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AQUA Culture AsiaPacific

Interview: Uni President Vietnam

Managing Shrimp Farms in Vietnam

Review of Japanese Shrimp Market

Extrusion and Conditioning Equipment

Phytase in Tilapia Feeds

Effects of Feed Mycotoxins on Tilapia, Catfish and Shrimp

Organic Selenium and Flesh Colour in Tuna

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Contents

Volume 2, Number 4 July/August 2006 MICA (P) 094/10/2005

Interview

Managing shrimp ponds

Industry Review

Feed Processing

Feed Technology

Nutrition and Health

Markets

Show Preview

Show Report

News

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WRITE TO THE EDITOR
We want to hear from you. Write your comments on the industry to the editor.

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Letters may be edited prior to publication

From the editor

Has Aquaculture come of age?

The Forbes Asia edition of 22nd May carried an article on aquaculture. Not being a subscriber or avid reader of Forbes Asia, I am hesitating to say that this is the first time aquaculture has been given prominence in this publication. Can aquaculture be equated to billionaires? Hagen Stehr of Clean Sea Tuna, Port Lincoln, Australia seems to think so. I quote "If I could be 30 again, I reckon I'd give Bill Gates a shake" says Hagen Stehr, the 62 year old chairman of Clean Seas Tuna, whose family is worth at least USD60 million.

A 34 kg Bluefin tuna, frozen and air freighted to Tokyo fetches USD2,500. Stocks are declining due to overfishing and quotas are set by the Commission for the Conservation of Southern Blue Fin Tuna in Canberra. Today, Stehr fattens juvenile tuna to market size but in the future, he wants to close the cycle through breeding projects in which he has invested USD 22.5million. "The future is not the Internet, its aquaculture". This may be an overstatement, but we get his drift.

We have seen a lot science and research driving aquaculture but what makes this article stand out is business driving aquaculture. The ever expanding sushi market together with reducing quotas for tuna fishing are perfect market conditions for aquaculture. It was the Japanese demand for shrimp that drove the shrimp aquaculture industry to start in S. E. Asia in the mid- 80s. Research and development are tools for the industry to achieve its objectives but it is only when market economics drive the industry, will aquaculture come of age.

Market economics is basically a question of demand and supply which ultimately determines the price. The price movement will subsequently affect its supply as it promotes or deters production. This closes the cycle and makes the industry sustainable in the long term. The global shrimp and salmon industries are good examples of long term and sustainable aquaculture businesses. There is a global demand for products based on these 2 species which can be measured by their per capita consumption. Global stocking and production data is available to forecast their respective supplies.

Where is the bottleneck today, demand or supply? Ed Scura SIS, Florida at the recent 5th National Shrimp Congress in the Philippines said, "The shrimp market is fully mature but shrimp farming is not". Ed mentioned this in connection with the farming of *P. vannamei* which uses domesticated stocks. This will be a step closer to the more modern production practices as in the livestock industry.

This can also be interpreted as the demand being constant but supply is inconsistent. Consistent supply can only be overcome once we learn to control survival rates through the careful use of management protocols and available technology. In any business, prices will drop with global trade and increasing efficiency and demand will increase high purchasing power. For the shrimp, the days of high prices have gone and the industry must work at increasing biological efficiency and look at the venture as a long term business.

This leads to a question of oversupply. Many countries are wary of their neighbours expanding aquaculture hectarage and increasing production. The words of Dan Fegan, also at the same meeting, corrected us by saying that "aquaculture producers should not fear each other for their competition is meat, poultry and pork". Aquaculture producers should learn to widen their horizon. The industry should work with seafood processors to increase demand to look beyond 'Fish on Friday' or the 'special seafood dinner'. It is only when seafood becomes an everyday meal that aquaculture will come of age.

Zuridah Merican

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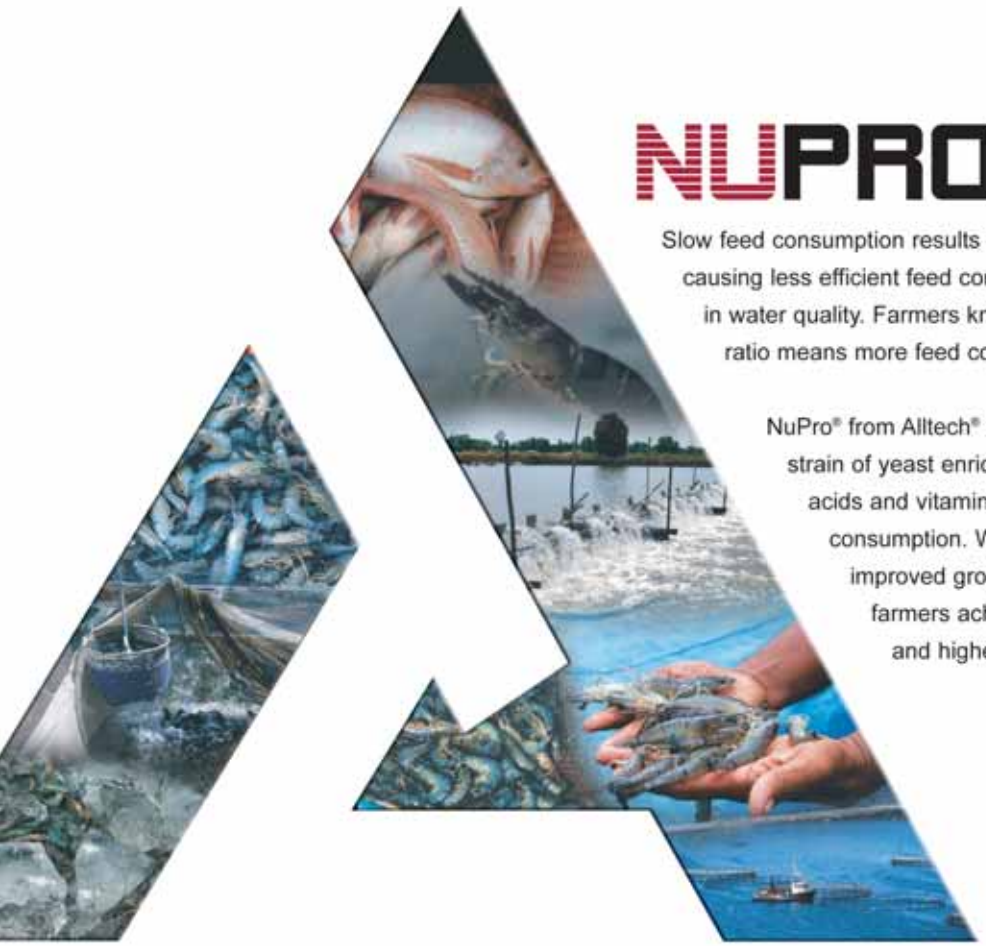

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A new beginning with whites in the Philippines?

By Zuridah Merican

In dire straits since 1997, shrimp farmers and other stakeholders in the Philippines are now looking forward to a revival of the industry with the planned removal of the ban on the commercial culture of the white shrimp *Penaeus vannamei*.

