic organism disease monitoring project province wide in 2000. By 2004, 268 monitoring stations had been established and the monitored areas covered 12,000 ha of ponds, 750 net cages and 64,000 m3 concrete tanks. At present, 350 monitors from 285 farms located in 207 towns, 79 counties and 21 municipal cities participate in this monitoring project.

In 2004, diseases of 26 major cultured species, including 18 kinds of finfish, two crustacean, one amphibian, two reptile and three shellfish, were monitored and data were collected on a monthly basis. One hundred and one types of disease have been reported: 12 viral, 34 bacterial, four fungal, 23 parasitic and 28 other types of disease.

Quality control improvements for aquatic products are in progress.

Improvements in product quality

Being one of the leading aquaculture provinces, Guangdong will adopt standards for environmental protection, quality control and self-monitoring by producers. The standards will be in compliance with international standards. Quality control must be in place throughout all cultivation processes. To improve the quality of aquatic products, the government and industry will invest resources in technology and environmental protection.

Technology for preservation, processing and transportation will be improved through innovation. The Guangdong government will take the lead in quality control (including residue testing) in production, processing, marketing and distribution in order to build a solid reputation for the provincial products in both the domestic and international markets. The province shall create brand name products backed up by advanced technology and product quality.

Environmental responsibility

Making aquaculture environmentally sound will require a variety of approaches by both the public and private sectors. Government regulation and support for aquaculture is part of the driving force for sustainability. Government regulations will include permit requirements for aquaculture sites, restrictions on the destruction of endangered aquatic species, and control on the irresponsible use of drugs and pesticides.

***The article was prepared with the assistance of Dr Zilong Tan, Intervet Norbio Singapore Pte. Ltd.*

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Managing water quality and fish health with probiotics

By Gordon Motherwell

In this article, the author explains how microbial technology creates healthy pond environments for optimal productivity.

The population of China is expected to rise from the present 1.2 to 1.6 billion by 2026 and the national per capita consumption of fish is projected to increase significantly over this period. The reality of dwindling wild fish stocks has led to the expansion of inland, brackish and in particular marine aquaculture as a key strategy for meeting national demand. Aquaculture production and the utilisation of open waters such as lakes and reservoirs, rivers and rice paddies have steadily increased in recent years. Unfortunately this has led to severe degradation of water quality and culture environments through rapid expansion and intensification of the aquaculture industry.

The Chinese government has realised the potential of probiotic water treatment systems to combat this problem. Probiotics have significant environmental and economic benefits, compared with treatments such as antibiotics and pesticides which have been used in the past. The government is aware that keeping up with the national demand for aquaculture products will require the application of probiotics if the industry is to remain sustainable. Thus in recent years research funds for the development of probiotic technology has significantly increased.

Probiotics include bacteria which assist in important functions such as enhancing the nutrition of the cultured animals, digestion of fish waste and toxic pollutants, disease prevention, ammonia removal and regulation of the phytoplankton bloom. Some of the bacterial genus selected and their descriptions are listed in the Table 1.

How the probiotics work

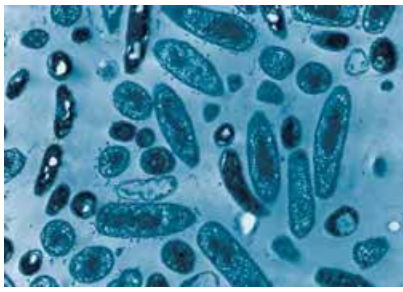
High ammonia and nitrite levels can cause direct fish losses due to toxicity, reduced appetites, poor food conversion and increased disease. Marine and freshwater nitrifying bacteria combat these problems. Those developed by Environmental Products Australia Pty Ltd (EPA) have a guaranteed ammonia conversion rate of 800 mg NH_3 per hour and will eliminate any risk of ammonia or nitrite toxicity (Table 1.) They are grown from natural marine and freshwater environments using the company's unique technology. This results in both high bacterial concentration and significant species diversity in a variety of pond conditions.

The many species of probiotic bacteria once added to the pond decompose organic matter at a faster rate than the natural microbial population leading to improved water clarity and less risk of disease.

Table 1. Examples of nitrifying bacteria

Bacterial Genus	Function	Classification
Nitrobacter Nitrospina Nitrosomonas Nitrospira Nitrosolobus	Freshwater ammonia and nitrite oxidisers.	Chemolithotrophic Bacteria. Gram negative, non-sporing
Nitrococcus Nitrosococcus	Marine ammonia and nitrite oxidisers.	Chemolithotrophic Bacteria. Gram negative, non-sporing.
Pseudomonas (14 species utilized)	Selected for their ability to rapidly breakdown a wide range of wastes.	Aerobic gram-negative rods and cocci
Bacillus (16 species utilized)	Effective in digesting fish wastes and in combating pathogens.	Aerobic and facultatively anaerobic. Endo-spore forming gram-positive rods and cocci
Streptomyces (4 species utilized)	Effective degraders of organic matter	Spore forming, resemble fungi in their structure.

Phytoplankton blooms serve many critical functions in most fish and shrimp production. They are the food source of zooplankton which provides a link between the bloom and the rest of the food chain. They produce oxygen through photosynthesis, take up nitrogenous fish wastes and provide shade. However bloom densities can fluctuate and crash resulting in oxygen depletion, high ammonia levels and subsequently fish mortalities. EPA's water treatment system can regulate the density of algal blooms and prevent crashes through biologically controlling nutrient levels. This control allows the farmer to achieve optimum photosynthesis and nutritional benefit from the bloom.



Nitrifying microorganisms present in EPA probiotics.

Water quality is crucial for successful pond aquaculture; however, less importance is given to sediment quality. The exchange of substances between pond bottom and water along with sediment quality strongly influence water quality. The addition of probiotic bacteria helps condition the pond sediment through enhanced waste digestion and nutrient removal. The probiotic bacteria stop the accumulation of organic matter hence maintaining a well oxidized layer. It is this oxidized layer which prevents the diffusion of toxic metabolites into the pond water.

The accumulation of organic waste and elevated nutrient levels in an aquatic environment is conducive to the presence of pathogens (such as Vibrio). It is better to prevent a disease rather than treat one, thus avoiding the use of antibiotics. Probiotic bacteria achieve this through significantly reducing pathogen build up through competitive processes and rapid degradation of organic wastes.

The addition of live bacteria also provides an extra food source for microorganisms in both the water column and sediment. This additional energy source is transferred down the food chain and elevates total pond productivity. Certain bacterial species also thrive in the fish/shrimp gut, improving the digestive process.

Improved water and sediment quality, low ammonia levels, controlled algal bloom and pathogen free water all result in significant improvements

Figure 2. Post harvest sediment of treated pond showing well oxidized layer and reduced sludge.

to pond productivity. Increased survival rates, better growth rates and higher yields all result from the correct application of the probiotic bacteria.

Below are the average results from Technology Proving Demonstrations (TPDs) at a Tilapia nursery and a tilapia grow-out tank facility at Kasetsart University, Thailand, 2005. The results are based on quadruple and triplicate replicate tests respectively. In all the trials, the probiotics used were from EPA.

From these results and many other case studies, it is clear that probiotics if used correctly can have substantial benefits to fish health and farm profits. Commercial experience dictates that all treatments must provide farmers with a reasonable cost-benefit, especially large farms with small margins. To this end the company developed a unique and easily managed culturing system, using a specifically designed microbial stimulant (Bio-Plus), that allows the farmer to treat his ponds very economically.

All these allows the farmer to improve pond water conditions and farm productivity at a cost-effective price while maintaining an environmentally sustainable farm.

Table 2. Summary of trial results from tilapia nursery

Treatment	Period (Days)	Growth Rate (mg/day)	Survival Rate (%)
Probiotic	30	10.7	84.5
Control	30	8.4	83.4

Figure 3. Growth rates over 30 days from tilapia nursery treated with probiotics.

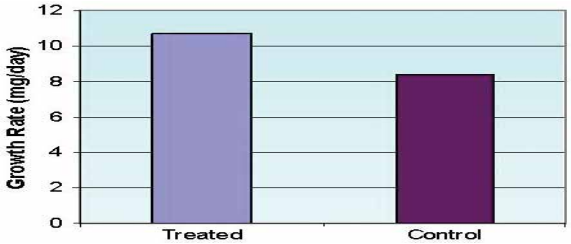


Figure 4. Survival rates over 30 days from tilapia nursery treated with probiotics.

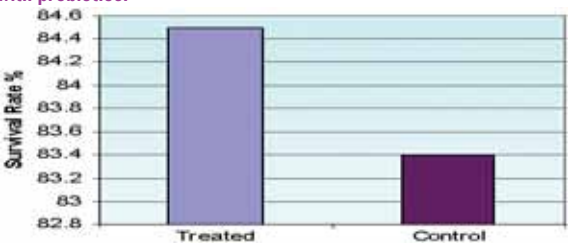
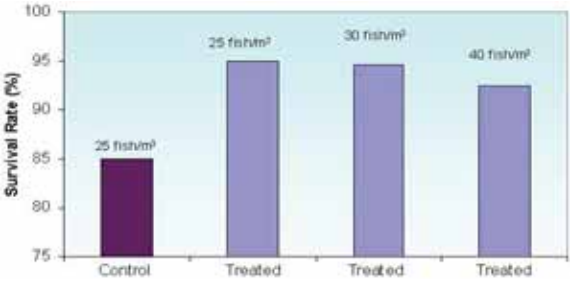


Figure 5. Survival rates from Tilapia grow-out tanks treated with probiotics. Survival rates at higher stocking densities using probiotics were also tested. Control stocking density = 25 fish/m³.



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Farming of the yellow puffer fish *Takifugu obscurus* in Korea

By Ng Chee Kiat

In Korea, the demand for this exquisite delicacy is in excess of 20 tonnes annually. Previously supplied from capture fisheries, the fish is now cultured in land based facilities from commercially produced fry.

Puffer fishes such as the yellow puffer, *Takifugu obscurus* or Abe are highly sought after delicacies in Korea and Japan. Also known as the river puffer, it is anadramous in nature and migrates up rivers in Korea and China to spawn. As is typical of puffer fish, it contains a highly potent toxin called tetradotoxin, one of the main reasons why the fish is such a delicacy.

The yellow puffer currently command prices of USD 35/g at the wholesale market. The fish is usually marketed at 300g. The market demand for this exquisite delicacy is in excess of 20 tonnes annually in Korea alone. Supplies come from natural catches and recently from aquaculture facilities. The seed is already produced commercially

The Gimpo Yellow Puffer Farm is a commercial indoor production facility located in Gimpo, near Seoul. This unique farm is operated by Mr Shin Deok Kyun and his family. According to his son, Shin Hyun, the farm has consistently been producing between 3 to 5 tonnes/year of this fish which it markets live to wholesalers and distributors around Seoul. The farm is fitted with heaters to allow year round production. Culture facilities consist of 18 circular tanks of 50-tonne capacity for grow-out and 6 smaller 5 tonne tanks for nursery operations.

Puffer fish fry are sold by commercial hatcheries at USD 0.50 each for 3 cm fish. The fish is stocked into nursery tanks at 3,000 to 5,000 fry/tank for a period of 3 to 4 months. By this time, fish will double in length to 8 cm long. They are then transferred to the large grow-out tanks for another 2 years to market sizes of 250 to 300g each. According to Shin, the fish are sometimes sold at 200 grams because of market demand.

Ground water is pumped into the facility and water change is minimal. The water is recycled through a series of biological filters and the water is kept warm by furnace heaters especially during the winter months. Temperatures are maintained at 20°C as long as possible to ensure maximum growth. Common problems in the culture of this fish are diseases and cannibalism as the species is very aggressive in nature. Cannibalism is however, greatly reduced when adequate feeds are provided.

Fish are fed 3 times a day on commercial diets during the grow-out stage. Commercial feeds of various sizes (up to 3 mm diameter) with protein levels of 45% have feed conversion ratios (FCR) of 1.5, according to Mr Kim Joo Min of SCR Co, which produces the feeds of 1.2 mm; 1.6 mm; 2.0 mm and also 3.0 mm in diameter for the yellow puffer. The feed costs almost USD 1.50 per kg. Commercial grow out feed for the puffer contain maximum levels of calcium of 1.2% and phosphorus of 2.0%.

Feeding yellow puffers with commercial diets in grow out tanks

The Yellow Puffer showing its expanded body when handled

Mr. Kim of SCF Co., Ltd. (left) and Mr. Shin Hyun Gap (right) of the Gimpo Yellow Puffer Farm

The peak demand for this fish in Korea is in spring, usually in the months of April and May. This is in contrast to Japan where the fish is in demand mostly in winter. In order to fulfill this market niche, Gimpo Yellow Puffer Farm uses wood fired furnaces to heat up the culture water especially during the winter months so that fish can achieve market sizes by spring time. The close proximity of the production facility to the market greatly helps the marketing and distribution of the fish.

The farm, which has been in operation for more than 5 years, has a production cost of no more than USD 10/kg. It markets the fishes directly to the wholesalers in batches of 100 kg each time. The farm also sells the fish occasionally to retail outlets, where prices can sometimes reach USD50/kg.

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Culturing spotted baby sea snails in disused shrimp ponds in Chantaburi

At the Chanthaburi Coastal Fisheries Research and Development Centre, researchers have been working with the private sector to develop techniques for mass production of juveniles and grow out in disused shrimp ponds.

The sea snail *Babylonia areolata* is a current candidate species for land based aquaculture in Thailand. Local demand has been rising but wild populations are on the decline. The market demand is estimated at 2,000 to 3,000 kg/day for markets in South China and 1,000 kg/day for the market in Shanghai. Producers in Vietnam, Thailand and China share this market. Thailand exported a total of 43.67 tonnes in 2004 (Thongrod, S., 2005).

In the square cages, juveniles are placed in two layers and are immersed in the shrimp pond. Feeding is with trash fish.

Interest in its culture is increasing as studies show that grow-out can be carried out in disused shrimp ponds such as those previously used for the culture of the tiger shrimp. This provides an alternative crop for shrimp farmers during a period when shrimp prices are low. Alternatively, other researchers have also demonstrated its culture in polyculture systems with seabass and grow out in flow through systems.

In the aquaculture of this sea snail, there is a two month hatchery period for the spats of 1-2 cm and another 6-7 months for the further grow out to marketable sizes of 5-6 cm. (120-150 pcs/kg). Marketable sizes vary with markets. In Thailand it is 60-80 pcs/kg but for export, the sizes are smaller at 90-100 pcs/kg.

At the centre in Chantaburi, the natural breeding of the sea snails is carried out in small concrete tanks. The average hatching rate is 95.0%. On reaching the swimming veliger stage which is usually after 7 days, the stock is then transferred to larger 2 tonnes tanks with 1 m water depth for the settling phase. After two months, the spats are about 1 to 1.8 cm and they are sold to farmers who continue to grow them in coastal bays for seven months until marketable size. At the centre, once spats are settled, they are also sold to local hatchery operators who continue to grow these to juvenile sizes of 1-2 cm.

Prices depend on sizes. The smaller one cm juveniles of 3,000 pcs/kg are sold for 0.60 Baht each whereas the larger 1,400 pcs/kg and each measuring 1.8 to 2cm are sold for one Baht each.

Aside from the work on the breeding and nursery techniques, researchers at the centre are working on suitable feeds for the larval stages of the sea snail. They are investigating the advantages of feeding *Chaetoceros* as compared to *Tetraselmis*. Other aspects being investigated are the costs of feeding with *Spirulina* powder. Until 2 months, the main feed is adult *Artemia* produced locally in

Grow out techniques

Disused shrimp ponds are used for the grow-out production. In one trial, they have stocked the sea snails in cages at a density of 400 pcs/m^2 in the pond. Growth was fast as within three months. The 1,600 pcs/kg spats grew to 250 pcs/kg. The sea snails were fed with trash fish and the FCR was 2. The bottom of the cages is lined with sand and waste in the sand is siphoned out daily. Aeration is provided by paddlewheels located near to the culture area. In the rearing cages, more aeration is provided by air lift systems.

In an experiment, researcher Luechai Darunchu studied the effects of density on the culture. In his experiments, the stocking density was varied from 350/m^2, 450/m^2, 550/m^2 to 650/m^2. The best growth was achieved at the lowest density but there was no statistical difference in growth rate between treatments. The main difference is actually in the difference in the number of days to reach marketable size. The variation was 15 days. As the spats were placed in several layers, he also discovered that there was no difference in growth of spats kept in the upper and bottom layers.

What is next for the centre? Research in this species will continue and next, they will develop moist feeds such as a mixture of squid, fish and oil. Also coming will be trials to test the growth of sea snails at lower salinities.

Reference

Thongrod, S., 2005. New species for aquaculture. Presented at the DSM Nutritional Products Conference, 24 November, 2005.

Larger sized juveniles (1,400 pcs/kg)

Smaller sized juveniles (3,000 pcs/kg)

Dr Lila Ruangpan (right) and Bung-orn Srimukda, at the centre. Dr Lila is now based in Bangkok

How to fast track the grouper culture business?

By Iffa Suraiya

The culture of the groupers can be a big business in Indonesia as the country has the right conditions – a warm climate, unspoilt farm locations, farm technology and most importantly, a steady supply of fingerlings from local hatcheries. So what is holding back the industry? Four industry players give their views.

In recent years, grouper culture has been expanding. Production estimates totaled 6,552 tonnes in 2004. The high value species are the mouse grouper (*Cromileptes altivelis*), mud grouper (*Ephinephelus suellus*), tiger grouper (*Plectropomus leopardus*) and orange spotted grouper (*P. maculatus*). The main culture areas are in Riau province (Serai Island, Kijang Island, Dompak in Bintan island and Senayan Island), North Sumatera, Lampung in South Sumatera, Java Island (Grajakan, Banyuwangi, and south east part of Madura), Bali (Gilimanuk in the North coast and Gili Genteng in the south), West Nusa Tenggara (NTB), Sulawesi (North, Central and South East) and Maluku.

Wayan Suja, owner of PT. Tirtalini Perdana has 250 cages holding tiger and mouse grouper in Teluk Saleh, on the north coast of Sumbawa Island

"The push factor for the development in grouper culture is the declining production from wild catch due to destructive practices, high prices of the grouper, availability of local fingerlings and the availability of trash fish for feeds", said Wayan Suja. "The import of fingerlings from Taiwan is too costly and other countries do not produce fingerlings in such large numbers as Indonesia".

Of course being a low cost producer has its drawbacks. Wayan recounted how this once went against producers in Indonesia. "In 2005, a Taiwanese company operating in East Java purchased large numbers of tiger grouper fingerlings of relatively good quality at low prices from Indonesia. They then sold these to farmers in Hainan Island, which then pushed down the price of tiger groupers. This brought down the demand for fingerlings and in turn hit back at several hatcheries in Gondol and Situbondo, causing them to close their business".

Wira Cahyadi has 400 units of grouper cage in north coast of Bali

The opportunities are in the export markets of the region, in particular, China and Hong Kong.

According to Wira, in the Hong Kong market, prices for live groupers range from USD 7.5 to USD 35/kg, depending on the species. Currently, the best market price in Hong Kong is for the mouse grouper. Buyers usually come directly to the cage farm and use well boats to transport live fish directly to Hong Kong.