During a business meeting on the last day of the 5th National Shrimp Congress held from 21-23 June 2006, Bacolod City, Philippines, industry groups, including PhilShrimp, PhilFry, feedmillers and the group from Aquasur, the biggest integrated multi-species aquaculture producer passed resolutions recommending the removal of the ban on the culture of this shrimp.

Earlier, based on his 16 month research on the experimental introduction of the shrimp into the Philippines, Dr. Westly Rosario, Interim Executive Director of the National Fisheries Research Development Institute (NFRDI) of the Bureau of Fisheries and Aquatic Resources (BFAR) had recommended that the ban be lifted. The next step is for BFAR to work on the amendment of FAO 207 to allow for the full commercialisation of the species.

BFAR directors from left; Ernesto Hilvano (Visayas), Atty Benjamin FS Tabios Jr (BFAR), Azucena A Inguillo (IV), Virgilio A Alforque (IX), Dr Dionisio b de La Pena (VII), Jaime C de la Vega (V) and Davoa Campeon

A previously contentious issue

Whether the vannamei shrimp should be cultured had been contentious. At the 4th National Shrimp Congress, held in Cebu City in 2004, there were mixed reactions to a proposal by some sectors of the industry to remove the ban on white shrimp culture. Opponents did not want the introduction of an exotic species which may introduce more diseases and threaten the culture of large sized black tiger shrimp which commanded premium prices. Proponents were frustrated with their untiring efforts to obtain consistent production amidst occurrences of white spot syndrome virus (WSSV)

At this meeting in 2004, Secretary Luis Lorenzo Jr decided that prior to any decision, specific pathogen free (SPF) broodstock will be imported for experimentation. Stocks were brought into the country and bred at government hatchery facilities and post larvae were distributed to accredited grow out farms. In the meantime, black tiger shrimp farmers agreed to reduce stocking density to 15 PL/m^2 and produce large size shrimp of 35-40g for international markets.

Right protocols important

Mr Malcolm I Sarmiento, Jr, Director of the Bureau of Fisheries Resources (BFAR) said, "Initially, there were so many apprehensions about the *vannamei* shrimp but now our experiments have proven that with the right

Marketing whites from the Philippines

One of the main concerns of the industry in the Philippines is the current volumes of production of whites from Thailand and China and its ability to compete vis-à-vis these origins. Chingling Tanco, MIDA Trade, presented trends in world shrimp markets and the part the country can have in these markets.

The largest growing market is the US with a current consumption rate of 4.2 lbs (1.9 kg). This is expected to increase to 4.8 lbs (2.18 kg) per capita in 2007. The EU market is also expanding. Other emerging markets are Russia and Korea. In contrast, the market has been flat in Japan, the largest importer for black tiger from the Philippines. The country only exported 6,421 tonnes of black tiger head on in 2003. The volume of *vannamei* shrimp imports into Japan also remains small.

Chingling Tanco with Pedro Bueno, NACA, Bangkok

"If the Philippines were to shift to the vannamei shrimp, they would need to look to the US market. While there is still a good commodity market for headless *vannamei*, the US market is looking at this product packed as IQF instead of block frozen. So Philippine processors will need to upgrade their equipment from contact freezers to either IQF tunnels or spiral freezers to be able to produce IQF", said Chingling.

She added , "We will need to deal with upgrading our plants too. To date, only 4 plants are eligible for exporting shrimp to the EU. We will need to get third party certification such as BRC and IFS, for our plants. Next, we will have to deal with traceability requirements. At the moment, many plants are still not even ISO 9000 certified.

"The processing industry and government will however need to make preparations to deal with a transition to a more competitive market for the white shrimp to cope with issues on food safety and non trade barriers. For example, the country lacks complete equipment for the testing of antibiotics residues and banned substances and has to send products to Taiwan for testing".

"Lastly, banks need to understand that with *vannamei* shrimp farming with good husbandry practice is no longer the gamble that it was with the wild black tiger but a viable and profitable business. Banks should be encouraged to invest in the country's shrimp industry".

Mr Malcolm I Sarmiento, Jr

protocols, negative consequences can be avoided. Indeed when the country open up to vannamei culture, adequate measures must be put in place to prevent any untoward development".

"We have learnt from other countries that have suffered with *vannamei* in the early 1990s and we do not want to experience that here. However, Thailand is doing very well and I have seen some of the hatcheries and grow out farms. They have evolved some very good systems and we will try to emulate some of them".

Mr Roberto A Gatuslao

Private sector to push

Mr Roberto A Gatuslao, President of the Philippine Shrimp Industry, Inc (Philshrimp) said, "We recommend that the ban be lifted nationwide and that hatcheries and grow out farms be accredited by BFAR. The private sector will definitely use the present groups to help in the implementation of this culture".

"In the beginning, I forsee that we will have problems with the hatcheries that continue to import non-SPF broodstock and with growers that buy these stocks. They must realise that this is a way to introduce diseases".

Philip Cruz

A revival to its hey day

At the congress, Philip Cruz, President, Cruz Aquaculture Corp, Bacolod, received a recognition from PhilShrimp for his award last year of 'The Outstanding Young Men Award' (TOYM) of the Philippines for his valuable contribution to aquaculture. Philip also presented an update on the situation in the country.

A strong advocate for the introduction of the *vannamei* shrimp for the last three years, he said, "In 1994, the Philippines produced 94,000 tonnes of the black tiger and exported USD 241 million worth of shrimp. By 2004, production has declined to 37,947 tonnes and the global share was only 1.5%. The lost to diseases was USD 150 million but worst was the lost of 25,000 jobs and other intangibles".

When *P. vannamei* is allowed into the country, Philip forecasted that the increase in production will be 20,000 tonnes in the first year and increasing by 40,000 by the fifth year. By 2011, he expects a total shrimp production of 140,000 tonnes.

He added, "Unlike neighbouring countries which also faced similar problems, and managed to revive their shrimp industry, our farmers continued to suffer. One of the reasons was that the industry remained too dependent on the government to solve problems".

Positions announcement

Intervet International BV (with its headquarters in The Netherlands and a business unit of the Akzo Nobel group) is the third largest animal health company in the world. Intervet has over 20 years of experience in fish vaccine development and is the global market leader in this segment. The success of the salmon industry, in particular the minimal use of antibiotics and the traceability of the final product, has been achieved to a large extent by the widespread use of vaccines.

In 2000, Intervet set up an R&D centre in Singapore, Intervet Norbio Singapore, entirely dedicated to the development of novel vaccines and other products for warm water aquatic animal species. In 2005, two Intervet fish vaccines have been successfully launched in the Asia-Pacific region and more are in the R&D pipeline.

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Applicants are also requested to support their application with a short note as to why they feel the position is suitable for them. (Only short-listed candidates will be notified.)

Brief news

Streptococcosis in Tilapia

Tilapia have emerged to become the second biggest cultured aquatic species group after carp, with a worldwide production of 1.82 million tonnes in 2004 (Fish Stats, 2006). Tilapia is a fairly low-value species and usually perceived as hardy, easy to culture and adaptable to many environments. However, this theory that tilapia is a hardy and disease-resistant fish species is no longer correct, according to a report by Intervet. The report said that producers, scientists and processors have now become aware that diseases may well be the number one threat for the future of this industry.

As the world production of tilapia increases, so has the incidence of infections. The major diseases affecting tilapia during the farming cycle have been identified. There are a number of bacterial and viral diseases and some of them are devastating. Among the diseases, streptococcosis is considered to be the most devastating disease as it can cause massive kills of large size fish and is responsible for heavy economic losses. More details on the disease can be found in the most recent Intervet AAH newsletter available at http://www.intervet.com/aah/newsletters.asp.

Investors to revitalise for ponds

Provincial authorities in East Jawa, Indonesia are seeking investors to help revitalise some 30,000 ha of ponds which have been abandoned because the owners lack resources to operate them. So far, PT Bina Makmur Sejahtera has indicated interest in the project, according to the a report in Kompas news. The ponds are located in the northern coast from Lamongan to Banyuwangi. In Situbondo, there are 8,000 ha of ponds whereas in Banguwanyi, these total 10,000 ha. The authorities want to revitalise these ponds for the culture of freshwater fish, seaweed and marine shrimp which will help meet the demand for fish and provide additional income to the community. The demand for fish is increasing as supplies from fishing has declined as fishermen have stopped fishing because of high prices of diesel.

Shrimp firms win case in US court

The China Daily has reported that nine Chinese shrimp enterprises have won their year-long campaign against a ruling by the US Department of Commerce (DOC). The US Court of International Trade ruled in June that the department had used unfair surrogate prices in its dumping ruling on imports of Chinese shrimp. In January 2005, the DOC said it would collect punitive duties of up to 112.8% on Chinese shrimp. As China is not regarded as a full market economy by the United States, the department used the prices of Indian shrimp growers instead. However, the shrimp taken as the surrogate raw material was a different species to the Chinese shrimp. This was used by the nine Chinese firms to file a complaint last March against the DOC. DOC will now make a new ruling in 90 days. The shrimp case was the largest dumping claim against Chinese farm products. China exported shrimps worth USD 380 million in 2004 when the dumping charge was initiated.

US tilapia market increasing

In Globe Fish, it was reported that tilapia imports continue to increase in the US. Imports increased by an average of 25% per year over the past five years. In 2005, there was a new record of 135,000 tonnes imported was reported for 2005. Frozen and fillets accounted for 58% of the imports. In January to March 2006, imports totalled 35,220 tonnes. Fresh fillets imported in the first three months were on par with figures in 2005. This was linked to reduced supplies in Latin America which was in turn attributed to the drought and disease related problems in Latin America. Asian producers then managed to increase exports by 9% for fresh fillets and 22% for frozen fillets.

EC inspectors suggest improvements

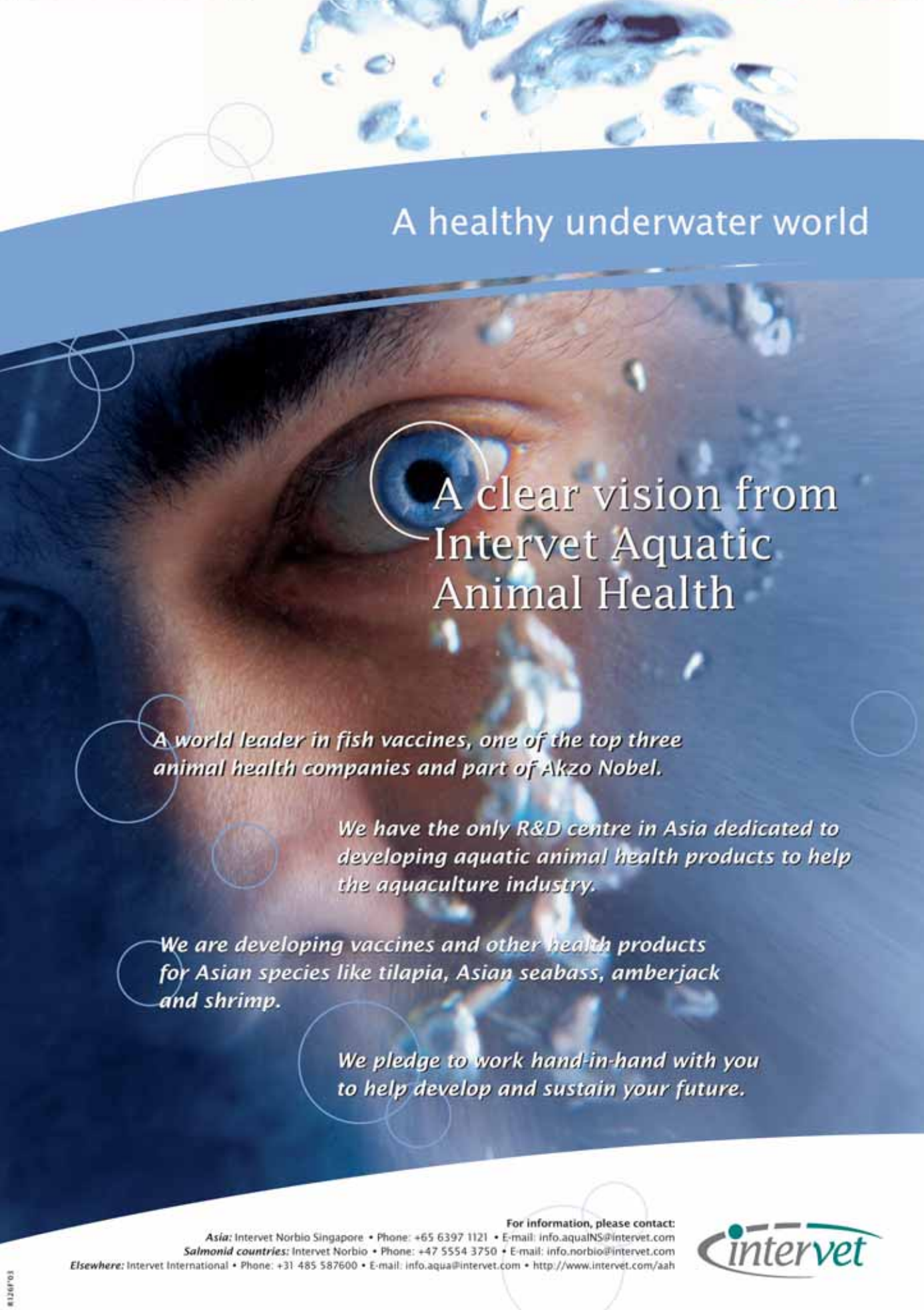
In its latest newsletter, the Bangladesh Frozen Foods Exporters Association (BFFEA) said that EC officials conducting inspections on the shrimp sector end 2005 had mixed reactions. The aim of the EC mission was to reassess the compliances with the special conditions awarded to fishery products from Bangladesh into the EU. Their main contention was on the HACCP which reflected the necessary elements but not always the existing situation in the facility. Recommendations were drawn up which included the updating of legislation to meet the EU requirements, systematic control of the initial part of the production chain to detect food safety related deficiencies as well as urgent actions to improve the performance of the laboratories involved in microbiological analysis. Exports of fishery products contribute 5% to the national GDP and in 2004, Bangladesh exported 24,2000 tonnes of products to the EU of which 20,000 tonnes was shrimp. A total on 59 plants out of the 68 licensed are have been approved for export to the EU.