"For the grouper, culture conditions must be in secure locations away from rough seas and winds and rivers than can carry farm, poultry and industry wastes. The current price for fingerlings range from IDR 1000 – IDR 2000 (USD 0.10-0.20) for 1-2 cm sizes. Prices for the tiger grouper are lower at IDR 700. To stock grouper in the cage, Wira suggests that fingerlings of 3 inches (about 8cm) are used. In Bali, these cost IDR 3000 (USD 0.3). The mouse grouper will take 1.5 years while tiger grouper only needs 10-12 months of culture to reach the marketable size of 500 g.

However, there are limitations in the market. Wayan said, "Different from the salmon market which mainly targets Western and Japanese cuisines, our production will need to cater for the Asian cuisine, particularly that of the Cantonese in the region. Restaurants serve 8 to 12 menus at one time and thus the variety of species is very important". He added, "Currently for Indonesian grouper growers, we are limited to two species only, ie the tiger and mouse grouper. In order to develop a good market in Indonesia, we have to culture 6 to 10 species of groupers".

Currently in Indonesia, hatcheries have the capability to produce 5 species of fingerlings, tiger, mouse, batik, sunu (*P. maculatus*) and potato grouper (*E.tukula*). The Gondol Research Institute for Marine Aquaculture (GRIM) in Bali is currently implementing seed technology in order to provide the grouper seeds. This station can produce at least 9 million fingerlings/year of size of 2-3cm and 6 million/year of fingerlings of size 5-8cm.

Grouper cage 3m x 3m x 3m

Tiger grouper fry ready to stock at 10 cm size

Preparing fresh fish for the grouper

The modern grouper nursery in Manado belonging to Indrajit.

Grow out practices

Both Wayan and Wira agree that the best way to culture grouper is to get 10cm fingerlings from nursery tanks and put in cages with good water quality and good currents. Usually the survival rate of fingerlings less than 10cm size is poor. At the same time, the main cause of mortality is parasitic infections, which kill the smaller fingerlings at high stocking density in areas with bad water quality.

The best combination is 10 cm size of fingerlings, good water quality, clean nets and drums and low stocking density. "Good treatment to infected fingerlings is a must." said Wayan. "A fresh water bath will be effective for most of the parasites".

Feeding regimes

Currently, farmers use trash fish. However, only groupers with previous 'training' (weaning) can be fed with pellets. Available pellet feeds have a crude protein level of 48% - 50%. This pellet had already been formulated by GRIM. So far there has been no available field data for pellet feed usage, according to Wayan.

Wayan added, "This is right moment for the feed industry to produce pellet feed. The increase in fuel price has affected the supplies of trash fish. Many fishermen could not go fishing. The fish supplies are decreasing and at the same time, quality is unstable."

Table 1: Potential Areas for Grouper Culture with Floating Cage System

Province	Region	Area (ha)
Aceh	Weh Island, Sabang, Lnok Sudu Gulf, Simeulu Island	200
West Sumatera	Ma Siperut, Sikapa, Siobar, Sipora Island, Sikkap Burial Island, Tarusan, Painan	100
Riau	Batam Island, Bintan Island	350
Jambi	Nipah Panjang, Kg Laut, Kuala Tungkal	50
South Sumatera	Bangka	200
Lampung	Hurun Gulf, Lampung Gulf	800
West Java	Banten Gulf	400
East Java	Gili Genteng Gulf, Grajakan, Banyuwangi, Perigi, Sendang Biru	300
Bali	Pejarakan	50
West Nusa Tenggara	Ekas Gulf, Waru Kelapa Gulf, Tanjung Sabodo, Saleh Sumbawa Gulf	440
North Sulawesi	Sangihe Island	200
South Sulawesi	Ujung Pandang, Pinrang, Slayar	200
East Kalimantan	Tarahan, Berau, Bontang, Sengkuriang, Adang Gulf	110
Maluku	Ambon	200

Sources : Ministry of Fisheries and Marine Affairs, 2005

P. Hidayat is General Manager of PT. Suri Tani Pemuka which produces grouper feeds from its factories in East Jawa.

Responding to this, P. Hidayat from PT. Suri Tani Pemuka (STP), said," We are well prepared for this. We have also given our full support to the trials done by Gondol Station. The feed used in Gondol was formulated and produced by STP"

However, Hidayat admitted that this success would not be good enough for farmers to change from using trash fish to pellet feeds. Wira Cahyadi is still using trash fish. The reason given is that grouper fed by pellet feed start to loose their appetite and growth is affected. By changing to trash fish, growth improved.

Giving more details on the acceptance of pelleted feed by the tiger grouper, Wira said, "Once the fish ate the pellet, it would spit it out. My assumption was that it was because of the hard pellet texture causing difficulties in chewing. Different from the mouse grouper, the tiger grouper has small teeth. The mouse grouper would instantly swallow the pellet. But this grouper has a unique feeding behaviour. Once they eat, they will not take any more feed for some time."

Indrajit, farmer in Manado, North Sulawesi operates a modern nursery and grow out farm

Indrajit, from Manado said, " Based on my experiences in using the grouper feed for more than 3 years, the current available commercial feed are still far from perfect in terms of growth rate and palatability ".

Nevertheless, all agreed that for the sustainability of the industry, pellet feeds are required.

Indrajit said, "To have a large grouper farm business in Indonesia, the best way is to use pellet feeds."

Wayan stressed, "In 5 to 10 years, the availability of pellet feeds will be very important, since supply will be more reliable than trash fish.

Wira said, "It is critical to formulate and produce a pellet feed with similar texture as fish meat. This should be one that is soft but will not disintegrate in the water."

As for the future, all four are confident that the cultured grouper market will be very good. "All will be fine if farmers can grow 6 to 10 species. Then many grouper traders will be more than happy to take our fish", said Wayan.

Part 1: Influence of farming methods

Quality issues in marketing white shrimp Penaeus vannamei to European markets

By Hervé Lucien-Brun and Frédéric Vidal

The two principal European shrimp markets, Spain and France have special requirements for the imports of raw frozen white shrimp, *Penaeus vannamei*, which are processed and marketed as cooked and chilled. In this two part article, the authors discuss how production and harvesting methods influence shrimp quality specifications ranging from organoleptic, off flavour to shrimp colouration that are demanded by consumers in these markets.

Cooked head on shell on shrimp in markets in France

Chilled and cooked shrimp of 80/100 size in France

The white shrimp *Penaeus vannamei* was introduced in Asia several years and production is increasing significantly. It is now becoming a very serious competitor to products from Latin America. Presently, the major shrimp producers export to the European Union, which is the second largest market (33% of the world market) after the United States (40%) and followed by Japan (27%).

The two principal European shrimp markets, Spain and France imported more than 85,000 tonnes and 50,000 tonnes of whole head-on tropical peneaid shrimp, respectively. In France, the market has special requirements because consumers buy mainly shrimp head-on shell-on (HOSO). Most of the white shrimp are marketed as cooked and chilled. Annual volumes total approximately 30,000 tonnes. In contrast, black tiger shrimp *P. monodon* are marketed principally in the frozen raw state. An exception is farmed tiger shrimps from Madagascar and from some farms in Indonesia.

In Spain, shrimp are mostly sold as raw frozen product. However, the amounts of cooked and chilled shrimp have been increasing in recent years and reached 30,000 tonnes in 2005. However, this increase in demand resulted in slight price increases. Consumption in Europe was affected immediately. This showed that the price/kg has an immediate yet negative impact on the consumption of the consumers. This is the main reason that the European market prefers smaller sizes of *Penaeus vannamei* shrimp, namely 60/80 pcs/kg in Spain and 80/100 pcs/kg in France. It is also a method to moderate pricing by downgrading size.

Accordingly, once the raw whole product reaches Europe, it is transformed through a cooking process ready for the market. Here, the frozen shrimp is thawed progressively, the amount of which is determined by market demand. It is then cooked, chilled, packed and supplied to distributors where they are sold within a maximum of 5 days. In France, the shrimp is sold as loose "fresh cooked" chilled product, through various outlets such as supermarkets (65%), specialty fish shops (30%) and the remaining 5% in restaurants.

This industrial operation must be carried out quickly given the instantaneous market demand. Strict sanitary codes are implemented and enforced by food health authorities in these countries. These demand that companies must implement very rigorous sanitary procedures. The raw material used therefore, must be of impeccable quality with regards to importers' specifications and that this quality must be constant.

The main quality points are that weight and grade must be in accordance with the submitted specifications. In addition, there is also a wide range of organoleptic criteria which are often subjective. These are:

- good flavour and taste
- constant reddish colour after cooking,
- firmness of carapace and head,
- absence of morphological defects such as necrosis and/or physical defects
- absence of melanosis

In most cases, the way in which the shrimp are farmed and then harvested is of extreme importance in order to produce a top quality product. The production process can be divided up into the following steps:

- Farming and harvesting method
- Preliminary sampling
- Leaving the pond
- Chill killing, treatment, processing
- Transport to the packing plant

Influence of farming method on the final quality of shrimp The farming method has a direct influence on the two important quality criterion- flavour and colouration.

Off flavour

In some pond conditions the shrimp could have off flavour such as a grassy or soil-like taste and odour called 'corn smell' (or 'olor a choclo' in Ecuador). This type of problem will cause customers to react immediately.

The 'off flavour' is the result of an excess of certain types of blue green algae or cyanobacteria in the pond, of which 'lab-lab' is an example. In frozen shrimp, this off flavour tends to be accentuated in the shrimp over long periods of time. This then becomes a frequent reason for major quality claims. A very light taste in fresh shrimp can become very strong when it is defrosted several weeks later. (This effect of the *Cyanobacteria* is well documented, as the same phenomenon is observed in wine in when grapes are covered with this algae)

The presence of *Cyanobacteria* can be observed in two specific cases. When inputs of fresh water are intermittent but greater than evaporation, there is decreased salinity. This effect is generally observed during the rainy season in tropical areas, in farms pumping water from river estuaries. The reverse is when evaporation is higher than fresh water intake into a pond and salinity increases. This could be observed in farm localized in desert area, in Middle East, for example. In both situations, the general effect is an almost total colonisation of the water by blue green algae or in the sediment as lab-lab.

The problem can be detected by tasting cooked shrimp during sampling. Corrective measures would be to increase the water exchange or increase aeration. Water movement is very important. Generally lab-lab problems originate in pond corners with low water movements and there is little water exchange. Another possible measure would be to alter the fertilization of the ponds with algae promoters and allow them to compete against the *Cyanobacteria*.

When the problems of *Cyanobacteria* are solved, it can be a few days before the off flavour is mitigated. Nevertheless, if the problem is well established and has persisted for a long time, it is more difficult to remove it. Therefore it is imperative that the problem is detected during the early stages via weekly sampling.

The use of an algae promoter in the ponds such as Water Oligo manufactured by Aqua Techna can help to reduce the quantity of the Cyanobacteria in the pond and thus reduce the problem of off flavours in shrimp.

Colour

The visual aspect of shrimp is one of the first criteria on which a decision is made by consumers when buying shrimp. Colouration of cooked product is one of the most important criteria attributed to quality. For most consumers, the red-orange colour of cooked shrimp is the most attractive component of the product. Unfortunately, due to dietary limitations, farmed shrimp is sometimes slightly under-pigmented.

Colour is one of the major factors considered in the determination of price. Buyers place importance on this criterion, both in sourcing as well as in pricing. Given the large amount of shrimp in world markets and the product offered to Europe, it is conceivable that the buyers would reject shrimp based on colour alone.

Cooking the shrimp

Astaxanthin is responsible for the reddish-orange colour in cooked shrimp. Most crustaceans are able to metabolize various pigments through different biochemical pathways to synthesize astaxanthin which is widely found in prawns from wild catch as well as in farmed shrimps.

The possibility to induce colour enhancement in the final product form through additives in the shrimp feed has undeniable economic advantages for the majority of the European markets. Several natural products rich in carotenoids such as *Spirulina* or paprika for example, or a synthetic form astaxanthin, have been tested in various commercial feeds with erratic, inconsistent results. Frequently the cost of such substances is so high than their use is economically prohibitive. (See next article on shrimp colouration).

Next issue: Part 2 of this article will discuss processing methods influencing shrimp quality and the control of melanosis.

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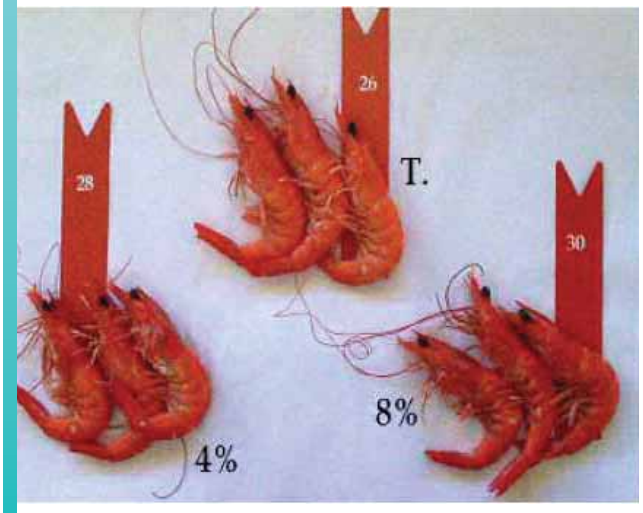
Shrimp pigmentation with natural carotenoids

By Hervé Lucien-Brun and Frédéric Vidal

Natural alfalfa concentrate in finisher feed fed during the last month of the grow-out cycle significantly increases the reddish colouration of shrimp after cooking.

Dr Gerard Cuzon and the IFREMER team in Tahiti, French Polynesia studied the effect of adding a natural source of carotenoids from alfafa concentrate on shrimp pigmentation. The product is obtained by the dehydration of this widely used forage. The extraction process uses water and heat application.

In a series of trials, conducted in clear water tanks with controlled parameters (36ppt and 26°C), the effect of the alfalfa concentrate Pigmentech (Aqua Techna, France) was tested on marine shrimp *Penaeus stylirostris*, at three inclusion rates T (0% Pigmentech), A (4% Pigmentech) and B (8% Pigmentech). There were 6 replicates.



Variation of the colouration between the three batches after 21 days of experimentation

Shrimp were individually weighed at the start of the experiment and fed 3-4 times/day at 5% body weight per day. Shrimp were sampled on day 7 and day 21 and two shrimp were sampled from each tank per time (6 replicates and thus 12 shrimp per treatment). The analysed parameters were:

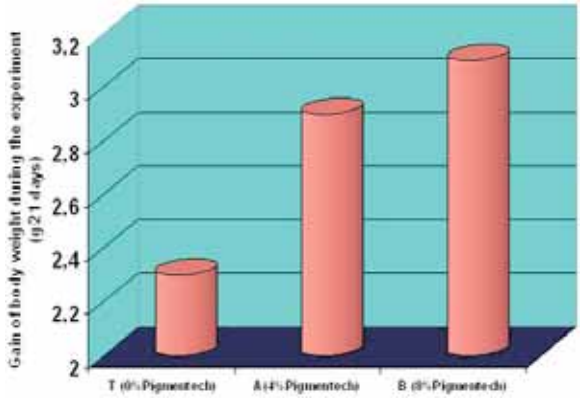
Pigmentation: For this purpose, 6 shrimp from each treatment were immersed in boiling water (5g/l of salt) for 3 minutes. Subsequently, the shrimp were placed on a black area and/or a white zone in order to evaluate colouration using the Roche index: SalmoFan™ (a graduated pink color chart from 20 to 34, see photo). Colour was evaluated by a team of 10 people.

Table 1. Changes in colouration after 21 days of experiment

T (0% inclusion)*	A (4% inclusion)*	B (8% inclusion)*
26.4 ± 1.3	28.3 ± 1.1	30.2 ± 0.9

**Percent inclusion of the alfafa concentrate Pigmentech in diet of shrimp*

Figure 1. Effect on the shrimp colouration



Zootechnical: The growth rate, survival and number of molts were analysed. After 7 days of experiment, there was no statistical difference between treatments. However, at day 21, the results were as shown in Table 1 and after 21 days of experiment, colour was significantly enhanced as seen in cooked shrimp.

The addition of the alfafa concentrate also showed a very positive effect on animal responses, especially in terms of growth as shown in Figure 2. This improvement in the growth rate may be explained by the digestibility of the proteins contained in the alfalfa. However, it could also be attributed to the high content of natural antioxidants and

Figure 2. Effects on the growth

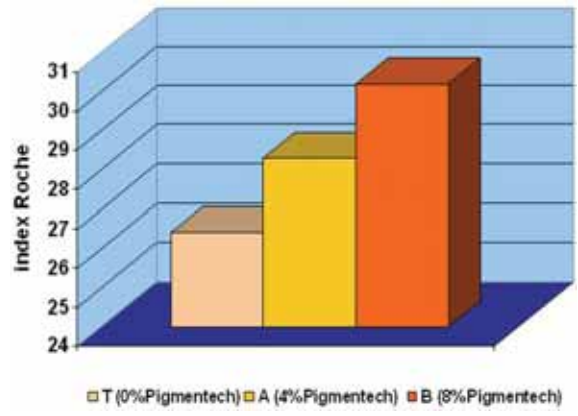


Table 2. Concentration in total carotenoids ((μg) in the tissues of the shrimp sample

Shell	Number of shrimp	Q (μg)	C (μg/g)
T (0%)	5	0.6 ± 0.1	18.7 ± 10.8
A (4%)	6	0.7 ± 0.2	12.2 ± 2.3
B (8%)	6	0.8 ± 0.3	20.8 ± 10.7
P (from pond culture)	6	0.8 ± 0.4	13.9 ±6.3
Epidermis	**Number of shrimp**	**Q (μg)**	**C (μg/g)**
T (0%)	5	24.8 ± 2.6	510 ± 141
A (4%)	6	32.8 ± 12.1	890 ± 221
B (8%)	6	42.2 ± 4.8	1,383 ± 318
P (from pond culture)	6	27.8 ± 9.9	781 ± 235
Hepatopancreas	**Number of shrimp**	**Q (μg)**	**C (μg/g)**
T (0%)	6	18 ± 10	28 ± 15
A (4%)	6	81 ± 66	119 ± 95
B (8%)	6	104 ± 78	156 ± 115
P (from pond culture)	6	340 ± 90	1,144 ± 520

Q is the quatity of carotenoids as μg/g in the sample (shell and epidermis, 3.6cm² per sample and the total hepatopancreas). C is the concentration of carotenoids as μg/g of dry weight of tissue after extraction.

Table 3. Distribution of the various forms of astaxanthin in the hepatopancreas and in the epidermis of the shrimp sample

Percent of total carotenoids in the hepatopancreas			
	Treatments		
	T (0%)	A (4%)	B (8%)
Free astaxanthin	43.9	31.9	29.4
Mono-ester astaxanthin	8.7	24.8	24.0
Di-ester astaxanthin	12.0	15.0	18.0
Total astaxanthin	64.6	71.7	71.4
Percent of total carotenoids in the epidermis			
	Treatments		
	T (0%)	A (4%)	B (8%)
Free astaxanthin	48.4	55.3	48.5
Mono-ester astaxanthin	17.1	18.6	26.4
Di-ester astaxanthin	18.4	12.3	10.9
Total astaxanthin	83.9	86.2	85.8

essential fatty acids. Nevertheless, no effect was observed in terms of molting rate or survival, during this period.