Barra juveniles in the US

Cell Aquaculture, based in Freemantle, Western Australia has announced that its production facilities in the US will be operational with the delivery of 13,000 barramundi *Lates calcarifer* juveniles. This is part of the company's expansion plans, according to a news report in Wabusiness News. In the US, the joint venture company is Delta Aquaculture. In May, the company announced the success with its first batch of fingerlings from its larval rearing system at James Cook University in Queensland. Chairman, Robert Sewell, said, "With the production technology well proven in Australia, one of our major hurdles to develop our business model overseas was to successfully ship our juveniles through the right logistical and regulatory channels. We have succeeded with shipments into Europe and the US". The company, listed on the Australian Stock Exchange in 2005 plans to develop more facilities in UK and Spain.

EU sets levels for dioxin and PCB in food

The EC has set maximum levels of PCBs and dioxins which will take effect from November 2006 to allow processors and other sector companies to test when sourcing for ingredients or releasing products to the market. This followed recent fears in Belgium, Netherlands and Germany as poultry feed was found contaminated with the family of cancer causing chemicals. As a result, South Korea banned the import of pork from Belgium. The feed ingredient company identified as the source of contamination, said that this occurred because of inadequate tests. The EU statement said that the new limits are meant to prevent persistent chemicals such as dioxins and dioxin like PCBs in the food chain. These steps will also set action levels and target levels for these chemicals in food and feed in the future.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5th national shrimp CONGRESS

By Zuridah Merican

In anticipation of the removal of the ban on *P. vannamei* culture, organisers of this congress have developed a complete program to prepare the industry on the culture of this species. During the two-day meeting held in Bacolod City from 21-23 June, 2006, more than 800 farmers and other stakeholders in the industry heard presentations on updates on the industry in the Philippines and the region and from farming technology, disease detection, culture technologies to market issues.

The future culture of *P. vannamei* will depend on the imports of specific pathogen free (SPF) broodstock. The major producers of SPF broodstock from Hawaii, Kona Bay and High Health Aquaculture (HHA) and Shrimp Improvement Systems (SIS) from Florida gave presentations on company profiles and products lines. Jim Wyban said that HHA is also developing a new strain GxTVR. He also presented the key factors of the success in *P. vannamei* farming in Thailand which was attributed to government support to the industry. The Department of Fisheries certifies the suppliers of SPF broodstock. Only CoC (Code of Conduct) certified hatcheries are allowed to import the broodstock and produce postlarvae. Ed Scura, gave a presentation on how the selective breeding is conducted at SIS.

Gina R Regalado and Dr David J. W. Moriaty

SPF shrimp

Dr Shaun Moss from the Oceanic Institute, Hawaii (OI) explained clearly that SPF is a result of selective breeding and is free of specified pathogens only. Currently, 9 viral pathogens are in the list. SPF does not imply disease or pathogen free and is not a heritable trait. Offspring are not considered SPF unless they are produced in an SPF facility. For shrimp to be SPF, the pathogens must be detectable, able to be excluded from a facility and it should be of economic significance to the industry. The SPF status will change with the level of security in the farm and hatchery it is kept in.

Trends in farmed shrimp production

Dr Pinij Kungvanji, Charoen Pokphand Foods Co Ltd, Thailand said that in 2005, white shrimp dominated global shrimp production at 75%. In 2006, total shrimp production will be 400,000 tonnes from Thailand, 370,000 tonnes from China, 180,000 tonnes from Indonesia, 145,000 tonnes from Vietnam and 120,000 tonnes from India. Some 80% of the production in China will be for the domestic market and in Thailand, there is a campaign to increase domestic consumption. Potential international markets are Korea and Australia.

From right, Edgar Sarrosa, Dr David Drahos and Dr Pornlerd Chanratchakool

To reduce fuel costs in production, he gave an example in Thailand where LPG is used with petrol. Costs of running aerators can be reduced with sensors which monitor oxygen levels. A way to increase production efficiency is to have a major and minor crop and stagger pond stocking to optimize the correlation with the demand from buyers and to have a smooth and better cash flow.

Dan Fegan, Alltech Inc, Bangkok in his presentation on recent advances in shrimp culture technology said that the customer is king, shrimp is now a commodity, prices are low and costs are rising. These require a focus on cost efficiency with good returns on investments. Although the ability of the Asian farmer to produce *vannamei* shrimp is already very high, most farms still have low biosecurity levels with high risks of disease transmission. **Dr Pornlerd Chanratchakool**, Novozymes, Bangkok said that the challenge is to produce what the market needs. Indonesia and Thailand are producing large size *P. vannamei* of 20 g or more. The way to tackle the market is through quality and traceability. The technical challenge is balancing pond parameters to ensure ideal water conditions in the pond conditions throughout the culture cycle.

Technology updates with BT culture

Ms Gina Regaldo, INTAQ, Philippines, said that costs of production, mainly from higher fuel costs, have increased 13% to 180-250 peso/kg whereas shrimp prices have dropped 11% in 2006 to 310 peso/kg for the large size shrimp. As the industry continues to faces threats from WSSV and vibriosis, measures to increase biosecurity have been implemented at costs of 20,000 to 30,000 peso/ha. Water exchange has been limited and a ratio of 1-3 ha of reservoir area to one ha of culture pond is now common. Other measures to improve ponds water conditions requires the farmers to use probiotics in culture ponds and chemicals and disinfectants in reservoir and culture ponds.

William Kramer

Dr Juan D. Albaladejo (right), Fish Health Section, BFAR and Mr Victor D Buenaflor, Buenaflor, Fish Farm Corp

William Kramer, Business development Group, Hoc Po Feeds, Philippines, presented information on trials to improve yields at three farms. In previous crops, problems encountered were a 'loose body' during inclement weather, inconsistent moulting and reduced feed consumption. With the use of direct fed microbials (Hoc Po) and top dressing feeds with NuPro (Alltech, Inc) and pond treatments with Pond Plus (Novozymes), he reported that yields have increased 27% to 4.5tonnes/pond at one farm. Survival rates were better at 89 to 96% as compared to 80% in the control ponds. There were improvements in FCR as well as tolerances to vibrio. The reduced water exchange helped a farm to evade a possible infection of WSSV from a neighbouring farm which was infected with WSSV.

Water and larval quality improvements

Dr David Drahos from Novozymes and **Dr David J. W. Moriaty**, INVE discussed the positive results on yields with the use of probiotics in shrimp pond culture. They also discussed the responsible use of non pathogenic strains determined by sequence identification. Quorum sensing of pathogenic bacteria which initiate disease associated processes was also covered. **Dr Patrick Sorgeloos**, INVE said that the impact of good quality postlarvae in grow out production is high survival and lower standard deviation. He discussed the various diets in postlarvae production and the importance of co feeding to take advantage of live foods. With the use of high quality diets, 45% of costs can be saved with black tiger shrimp postlarvae production whereas the cost saving is 20% with vannamei shrimp in Panama. **(More information on the congress, email: nppmcl@mactan.ph)**

(Note: Detailed reports on selected presentations at the congress will also appear in future issues of AAP)

Changing industry patterns to gain a lead

In April, Jeff, Jie-Cheng Chuang recalled Uni President Vietnam's foray into the shrimp feed industry back in 1999 and its evolution to be a leading shrimp feed manufacturer in the country.

In 1999, Jeff Chuang came to Vietnam to help start off the aquatic feed business and since then, it has been challenging times as he develops and expands the aqua feed business. Jeff, a Masters graduate in aquaculture from the National Taiwan Ocean University, began his career in aquaculture with the Aquatic Ttechnology Division of Uni President Taiwan in 1995. In 2000, he was Director of Aquatic Feed R&D and in 2002, Director of the Aquatic Feed Division. Today, he is the Vice President of Foodstuffs Group Uni-President VN responsible for the aqua and animal feed and wheat flour business.

The initial challenges

When Jeff Chuang first came to Vietnam, the shrimp culture industry was relatively new but expanding fast.

"In 1999, shrimp production was only 50,000 tonnes. The largest feed company was Charoen Pokphand (CP) with an estimated market share of 60% and other suppliers were the smaller local feed mills, such as the state owned Seaprodex. Most of the shrimp farms were located in the central region. Shrimp production in the Mekong Delta was just starting. The shrimp feed market was evolving. Thus, Uni President Taiwan made the decision to set up production facilities in Vietnam," said Jeff Chuang.

"Our first challenge was how to get a market share considering that our competitors have been in the country for almost ten years and have captured the market".

"We also needed to work with the different culture models practised in Vietnam at that time. It was largely extensive. Although species-wise, we are similar, i.e. black tiger shrimp, but in terms of technology we are quite different. In Taiwan, we have been used to intensive culture systems for the last ten or more years".

"We also knew that feed production cost would be higher as most raw materials, except for wheat flour, had to be imported. These were then subjected to (and still is) to import taxes, different to mainland China and Taiwan where fish meal imports do not carry any duties. For the farmer, this means that his cost of production may be higher than say in Thailand, Indonesia and India, the other main shrimp producers and Vietnam's competitors at that time".

AAP: In which segment of the aqua feed market do you have a lead and how long did it take you to achieve this?

UPV: Our achievements have been more in the shrimp feed market in Vietnam. In 3-4 years, we have managed to gain a large market share. Our largest sales are in feed for the monodon shrimp. In Vietnam, we have two aqua feed mills in Binh Duong and Tien Giang province and a hatchery in Binh Thuan. In 2007, a hatchery dedicated for the production of both postlarvae of *P. monodon* and *P. vannamei* will start operations. The production will be 300 million PL12-15 for each species. Globally, this is the first upstream activity for Uni President.

Separating the market

What actually helped us to gain market share was the different mind set of the Vietnamese farmers in comparison to farmers elsewhere. In Taiwan and mainland China, for example, farmers merely asked for feed at low prices. In contrast, here the shrimp farmers assess feed quality and calculate the costs of feeding against conversion ratios, shrimp growth rates etc and the culture period. In Vietnam, farmers know that they can grow shrimp to larger sizes of 30/kg in less than 130 days only with higher quality feeds. For them feed quality is the most important criteria. Thus it was easy for us to separate the markets and target the high end feed market.

Over the years, we see that shrimp growth rates in most farms have been improving. Different from other countries, farmers attribute this to the use of the high quality feeds. In fact the best sales are now of those premium feeds with 'growth enhancing' features. Also, it is through our efforts in setting these high standards for monodon feeds that other producers are following our approach.

AAP: To be a leader in the aqua feed business in the Vietnam, what are the company's plans in terms of strategic planning?

UPV: Up to now, Uni President has resisted any integration in the shrimp industry in Vietnam. Unlike our competitors, we have remained in the aqua feed business only. However, with the integration activities of several companies in Vietnam happening around us, we have had to review this. We see that the difficulties with the production of disease free black tiger and the difficulties faced by the farmers. To keep the industry sustainable, we needed to look at the domestication of broodstock and the production of disease free and quality postlarvae.

We now have a hatchery on lease and we will test the model and technical aspects of this upstream integration. We have acquired land to build a hatchery by end of this year. Our next step is to set up a processing plant.

Another change has been in providing credits for feeds. This is a usual practice by most feed companies and especially by those that do contract farming. We still do not provide credit directly to farms but work through our distributors.

AAP: In your opinion, what is the future direction for Vietnam's feed market?

UPV: We are positive that the shrimp culture industry will continue to develop in Vietnam.

The Ministry of Fisheries Vietnam has already agreed to develop *Penaeus vannamei* culture in the north and central Vietnam and I think that soon Vietnam will culture the vannamei shrimp in the same intensity as in mainland China and Thailand. At the same time, shrimp production from the south will continue to increase. The prediction from industry is that production will increase to 460,000 tonnes by 2010 and that black tiger shrimp will dominate production at around 65-70% of production.

As for our role, we already have 22 to 25% share of the shrimp feed market. Next year, we will produce feeds for the vannamei shrimp. When Vietnam enters the WTO, she will have an avenue to fight against the antidumping tariffs and customs bonds which can improve the future of her shrimp and catfish exports. When successful, this will help with her exports.

The catfish industry will expand to a production of 500,000 tonnes from the current 400,000 tonnes. The government is encouraging diversification to tilapia culture which is less prone to diseases. The government is also encouraging catfish and tilapia culture in the west region of South Vietnam. In the future, I expect that more than the current 50-60% of catfish produced will be fed on commercially produced aqua feeds. More farmers will shift to floating pelleted feeds as fillet percentage is low and flesh tends to be yellowish with farm made feeds based on trash fish. Thus, step by step, we can encourage them to use commercial pellets. In fish feed production, we will gear up feed production when our factory in the Mekong Delta is fully operational in June 2006.

Marine fish culture is fast developing too. We will use our experiences with the industry in Taiwan to develop the same in Vietnam. We are also ready with the production of feeds for the grouper as we have recently obtained a production licence. Next will be feeds for the cobia and seabass.

AAP: What would be the future improvements in feed manufacturing in line with industry standards?

UPV: Feed traceability is a future objective for this new factory in the south and this will most likely be completed in 1-2 years. At the moment, we will be working for a HACCP and ISO certification for the new factory which will benefit our farmers. With this certification, they can give an assurance on the quality of the feed to the processing plants and ease exports to the EU and Japan.

On the use of genetically modified organisms, we are giving the necessary attention but we are not at the stage of separating our raw materials. This will be implemented when this is imposed by the processing plant or importing countries. In Vietnam, imports of soybean meal are mainly from Argentina. Certification on the non GMO status is not available. On the other hand, prices for certified imports from the US are too high.

As to the replacement of fish meal with plant proteins, we carry out trials to substitute fish meal with other sources of proteins and on the supplementation of amino acids. Our options are animal or soybean meals, but more needs to be done as costs may not be comparable when we have to use more squid meals as attractants and additives, such as those to combat the anti-nutritional factors.

AAP: How do you bench mark your feeds against those of the competitors?