This first study showed that shrimp colouration was enhanced by the use of the concentrate in the feed, even at low rates of inclusion (4 and 8%). This showed that shrimp fed with these diets could accumulate the carotenoid pigments and demonstrate similar beneficial effects. Similar results were obtained with *Penaeus vannamei* by separate teams in Thailand and China.

Analysis of carotenoid contents

The purpose of the second work carried out by O. Berticat, R. Castillo and G. Nègre-Sadargues from the Laboratory of Ecophysiology of the Invertebrate, University of Montpellier, France was to investigate factors controlling the nature of the pigments involved in pigmentation of shrimp. The pigments present in the concentrate are mainly yellow (lutein) and orange (carotene). Thus, the objective was to determine the nature of the pigments obtained after bioconversion by the shrimp.

During the experiment carried out in Tahiti, six shrimp in each treatment T, A and B, were sampled and deep frozen at -80°C. At the same time, shrimp (group P) were sampled from semi-intensive earthen ponds in a farm in Tahiti.

For each individual animal, the total carotenoid inclusion level and the qualitative analysis of these pigments were carried out by chromatography on tissues. These results in Table 3 showed an increase in the carotenoid concentration in the epidermis from group T to B. The same tendency could be noted in the hepatopancreas.

In each group, the exoskeleton was near transparent with a very low concentration of carotenoids. The epidermis is the richest tissue in pigments. This concentration was directly related to the level of pigments present in feed. The pigment content in the hepatopancreas showed significant individual variations. It also showed increasing concentrations with the increases in the level of pigment in food.

In spite of the small number of analyses carried out, the results indicated that *P. stylirostris* fed pellets supplemented with carotenoids absorbed the pigment in the feed, which after bioconversion, accumulated in the hepatopancreas before being transferred to the epidermis during the formation from the new integuments during the premolt stages.

The concentration in the carapace of shrimp from the earth pond (batch P) showed contents of pigments comparable with those of the three other treatment groups. The hepatopancreas was pigmented much more than the epidermis and is similar to that of group A. Compared to this "wild" batch, the control animals (0% carotenoid) were de-pigmented and those fed with pellet enriched with 4% of Pigmentech preserved the initial content of pigment, while those where the feed enriched with 8% have the highest carotenoid level. In treatment groups, the pigments from the alfafa concentrate appear to be better absorbed than the natural pigments available in the earthen pond resulting in a better colouration of the tissues.

The various forms of astaxanthin of which the quantity increases in the epidermis and the hepatopancreas of supplemented shrimp came from yellow carotenes and xanthophylls provided by the supplementation in the feed.

Economical aspects

The alfalfa concentrate is also one of the least expensive sources of carotenoids available on the market. If we compare the cost/g of active ingredient, Pigmentech can be the most price competitive product compared to most common products used as colour enhancers, such as synthetic astaxanthin, paprika or the *Spirulina* based pigments.

In the above trials, we were only considering the effects on pigmentation through the inclusion of carotenoids in the pelleted feeds. There are, however, other additional benefits of the inclusion of the alfalfa-based pigment as a source of limiting amino acids, essential fatty acids and antioxidants, all of which have effects on economically important variables such as growth and survival. Moreover the high level of protein in the concentrate allow its use as an ingredient to substitute for other, more expensive dietary components such as fish meal.

Conclusion

These studies showed that the incorporation of the natural alfalfa concentrate at between 4 to 8% and fed during the last month of the grow-out significantly increases the reddish colouration of shrimp after cooking. Subsequent analysis showed a significant increase in carotenoids, particularly in astaxanthin, in the shrimp tissue.

Using peas in tilapia feed formulations

By Howard Hill and Timothy Welsh

Feed peas can be an economic substitute for soybean meal in tilapia formulations. In this article, the authors show that feed pea can act as a plant protein substitute in fish feeds without affecting growth performance.

The use of feed peas, *Pisum sativum*, as a substitute for other vegetable sources of protein and energy has been well researched and proven (Welsh, 2002; Welsh and Creswell, 2003). Peas have long been known as an alternative crude protein source, as well as a source of energy and starch, in other animal feeds (Tables 1 and 2).

Table 1. Proximate composition of feed peas

% as is	Range
Moisture	10.0 - 11.0
Crude Protein	22.0 - 25.0
Crude Fat	1.0 - 1.5
Crude Fiber	4.0 - 7.0
Ash	3.0 - 3.5
Gross energy (kcal/kg)	4,000 – 4, 200

Source: Allan 1997

Table 2: Carbohydrates in feed peas

Carbohydrate type	%
Starch	34.8 –54.1
Cellulose	2.4 - 7.9
Sugar	1.0 - 5.7
Oligosaccharides	3.7
Crude fiber	4.9 - 6.3
Acid Detergent Fiber	6.0 - 8.7
Neutral Detergent Fiber	10.0 - 12.0

Small-scale trials using feed pea as a protein substitute have indicated that, based on prices of soybean meal and fishmeal, peas can be used as an economic substitute. Research has identified peas as an effective pellet binder (Hill & Welsh, 2006) and showed that the addition of peas to an aqua formulation had a binding effect which improved the fines and water stability of feed pellets. Plant breeding of peas is carried out using traditional methods, which further enhances the value of feed peas as a non-GMO (genetically modified organism) ingredient.

The USA Dry Pea and Lentil Council contracted research with a large feed miller in the Philippines in order to conduct feeding trials with the tilapia, *Oreochromis niloticus* fed diets with inclusions of pea. The trials covered all growth stages from starter to final harvest. The trials in cages on Sampaloc Lake, San Pablo City had the following objectives.

1. To compare average daily gain (ADG) and feed efficiency, measured by feed consumption (FC) and feed conversion ratio (FCR)
2. To measure fish dimensions (length and width) in order to establish a possible correlation between feed and fish size

The trials

Nile tilapia fingerlings were obtained from the Sandigan Cooperative, Samplac Lake, San Paulo. Six cages, each measuring 10m x 10m x 7m were used. The preparation and setup followed standard practices. Each cage was stocked with 5,000 fingerlings. The 6 cages allowed for 3 replications of two treatments. Before the experiment, the fingerlings were fed a standard fry mash for 24 days. By the start of the experiment, fish were 45 days old and weighed 14g. Up to this point, all fingerlings were reared under the same conditions and received the same standard fry mash. Therefore, similar weight gain and losses can be assumed.

The trial had 3 phases-starter, juvenile and adult. Feeding with the starter formulation containing 12% pea lasted 35 days. Feeding of the juvenile formulation containing 20% pea lasted 22 days, while an adult formulation containing 25% pea was fed for 36 days. (Table 3)

Table 3: Trial feeds and treatments with pea content

Feeding Days	Formulation	Treatment	Component
35	Starter	T1	12% Peas
		T2	No Peas
22	Juvenile	T1	20% Peas
		T2	No peas
36	Adult	T1	25% Peas
		T2	No Peas

All diet formulations were designed to provide similar nutrients, based on combinations of different raw materials. The composition and prices of the major raw materials are shown in Table 4. Peas mainly replaced soybean meal and raw materials that contain energy, such as high fat rice bran or tapioca. Ingredient prices are rounded figures in USD, and based on market survey information for prevailing prices in the Philippines during March 2005 (USDPLC).

Table 5. Length and width measurements of fish

Stage	T1 – with Peas		T2 – without Peas	
	N	Length (L) / Width (W) in cm	N	Length (L) / Width (W) in cm
Start of culture (14 g)		L 7.0 - 9.0		L 7.0 - 9.0
	15	AVG = 7.6	15	AVG = 7.6
		W 3.0 - 4.5		W 3.0 - 4.5
	15	AVG = 3.5	15	AVG = 3.5
14 days from start of culture		L 10.0 – 12.0		L 10.0 - 12.0
	10	AVG = 10.8	10	AVG = 10.5
		W 4.0 - 5.0		W 4.0 - 5.0
	10	AVG = 4.5	10	AVG = 4.6
93 days from start of culture (harvest)		L 17.5 – 20.0		L 17.0 - 21.5
	14	AVG = 19.1	16	AVG = 19.1
		W 7.5 - 9.5		W 7.5 - 9.5
	14	AVG = 8.8	16	AVG = 8.5
Gain during trial		L = 11.5,		L = 11.5,
		W = 5.3		W = 5.0

Table 4. Feed composition, nutrient analysis, and cost in USD

		Starter				Juvenile				Adult			
	Cost	T 1		T 2		T 1		T 2		T 1		T 2	
Ingredients*	USD/ mt	12 % Peas		No Peas		20% Peas		No Peas		25% Peas		No Peas	
		%	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost
Peas	225	12	27			20	45			25	56		
Corn, yellow	165	10	17	10	17	6	10	10	17				
Pollard/Midds	150			6	9	6	9	20	30	25	38		
Rice Bran HF	170	3	5	11	19	15	26	15	26	20	34	20	34
Tapioca Pellets	135							7	10			11	15
Corn GM 60%CP	485	6	29	6	29								
SBM 47% CP	310	43	133	47	146	36	112	44	136	24	76	34	104
Other materials		26	105	26	106	17	62	18	69	11	42	10	43
Total cost (USD/mt)			316		317		264		267		238		234
Analysis		%		%		%		%		%		%	
Moisture		11.0		11.2		10.8		11.3		10.0		13.0	
Crude Protein		35.1		35.0		28.8		28.6		25.2		25.0	
Crude Fat		5.2		6.4		6.2		6.4		5.9		6.2	
Crude Fiber		3.7		3.7		4.8		4.4		5.5		5.5	
Ash		6.8		7.2		6.7		7.3		8.2		8.7	

** Formulas used are solely for demonstration purposes and based on analysis of the specific materials used in the trial and are not applicable to raw materials with different composition. Other materials were similar in their inclusion and added to obtain similar nutrient composition in all treatments.*

Table 6. Estimates of biomass changes & final growth performance

Treatment	Feeding days	Initial Wt (kg)	Final wt. (kg)	Weight gain (kg)	ADG (kg)	Total FC (kg)	ADFC (kg/day)	FCR
T1 Replicate 1	93	48.2	835.0	786.8	8.5	1368.9	14.7	1.74
T1 Replicate 2	93	61.5	711.0	649.5	7.0	1426.2	15.3	2.20
T1 Replicate 3	93	61.5	696.0	634.5	6.8	1426.2	15.3	2.25
T1 – With Peas Average	93	57.1	747.3	690.3	7.4	1407.1	15.1	2.04
T2 Replicate 1	93	44.0	660.5	616.5	6.6	1368.4	14.7	2.22
T2 Replicate 2	93	61.5	805.5	744.0	8.0	1426.2	15.3	1.92
T2 Replicate 3	93	61.5	721.0	659.5	7.1	1426.2	15.3	2.16
T2 - Without Peas Average	93	55.7	729.0	673.3	7.2	1406.9	15.1	2.09

ADG=average daily growth, FC=feed consumption, ADFC=average daily feed consumption

Table 7. Total cost of feed used

	Starter		Juvenile		Adult		Total	
	T1	T2	T1	T2	T1	T2	T1	T2
	12% Peas		20% Peas		25% Peas		With Peas	
Cost (USD/mt)	316	317	264	267	238	234		
kg used	257.3	257.2	293	293	856.7	856.7	1,407.0	1,406.9
Cost (USD/mt)	81.29	81.48	77.33	78.14	203.80	200.87	362.43	360.49

Trial Results

Fish dimensions

Sampling within this "live" type situation provided some difficulties. Accurate measurements were only possible at the start and at harvest. Only small sample sizes were taken in the intermediate phases between starter and juvenile and between juvenile and adult. Fish length and width measurements can be seen in Table 5. There were no significant difference between the treatments.

Weight gain

The results showed that tilapia fed with diets containing the feed peas (T1) had a slightly higher initial weight (2.5% or 1.4 kg; see Table 6) compared to the non-pea group. This difference remained constant to harvest, when final weight of the T1 group was 18.3 kg higher. This was an additional 16.6 kg in weight gain. The average daily gain (ADG) was 7.4 kg for pea-fed tilapia group and 7.2 kg for non-pea group. These results were achieved with the same level of total feed consumption of 15.1 kg/day. The feed conversion ratio (FCR) for treatment T1 fed with pea was slightly (+2.5%) better than treatment T2 with no inclusion of the pea.

The evaluation of the results was limited to a comparison of numerical averages because the small number of observations (3 replicates) limited statistical comparisons.

The total feed cost of the various formulations can be seen in Table 7. Some advantages can be seen in the pea formulations for starter and juvenile, which provided some reductions in the overall cost of feed through these stages. At the adult stage the pea formulation had a higher cost, which equated an additional cost. Over the entire feeding program, the additional cost for using pea within the formulation equated to USD1.94, or was 0.5% more expensive than the non-pea formulation. In this trial however, the extra 16.6 kg harvested covered the extra cost.

Thailand reduces dry pea tariff to 5%

In February, the Agriculture and Cooperatives Ministry announced that it will temporarily reduce tariffs on three types of pulses from 23% to 5% in 2006. The 5% tariff will be applied for dry peas, chickpeas, and lentils on a temporary basis in 2006 from previous rates of 23% for dry peas and chickpeas and 30% for lentils.

This will reduce the production costs of local dry pea snack producers and enable them to extend their markets. In addition, this will also provide an alternative ingredient for the feed industry. The Thai government will also benefit from higher tariff collections on the imports, which are mostly imported from Canada, Australia, and New Zealand.

The Office of Agriculture Economics has conferred with food processors, Association of Soybean and Rice Bran Oil Producers and Association of Thai Feed Millers. It has also analysed the impact of these three pulses' tariff reduction. They do not see any impact on feed ingredient prices because these pulses cannot be substituted for soybean or corn. Meanwhile, there is no impact on Thai pulse farmers because current production is not enough for local consumption. The products must be imported mostly from Canada, where Thailand does not have any free trade agreement.

This pulse tariff reduction will not have any impact on exports of crispy dry peas because processed peas would have high expenses with packaging and shipping. As a result, processed peas would be distributed mainly in local markets.

This one year trial will allow the concerned parties to evaluate the results of the pulses tariff reduction in terms of import volume and local consumption. This will also protect and give a period of time for local farmers planting substituted crops (i.e. soybean, mung-bean, and ground peanut, etc.) to make the necessary adjustments. (Source: translated and adapted from Krungthep Thurakij Newspaper, Bangkok, February 09, 2006)

Conclusions

It was concluded that the inclusion of peas into the formulations gave similar results as formulations based entirely on soybean meal as the major protein source. Depending on the cost of peas, they can be a viable alternative to soybean meal, especially in times where soybean meal is expensive.

Increasingly, trial results are showing that feed pea can act as a plant protein substitute in fish feeds without affecting growth performance.

(Editor's note: An article on the use of peas as binders will be published in the next issue Volume 2 (4)).

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Tim Welsh

Howard Hill

Tim Welsh is Managing Director of AgriSource Co. Ltd., a Bangkok-based food and agribusiness consultancy company that represents the USA Dry Pea and Lentil Council in ASEAN. Email: tim@agrisource.co.th

Howard Hill is Senior Project Manager for AgriSource.

First launch of fish feed segment

On March 7, Thailand's Inteqc Feeds marked its diversification into fish feeds with a river cruise on Bangkok's Chao Phyra River. Guests included 180 customers, mainly from the Northern, Eastern and Central parts of Thailand, distributors and local and international suppliers.

At the launch, Factory Manager Narath Plythirun (extreme left), Dr Preecha Ekthumasuit (second from left) and the Inteqc Feed team.

Dr Dhanapong Sangsue, Technical Manager said, "We started the production of sinking fish feeds in January 2006 and in February when our extruder was fully operational, we started the production of floating feeds. The special feature of the fish feeds in our Fish First, First Choice and First Mate range is the '*Immuneteqc Technology*'.

He added, "Basically, we start from sourcing quality ingredients, both locally and imported, in order to provide the right fish feed formulation for our customers. Furthermore, by using a combination of peptides, Protorsan and activated yeast, marketed by our sister company "Lab Inter", we have developed a feed that can stimulate general immunity against diseases in fish. "

Inteqc Feed is part of the Inteqc group of companies with its principle business is the manufacturing and marketing of feed additives for the terrestrial animal and shrimp industry. Inteqc Feed was established in 1999, mainly to manufacture and market shrimp feeds. Since 2004, it also produced flakes for shrimp larvae. It currently has 7 brands for the culture of black tiger and white shrimp under the various culture regimes.

The company decided to enter the market for fish feeds as the ingredients used are closely similar to shrimp feeds. It had been waiting for the right time to diversify into the fish feed market for several years. Dhanapong said, "We started from what we could do best, that is with shrimp feed. It took us took us only 6 years to become the second top producer in Thailand. When we have proved our Innovation, Technology, Excellency, Quality and Commitment (Inteqc) in shrimp feed, we were ready to go into fish feed production".

The formulation for this new range of feeds was developed in house. The first launch was of feeds for the omnivores such as catfish, gourami and tilapia. Next in the plans are feeds for carnivorous species and following this, feeds for the marine fish.

The company has targeted the fish culture areas in the Northern, North Eastern and Central region as future markets. This is where the main aquaculture species are catfish, tilapia and gourami. The tilapia feeds have 32-30% crude protein for grow out and 26% crude protein for the finisher feeds. The range of crude protein in feeds for the snake skin gourami range from 15-18%. Selling prices are around 10 - 20 Baht/kg (USD 0.3 – 0.5/kg). To market the feeds, the company will use its current network of distributors for its feed additives and animal feeds.

The company also announced the construction of facilities for the Knowledge, Research &Development Centre, complete with ponds, wet labs and library, which will come on line in mid 2006. Additional staff will be employed for R&D, in addition to using experts from local universities. The total investment will be more than Baht 12 million (USD 3 million), excluding equipment.

From left. Dr Victor Suresh, R&D Manager, Bentoli, Kawit Theerachun , Engineer, Inteqc Feed, Dr Chutima Tantikitti, Prince Songkhla University, Rutchanee Chotikachinda, R&D Manager and Dr Dhanapong Sangsue, Technical Manager, Inteqc Feed and Michael Van Den Dries, Feed International Europe.

From left, Kamon Sangkapondechapaiboon, Siam Plus with Dr Preecha

New lab technician for Wenger Technical Centre

The Wenger Technical Centre recently announced the addition of Rhonni Mitchell as a laboratory technician in its world-renowned agrifood laboratory. An employee of Wenger Manufacturing for nearly three years, Mitchell takes on the responsibility of analysing samples that have been sent to the lab by Wenger customers, as well as samples produced by clients using the centre's production scale extrusion and drying equipment.

"One of the best parts of the job is working with the people involved in this industry," says Mitchell. "That includes both the staff here in the Technical Centre and the customers who rely on our services."

Although the Wenger Technical Center offers a variety of laboratory analysis procedures, including access to Wenger's phase transition analyzer, Mitchell says most tests begin with a gelatinization test, rapid viscosity analysis (RVA), and phase transition analysis (PTA). Test procedures can also be performed to determine such things as maximum fat uptake, water solubility index, piece density and pellet durability index, to name just a few.

"Our main goal is to help the customer with quality control and to make sure the product is meeting the standards that have been established," she relates. "As a result, I get to experience something new almost every day."

The Wenger Technical Centre assists clients with development of product prototypes and production processes; project planning, and training and testing procedures. Celebrating its 40th anniversary in 2006, the centre also maintains a cooperative extension relationship with several major universities that offer extrusion-related research.