UPV: How we judge this is not only on the quality of the feeds but also on the services from 70 technicians that advise farmers. We have long-term clients who have been with us for as long as ten years. On the efficacy of our feeds, we collect data from the farmers using our feeds and calculate the feed conversion ratios etc.

Relevant article: First with groupers feeds in Vietnam. AquaCulture Asia Pacific, Volume 2, Number 3, p 8.

Uni President with its headquarters in Tainan, Taiwan was established in 1967. The company began with the production of animal feeds and wheat flour. Since then, it has expanded into the production of aqua feed, edible oils, foods, beverages and other household products. During the boom in shrimp culture in the Asian region, this company was synonymous with shrimp feed production technology in Asia and exported Taiwanese shrimp and feed production technology to many corners of the region.

The company's aqua feed business now has an annual revenue of USD 100 million from a production of 160,000 tpy. These are from one feed mill in Taiwan, 4 in mainland China, 2 in Vietnam and a new joint venture shrimp feed mill project with Godrej in India.

In aqua feeds, the concentration is on feed production for the various regional species. In mainland China, 60% of feed production at the feed mill in Chungsan in Guangdong Province is for eel culture and the rest are for marine shrimp, tilapia and marine fish. The feed mill in Shanghai produces feeds for the crab and soft shell turtle and that in Qingdao, Shandong focuses on the flounder. The feed mill in Szechuan produces feeds for the freshwater carps, catfish and tilapia.

The Japanese Shrimp Market in 2005

by Fatima Ferdouse

A decade long economic downturn during the 1990s and shrinking disposable incomes have taken their toll on the consumption and market growth for shrimp in Japan. Nonetheless, ebi or shrimp continues to be the favourite seafood for the Japanese. Although Japan is the second largest single market for shrimp after the US, its per capita consumption of shrimp is still higher at 2.5kg, compared to only 1.90kg (4.20 lb) in the US.

In 2005, imports of fishery products increased by nearly 2% in value but in quantity, the total fishery imports fell by 4% to 3.34 million metric tonnes. This could be attributed to the waning demand for traditional block frozen products, whether it is finfish including tuna, shrimp or cephalopods.

Nonetheless, the market continued to import more semi-processed and processed seafood in response to the growing demand. In 2005, imports of prepared fishery products (excluding raw frozen products) were more than 400,000 metric tonnes. The value of these imports was ¥290.29 billion or USD2.43 billion which was nearly 17% of the total fishery imports. A similar trend was also observed for shrimp imports which was the single largest product group in terms of value.

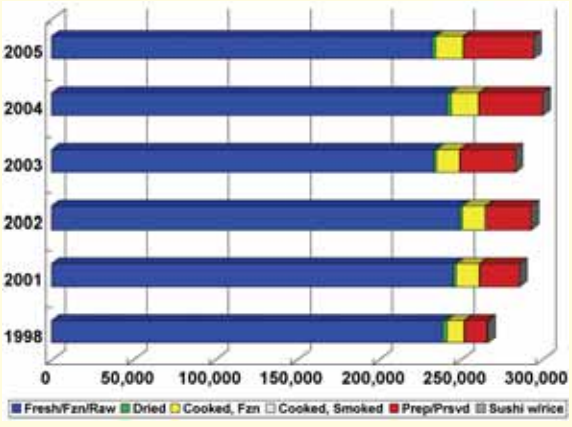
Shrimp import trends

The 2005 imports of fishery products did not benefit the shrimp sector to a great extent, particularly for raw frozen products. The market for block frozen shell-on shrimp has been fluctuating during the last ten years without any real growth in sight. However, there has been a continuous and steady growth in demand for imported breaded, cooked (including *sushi* shrimp) and other prepared shrimp products.

The import value for all types of shrimp in Japan totalled ¥268.46 billion or USD2.25 billion. In quantity it was 294,658 metric tonnes which was a 2.3% decline against 301,608 metric tonnes imported in 2004 (Fig 1). Lower imports of raw frozen shrimp, particularly the shell-on varieties, was the main reason for this decline.

With dwindling imports, the frozen raw shrimp category had the largest share in the total supply with an import value of ¥213.85 billion or USD 1.79 billion in 2005. This product group includes all kinds of head-on or whole shrimp, shell-on tails, peeled *nobashi* (tail-on) and raw peeled (pud and p&d) products. (Table 1)

Figure 1. Japanese imports of shrimp by product type, in metric tonnes



The import value of processed shrimp including breaded *tempura* shrimp, *sushi ebi*, various kinds of shrimp preparations and cooked shrimp was ¥ 51.2 billion or USD 428 million. The market also imported smaller quantities of live, chilled and dried shrimp in 2005.

Tropical shrimp dominated supplies which are largely imported from Asian countries, namely Vietnam, Indonesia, India, China and Thailand. Nearly 98% of value-added shrimp products were imported

Japan – an economy on the road to reform and recovery

Japanese import bill totalled ¥ 56.88 trillion or about USD 475.98 billion in 2005, which is 15.5% higher compared to 2004. More than 10% (>USD 50 billion) of this was spent on food imports including fishery products.

Economic Indicators ……	Annual imports of fishery products into Japan in
• In 2005, the Japanese GDP grew by nearly 2% and unemployment was reduced to 4%. • The annual import bill for food was more than USD 50 billion; for fishery products, it ranged between USD 14-16 billion during the last five years. • 51 percent of the current food fish supply in Japan is derived through imports. • "Based on the health and nutrition of the Japanese people, per capita fish consumption shows an increase as people advance with age"….reported the Japan Fisheries Association. • By 2010, the number of senior citizens in Japan will be more than the younger population.	Q=quantity in metric tonnes V=value in USD **2001** Q=3.82 million; V= 14.23 billion **2002** Q=3.82 million; V= 14.08 billion **2003** Q=3.32 million; V=13.51 billion **2004** Q=3.82 million; V=14.24 billion (¥ 1637 billion) **2005** Q=3.34 million; V=13.96 billion (¥ 1668 billion)

Table 1. Japan: Imports of shrimp (all types) in 1998 and from 2001 to 2005 in metric tonnes

Product type	1998	2001	2002	2003	2004	2005
Live	364	577	406	293	383	271
Fresh/chilled	85	99	36	19	33	19
Frozen, raw	238 906	245 048	248 868	233 195	241 445	232 443
Dried/salted/in brine	2 349	1 704	1 875	1 977	2 351	2 008
Cooked, frozen	10 338	14 045	13 936	13 927	16 745	17 051
Cooked & smoked	376	515	468	453	618	422
Prepared/ preserved (incl. tempura & canned shrimp)	13 984	23 980	27 678	33 361	39 692	42 181
Sushi (with rice)	50	160	194	92	341	263
Total	**266 038**	**286 128**	**293 461**	**283 318**	**301 608**	**294 658**

from four countries, namely Thailand (40%), China (23%), Vietnam (17%) and Indonesia (17%, Table 2).

Black tiger shrimp is still the preferred species in the Japanese market. Imports of raw nobashi (peeled deveined tail-on) shrimp are also increasing which are mainly sourced from Vietnam, Thailand, and Indonesia and lately from China (see box).