Wenger Manufacturing, Inc., headquartered in Sabetha, Kansas, USA, is a global designer, manufacturer and distributor of extrusion processing equipment and related replacement parts. Wenger systems are distributed in over 90 countries, through international sales offices in the U.S., Europe and Asia. Wenger offers a full product line including single and twin screw extruders, snack extruders, forming extruders, conical co-rotating twin screw extruders, universal pellet/cookers, dryers and flavor coating and enrobing systems for animal feeds, snack foods and cereal foods.

Grant for Research Centre on Extrusion in Pakistan

Dr. Mian N. Riaz, Head, Extrusion Technology Program, and Graduate Faculty of Food Science and Technology Program at the Food Protein Research and Development Centre, Texas A&M University and Dr. Faqir M. Anjum, Director, Institute of Food Science and Technology, University of Agriculture Faisalabad have received a grant of USD 709,000.00 to establish an Extrusion Centre at the University of Agriculture, Faisalabad, Pakistan.

The two year award is from the Pakistan-US Science and Technology Cooperative Program (National Academy of Sciences, US Agency for International Development (USAID) and Higher Education Commission of Pakistan). The selection process was highly competitive with only 11 awards out of 112 proposals.

Extruded food and feed products play a significant role in human and animal health in the US and other nations. To date this technology is absent in Pakistan, where it could have a major impact on food quality and utilization. The present project will establish the Centre for Excellence in Extrusion Technology. One of the focus of this Centre will be to promote and teach fish farmers to use extruded aqua feeds. This centre will also carry out teaching, research and product development for students.

Alltech-NACA Shrimp Health Management

Training Workshop, July 24-29, 2006, Bangkok, Thailand

As part of Alltech's efforts to develop further understanding and knowledge by industry professionals, it will collaborate with the Network of Aquaculture centers in Asia-Pacific (NACA) to conduct this workshop aimed at aquaculture producers and professionals involved in the shrimp industry.

Shrimp farmers know that healthy animals bring healthy returns and that the combination of sound husbandry, quality feed and a good environment are the best guarantees of success. However, this workshop will move beyond a simple technical focus to include some key business issues facing today's industry. Topics will cover aspects of shrimp culture from post larval assessment, pond preparation, water and feed management, shrimp health and disease management to basic farm operations management. Presenters are as follows:

Daniel F. Fegan, Regional Technical, Manager-Aquaculture, Alltech Thailand has worked in commercial aquaculture in the industry in Asia and Latin America.

Dr. Pornlerd Chanratchakool, Technical Manager, Novozymes A/S was behind the original NACA/AAHRI training course on shrimp pond health management which started in 1994. He is a recognised expert on aquatic animal health, especially for the shrimp.

Julian G. Davies, Managing Director, Siam Natural Resources Co., Ltd., Thailand. SNR has two shrimp farms in Trad Province and is an industry leader in the development of commercial farm management systems and direct marketing of farmed shrimp to retail markets.

Professor Tim W. Flegel, Mahidol University, Thailand heads 45 researchers at Centex Shrimp, Faculty of Science, Mahidol, University, Bangkok, Thailand. He is active in regional and international activities related to shrimp health management.

The registration fee is US$ 550. 00. The workshop is limited to 50 people. Contact:shrimp-school@alltech.com to make reservations and details on the workshop.

Easy test for Malachite green residues

Concerns are mounting on the risks to human health from the consumption of treated freshwater fish. These include carcinogenesis, mutagenesis, chromosomal fractures, tetragenecity and respiratory toxicity. More importantly is that there is a continued presence of the harmful Malachite Green (MG) and major metabolite Leucomalachite Green (LMG) in aquaculture products. More countries are including it in the list of banned substances in aquaculture. The chemical is usually determined by HPLC or LC/MS-MS. These methods are accurate but time-consuming in the preparatory stage and require rather costly apparatus.

Malachite green and leucomalachite green ELISA Kit

Nice Garden of Taiwan has Malachite Green (MG), and Leucomalachite Green (LMG) ELISA kits which offers a fast and convenient surveillance option. These kits, based on indirect competitive ELISA principle, were designed specifically to detect MG/LMG residues. It uses an enzyme immunoassay for the qualitative and semi-quantitative analysis of MG/LMG presence in fish muscle and pond water.The detection limit for MG/LMG is 0.5 ppb. There are no cross reactions to other antibiotics and sulfa drugs.

Results are obtainable in 90 minutes and the throughput per kit is over 80 test samples. Other merits include a simple and rapid preparation procedure (e.g. sample extraction can be done in one hour), water samples can be tested directly (i.e. no extraction is required) and LMG residues can be tested without any extra MG conversion procedure. In all, the assay provides a rapid and reliable analytical test result.

Immuno-modular protein to fortify biological defense

A constant issue of concern in aquaculture is disease outbreaks. Risks increases with high stocking density and farmers are often hit hard when high viral and bacterial levels or stress factors opens pathway to the spread of diseases. To address this, Nice Garden has an innovative product called LZ-8 Immuno-modulatory protein.

The company said that LZ-8 Immuno-modulatory protein presents a better option for both consumer and environment safety compared to venturing on banned antibiotics. L-Z 8 does not cause innate responses to plummet after a period of administration.

LZ-8 is featured with quasi-lectin coagulation and chemotaxis activities which enable it to function as an immunity modulator to fortify the biological defense of the animal. It prevents disease infections and improves survival rates. LZ-8 originally came from Ling –Zhi (*Ganoderma spp*). A patented technology (pending) is utilised to generate and extract LZ-8 protein from food-grade baker's yeast for mass production. Respective experiments conducted on fish and shrimp show positive responses such as better survival rate against Iridoviruses and Vibrio infection, increased THC counts and activated phagocytosis (Figures 1 and 2)

For more information: email: aqua@nicegarden.com.tw; web: www.nicegarden.com.tw

Figure 1a. Effect of LZ-8 on haemocyte count in shrimp

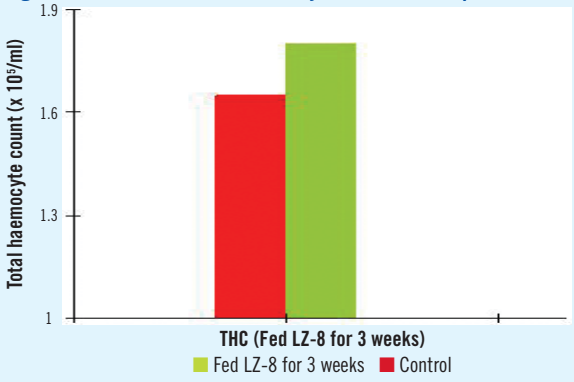


Figure 2a. Challenge immature grouper with iridovirus TGIV

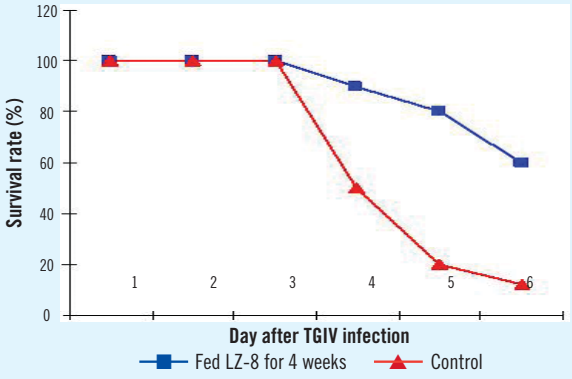


Figure 1b. Antivibrio activity in the haemolymph of shrimp observed during 3 hours incubation

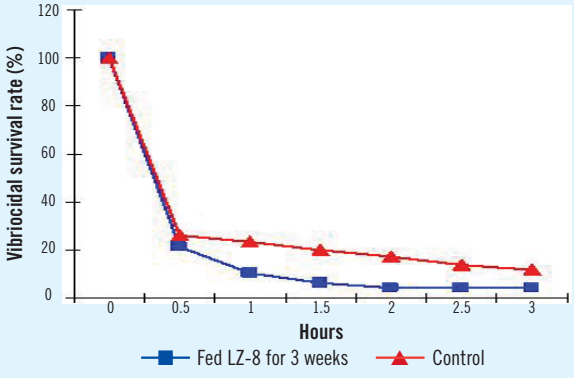
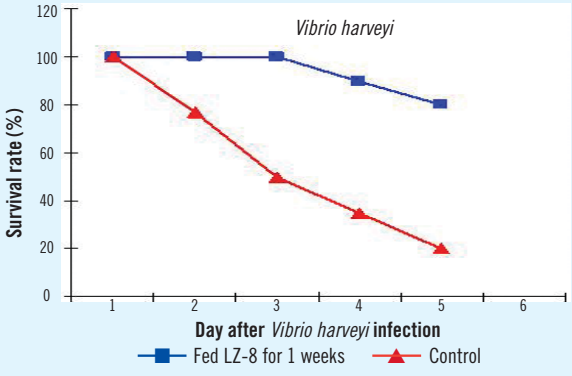


Figure 2b. Challenge immature grouper



Processing technology at Victam ASIA 2006

It was the who's who in feed manufacturing equipment at Victam Asia 2006 held in Bangkok from March 8-10. Most displayed extruders or scale down models. Visitors' interests were seen from poultry or toll feed producers keen to divest into the fish feed segment as sales of poultry feed decline with the uncertainty posed by the Avian flu virus. It could also be a reflection of increased interests in advances in extrusion technology as attention moves to marine and freshwater fish feed production.

Doug Baldwin (right) and Jacqueline Chuang,Wenger

Danny Huang of Idah Machinery Co Ltd with a piece of the cladded screw

Richard Hickey (left) and Laif Walde, Sprout Matador

According to the organisers, the general reaction from visitors, conference delegates and exhibitors was that the overall event was a great success. About 3,900 visitors from 51 countries attended the trade show at which 128 exhibitors from all over the world participated. A one day seminar of aquafeed production organised by Aquafeed.com was attended by more than 150 participants (See page 12).

At the show, **Wenger, USA** represented by Doug Baldwin and the team from the Asia Pacific Office exhibited their Model X-185 Optima Extrusion Cooker with Back Pressure Valve, used to control product density and degree of cook. More importantly, it is to improve the palatability for both floating and sinking aquatic feeds as well as pet food by increasing the mechanical energy of the products. The team said that it was a successful event for them and they concluded an order for the show unit.

At the **Stolz**, France booth, Louis Mourey said that in tests conducted in Vietnam, they demonstrated that the thermo hygiene conditioning allows the processor to dispense with post conditioner without causing damage to the quality of the pellet. Keeping shrimp feeds for 6 minutes in their thermal conditioner produces a pellet with 87% stability. The company also announced a new joint venture Stolz-Miras in Vietnam to manufacture and assemble Stolz machinery for the Asian market.

Idah Machinery Co Ltd introduced its new tungsten carbide cladding on extruding screws. According to Danny Huang, this change in material is important to maintain the durability of wear of components. The life is extended to 40 months and it will reduce replacement of parts. The cost savings in maintenance will be 50 to 80%. With this cladding, equipment resists high impact pressure and temperatures. The cladding is possible for all existing models of screw including those of other brands. Danny estimated that this cladding will be the future for all screws.

At the **Sprout Matador** booth, Richard Hickey demonstrated the new Flextex system. This is used to optimise starch cooking and allows for control of density, shape, uniformity, structure, taste and digestibility of the extruded product. The system is used in producing medium and high energy feeds where optimum oil absorption is required with minimum carbohydrate content. In turn, reduction of the starch fraction whilst maintaining functional quality, results in formulation cost savings. Basically the system can be used for producing all aqua and pet foods where an on-line control of the pellet texture and expansion rate is desirable.

The exhibition had for the first time included exhibition pavilions from both Thailand and China. According to Ms. Saovapak Kositkhun, Administration Manager, 2005 had been a good year for Thailand's **Triumph Engineering Co., Ltd**. The company conducts R&D and manufactures in Thailand. At the show, the company displayed its latest twin screw extruder for production of aqua and pet feeds and 60 tph for animal feeds. Here the twin screws are encased to ensure the highest shear and uniform distribution of feed. In the following years, it plans to invest more in the development of extrusion technology. In 2006, it expects a better sales performance. Besides Asia, the company sells to the US markets and has targeted India and Middle East as future markets.

The large booth for Thailand's Triumph Engineering Co., Ltd. From right Ms. Saovapak, Administration Manager and Mrs. Valai Kositkhun.

At the Kahl booth, From Left, Dr Joachim Hertrampf, Malaysia with Olaf Naehrig and Christian H.J.Dick, with a model of OEE.

Chinese companies such as Jiangsu Muyang Co Ltd and Zhengchang were prominent with large display units. Lui Guang Dao, General Manager for International Sales, **Jiangsu Muyang Co Ltd** said as aqua feed sales in China rose some 40-50%. In tandem the company has performed well in 2005. The market for the company based in Yangzhou, has been for large companies building up new facilities and others which are upgrading equipment. In 2004, it launched 89 new products. Amongst its customers are the large feed producers in China- Tongwei, Hope, Evergreen, Zhengchang, Chia Tai and Luihe groups.

Denmark's **Amandus Kahl** group's entry into the Asian market was 40 years ago. At the show, interest was on its extruder OEE marketed for the production of fish and shrimp feeds. This was developed some ten years ago and has been in use in the US, South America, Europe and in the Philippines, China and Malaysia and mainly for the treatment of oil seeds and high starch ingredients (i.e. as expander). Olaf Naehrig, Senior Area Manager Asia/Pacific said that Asia is a target market as fish feed production is increasing but it is also an extremely competitive market for feed equipment manufacturers.

At their booth, visitors had a feel of the workings of the extruder which has a movable die and provides the option of acting as an extruder or expander. With a model unit, Christian H.J.Dick, Area Manager, Asia/Pacific and CIS explained to visitors the features for the extruder which can produce crumble feeds and pellets from 1 to 12mm in diameter with slow sinking and floating properties. It allows for an easy and rapid die change. In Germany, the Kahl group has a pilot plant where customers and prospective buyers can carry out product test to obtain a reliable production.

Peter Astley, Development Director, **Datastor Systems Limited** explained to trade visitors the process control technology for feed traceability during feed manufacturing developed by the company. An important feature is a separate intake of bulk raw materials which requires control logic, mainly because the use of GMOs (genetically modified feedstuffs) is being legislated. The UK based company has a 27 year history of providing plant wide systems management and control to feed manufacturers. Through its Datamanager software, it provides traceability from raw material intake to finished product and vehicle number product delivery. These incorporate all aspects such as checks on cross contamination between species in plants producing aqua and poultry feeds. The system gives a fast tracking of product quality and quick responses to queries, either in house or from downstream users. The systems are being used in several facilities in Asia such as DSM's premix facilities and feed mills in Thailand, Vietnam, Korea and China. Its most recent market is the US based Land O Lakes with 80 plants.

At the Datastor booth, from left, Peter Astley, James Lin and Fiona Lee, Nice Garden, Taiwan and Panachai Limvachirachot, Thai Union Feed Mill, Thailand.

Four years ago, Cargill, USA began packaging its technology and global lessons in the feed, animal production and commodity trading into **Cargill Consulting Services**. At their booth, Mark Knief (General Manager, Consulting Services) explained that they draw on the Cargill's worldwide experience and resources such as in engineering, nutrition and risk management to work with a customer. The experiences are drawn from its 200 feed mills in several countries. In aquaculture, they have brought their knowledge and expertise to a tilapia farm in South America.

Feed Additives

Germany's **Gepro Geflugel-Protein** introduced their 100% poultry base AquaTrac products for aquaculture. Recently, the use of the product AquaTrac®Sol, a hydrolysed and spray dried poultry protein with strong binding and palatability properties was tested on juvenile white shrimp *Penaeus vannamei*. Good pellet stability, palatability and beneficial effects on growth on shrimp were obtained. A level up to 6% was used to replace fish meal in the diets with 43% crude protein. The company has recently set up a representative office in Bangkok to market into the Asian market.

Also at the show was **Chemoforma Ltd**. from Switzerland. Vannagen, one of the products of Chemoforma, contains PSB-Complex composed of high concentrated purified nucleotides and purified RNA for rapid cell multiplication specifically formulated for aquaculture. Vannagen is already widely-used in Asia for its growth promoting and immunostimulatory properties in shrimp feeds as approved in studies on its effects in *P. monodon* from India (see Aqua Culture Asia Pacific, Vol 2 (2) and Australia (Aqua Culture Asia Pacific, Vol 1 (4)). In Europe, a similar product is incorporated into feeds for marine fish for several years. Peter Koeppel, General Manager, said that after completing successful trials in diets for the seabass in Thailand, the company will introduce the general use of this complex in feeds for tropical marine fish.

Leili Nature Natural Products from China introduced its algal feed additives. The company has a 12 year history in the production of these additives for the livestock and aqua feed industry. The annual capacity for the production of these additives in more than 10,000 tpy and products manufacturing follow ISO standards. The product is from Sargassum and Laminaria originating from the South China Sea and the seas south on Mindanao.

The organisers of the event have announced that the event will be held again in Bangkok during the Spring of 2008.

21-23 June

5th National Shrimp Congress
Bacolod City, Philippines
Telefax:+63 2 372 5055.
Email: jalbaladejo@bfar.da.gov.ph;
jalbaladejo99@yahoo.com;
mariaabegail11@yahoo.com
Web: www.bfar.da.gov.ph
(see page 17)

21-23 June

Shanghai International Fisheries and Seafood Exposition 2006
Shanghai, China
Contact: Kim Yang
(see advert page 27)

3-8 July

The Second International Symposium on Cage Culture in Asia
Hangzhou, Zhejiang Province, China
(see page 44)

12 June - July 1

3rd Practical short course: Aquafeed SEA 2006
Pattaya, Thailand
Tel: +32 (0)51 31 12 74
Fax: +32 (0)51 31 56 75
Email: aquafeed@pro.tiscali.be
Web: www.membraneworld.com/aquafeedsea.htm

24- 29 July

Shrimp Health Management Training Workshop
Bangkok, Thailand
(see page 40)

25-28 July

14th Annual ASA Southeast Asia Feed Technology and Nutrition Workshop
Recent Advances in Aquaculture Nutrition and Feeding
Siem Reap, Cambodia
(see page 9)

27-30 August

Australasian Aquaculture 2006
Adelaide, South Australia
Contact: Claudia Metti
Tel: +61 8 8226 2269
Fax: +618 8226 0330
Email: metti.claudia@saugov.sa.gov.au
Web: www.australian-aquacultureportal.com
(see IBC)

24-29 September

13th Annual - Aquaculture Feed Extrusion, Nutrition, & Feed Management
Aquaculture Feed Extrusion, Nutrition and Feed Management
Texas A&M University, USA
Contact: Dr Mian Riaz
Tel: +1 979 845 2774
Fax: 979 458 0019
Email: mnriaz@tamu.edu
Web: www.tamu.edu/extrusion

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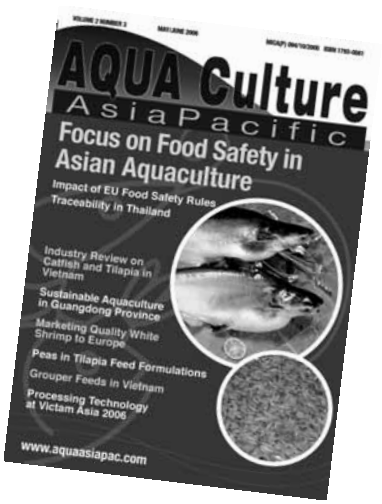

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