Table 2. Japan: Imports trends of frozen raw shrimp from Asia and other producers from 1998 to 2005, in metric tonnes

Country	1998	1999	2000	2001	2002	2003	2004	2005
India	50 411	52 756	50 005	42 991	34 821	28 191	31 571	26 309
Indonesia	53 726	50 619	49 795	55 617	53 608	52 392	48 623	45 574
Thailand	17 783	19 320	18 651	20 574	18 987	16 930	17 192	18 398
Vietnam	26 709	30 253	33 098	35 664	41 516	47 641	55 506	54 573
China	12 197	13 489	16 545	14 926	19 598	20 534	22 609	24 092
Philippines	7 384	7 855	8 335	8 423	7 996	6 422	6 273	6 237
Bangladesh	3 748	5 513	4 147	3 169	3 241	3 004	3 415	3 194
Myanmar	4 473	4 372	4 464	4 148	5 568	5 377	7 630	7 519
Malaysia	2 767	3 100	3 057	3 848	4 481	3 262	3 173	3 061
Sri Lanka	3 930	1 593	3 315	3 188	2 168	3 054	1 817	1 227
Pakistan	951	873	760	633	812	544	604	402
Sub Total	184 079	189 743	192 172	193 181	192 796	187 351	198 413	190 586
Others including Ecuador, Brazil, Madagascar, Mozambique, Australia, Russia, Canada, Greenland and Iceland	55 072	57 571	54 455	51 867	56 072	45 900	43 032	41 857
Total	**239 151**	**247 314**	**246 627**	**245 048**	**248 868**	**233 251**	**241 445**	**232 443**

Source: Japanese Customs.

Outlook

Despite some positive indications on Japan's economic recovery, the seafood market remains price sensitive, particularly for high value species such as shrimp and sashimi grade tuna. Hence, the high consumption pattern is still linked with occasions such as the Cherry Blossom, Golden Week, Bon Festival, school holidays and family celebrations.

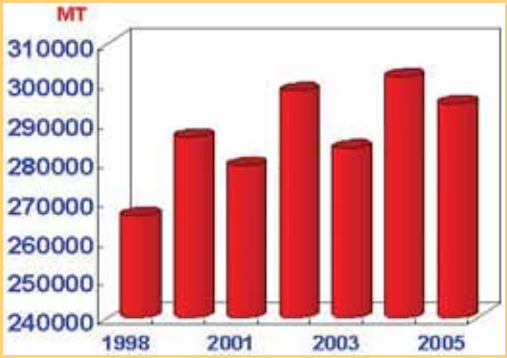
During January-March 2006, Japanese shrimp imports totaled 61,061 tonnes at a value of ¥54.21 billion (USD 461.39 million) which was slightly lower than the last year. This was mainly associated with the "off season" and low stocks in Asian producing countries. In quantity, the market share of raw frozen products (all shell-on and peeled types) was 74% in total shrimp imports.

Supply short falls in raw frozen (-7.17%) and cooked frozen (-15.23%) contributed to the overall decline in shrimp imports compared to the same period last year. However, supplies of higher value shrimp continue to follow the positive pattern observed throughout 2005. During the first quarter of this year, the import value of cooked frozen and prepared shrimp was ¥ 13.16 billion or USD 112 million.

Consumer demand for shrimp has been good in Japan during the this year's spring festival in April-May. Brisk trading was reported particularly at the catering trade which was supported by the traditional outdoor dinning through the Cherry Blossom and Golden Week celebrations.

*** Information for this review was extracted from the Shrimp Report prepared by the author. The full paper is available from INFOFISH, email: infish@po.jaring.my*

Japanese imports of frozen raw shrimp



- Supplies of frozen raw shrimp were erratic with falling market share. This segment of the market was dominated by the black tiger shrimp *Penaeus monodon* for a long time.
- However, since 2004, the market acceptance for farmed white vannamei shrimp has been improving, particularly from supermarkets which have started to sell it as thawed raw shell-on products, by piece or by weight.
- A better demand for vannamei is also reported from sushi shops. Supplies are mainly from Thailand. China was the largest supplier of small sizes peeled (pud) *vannamei* used in thousands of noodle shops through out Japan.

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In her capacity as adviser and also as a marketing consultant, she works closely with the fishery industries, government bodies, various regional and international organizations in the Asia/Pacific region and beyond. She is also a frequent speaker at national and international conferences and symposiums. INFOFISH is the Intergovernmental Organization for marketing information and technical advisory services for fishery products in the Asia/ Pacific Region. Email: infish@po.jaring.my Web: infofish.org

Q & A on equipment for extrusion and conditioning

The presence of several equipment manufacturers at two recent trade shows, Victam Asia, March 8-10 and at the WAS/EAS trade show, May 9-13, attracted the attention of many aquafeed producers. Many were eager to display new processing technology, particularly in the area of extrusion. In this article, AAP asked the feed industry to pose specific questions on how current technology could help to improve the processing of fish and shrimp feeds. Below, selected equipment manufacturers have provided some answers to these queries from feed producers in Asia.

Q: How can I produce several types of both floating and sinking pellets on the same equipment? How will it be possible to get production to 'in spec' quality as fast as possible?

The production of both floating and sinking feeds has been a requirement of extruders since they entered the area of aquatic feeds. Initially this was accomplished by increasing water levels in the feed. However, this method did not allow for energy control as more water resulted in less energy or cook of the final feed.

The development of an atmospheric vent in the middle of the extruder barrel allowed for the reduction of pressure and increased density. This worked well at the time it was developed. As the industry required further developments in extruder control, we now have the BPV or Back Pressure Valve which allowed for the effective open area the extruder sees to be independently controlled without changing the die to increase or decrease energy inputs and allow for density control of the feed being produced within a range of +/- 20%. It also allowed the extruder operator to modify the operation conditions to get into correct specification product at a much faster rate. Periodic adjustments would be required if there were any variations in ingredients or from effects over time due to slight extruder wear.

If additional density is required we would recommend the use of the DMS, Density Management System which mounts on the end of the BPV or a secondary extruder called the PDU, Product Densification Unit. The PDU extruder gives the highest capacity level and the DMS gives the ability to do both. However, the sinking feed production rate would be somewhat reduced when compared to the PDU production levels. Either system does not require a great quantity of time if the overall system is set up for these additional equipment applications.

The following two photos (below), show both of these systems which can be used with ease on any sized extruder with the DMS system on the left attached to the BPV and on the right the Extru-Tech PDU extruder accepting production from the cooking extruder via a pipe die. The EDMS system or both the BPV and DMS machines would give a capacity of up to 7000 kg/hr on a shrimp feed while the PDU system would approach the 10,000 to 12,000 kg/hr rate also on shrimp feed.

Joseph Kearns, Wenger, USA

Model X-185 Optima Extrusion Cooker with Back Pressure Valve being used to control product density, degree of cook and more important 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.

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The characteristics of aquafeeds are completely different than feed from any other industry. You simply cannot utilize production techniques designed for another industry to produce aquafeeds. Your operation will benefit from our exclusive production techniques that are engineered from the ground up for aquafeed production. This is exactly what you'll receive when you partner with Extru-Tech®.

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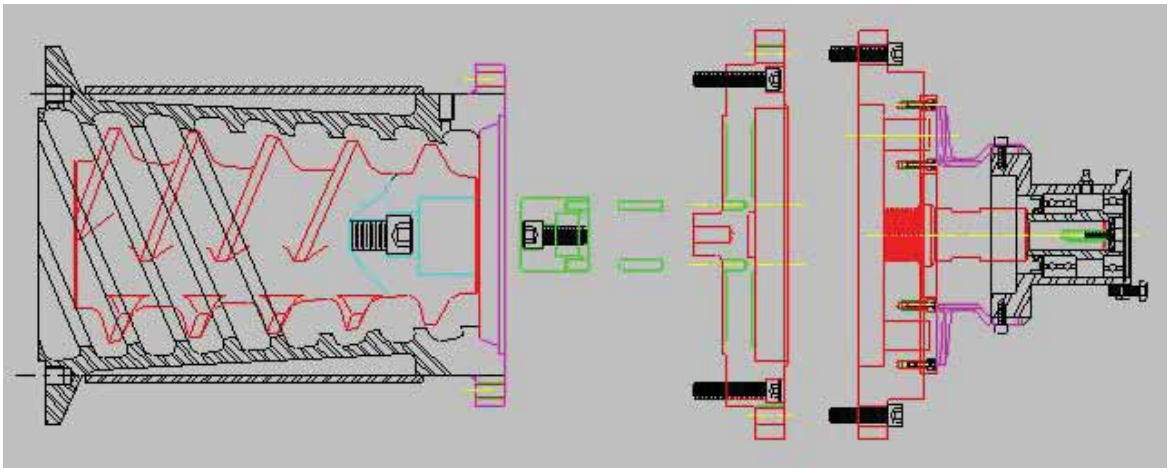


e-750/x175 large die

e-925/x-235 large die

Q: How can I increase capacity using my existing equipment?

When running small sinking fish feeds production much higher open area is required in the extruder die plate. Compared to just 4-5 years ago, smaller and smaller sinking fish feeds are being run directly off the single shaft extruders. In making the smaller feeds, smaller holes are needed in the die which in turn creates more "drag" in the die compared to larger holes for the larger pellets.

An example of this for low fat sinking fish food would be:

- When using 1.2mm holes in a die it would require approximately 650sq/mm to produce 1000kg/hr.
- When using 6.0mm holes in a die it would require approximately 500sq/mm to produce 1000kg/hr

Due to the need for more open area in the dies for the smaller pellets, Extru-tech can now offer an option to install a larger die on the end of the following extruders: Wenger X-175, X-235 or Extru-tech E-750 or E-925. For the X-175 and E-750 this up-grade would consist of a new cone head, a larger supported spacer, a larger die and larger knife blade holder assembly. With this installed on the end of the extruder the customer can expect a 15 to 25% increase in open area, depending on the hole diameter.

For the X-235 or the E-925 this up-grade would also consist of a larger support spacer, a larger die and larger knife blade holder assembly. Due to the die being larger and heavier this would also consist of a die hinge assembly to hold the die for the operator. Again a 15 to 25% increase in open area can be expected, depending on the hole diameter in the die. These are shown in the photos (above and left).

Q: Can the same machine be flexible enough to produce full fat soy to sinking shrimp feeds and floating fish feeds? If so, would the changeover time be long hence sacrificing production efficiency?

The extruder OEE is marketed for the production of fish and shrimp feeds and for the treatment of various oil seeds. At Victam Asia 2006, we have explained that the extruder acts as an expander or extruder depending on the die. With an easy and rapid die change, the resulting product can range from crumble feeds to pellets from 0.8 to 12mm in diameter with slow sinking and floating properties.

The OEE was developed to improve on versatility of extruders by a change of a hydraulically adjustable die without special tools. The die can be extended into and withdrawn from the outlet casing quickly and efficiently and with little lost of time while feed mix retains its temperature in the conditioner. The change can be effected in 2-3 minutes. Products of different sizes, density and levels of starch gelatinization can be easily produced.

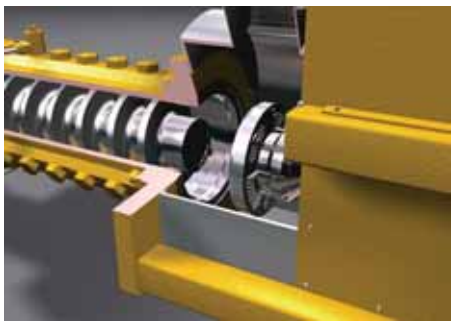
Blockages are avoided by the adjustable die. This is in contrast with traditional extruders where the die head is fixed to the barrel and the operator needs to cool down the machinery before a die change. There are four models of the OEE with sizes ranging from 100kg/hr to 8 tph. At a capacity of 100 kg/hr, it is ideal for the production of small batches with very small pellet diameters, production for product development and R&D.

Christian H.J.Dick, Amandus Kahl

At start-up it does not require extra water addition as it can be started with an open die. This reduces the quantity of wasted products. In

any extruder, often wear and tear is on the last three segments of the machine. In the OEE design, the last few portions can be easily replaced without affecting the other segments.

There are stop bolts in the extruder which gives extra kneading of the mix. Thus, even though the extruder is single screw, it has the capabilities of producing products closely similar to those from a twin screw extruder for certain applications. There are no changes in energy consumption but the longer retention time provides for better conditioning results. There is more flexibility with Kahl machinery especially when using the expander function for the treatment of oil seeds such as full fat soybean and as well for the production of expanded crumbles for pigs and poultry with proven feeding advantages.



Detail of Extruder die in the OEE

….and in post conditioning shrimp pellets

Q: Why is retention time important? How can I achieve this on your equipment and why would this be better than a three stage conditioner?

In the mid nineties, Stolz, France developed the Thermo Hygienic Conditioning System (THCS). This system allows the destruction of all micro organisms present in the meal which can contaminate the food chain. However, when placed before pelleting or extrusion, it performs super conditioning which allows for an improvement in physical and nutritional qualities of the pellet. This means, one machine with two possibilities, said Louis Mourey at the Stolz France booth at Victam Asia, 2006.

It was explained that in shrimp feed production in Asia, to achieve higher levels of water stability and pellet durability, shrimp feed processors have a choice between a two stage conditioner (40s) or a three stage conditioner which retains the pellets for a longer time (up to 1 min 10s). But to produce shrimp pellets with the right physical attributes, it is by inclining the conditioner and allowing the adjustment of the flow that this company has succeeded in controlling the retention time of treatment and created pellets that are more durable (Philippe Serene, consultant, Vietnam; pers.com).

"Keeping pellets for six minutes in the thermal conditioner has allowed the feed producer to obtain a product with 87% stability after 4 hours and this makes the equipment a "super conditioner". The conditioning operation depends on humidity, temperature and treatment time. Figures from some trials conducted at a Vietnamese feed mill showed that the stability of the pellet was directly related to temperature and retention time. So with the Thermo Hygienic Conditioning System, we have upset current norms", said aqua feed consultant Louis-Marie Tricot in the company's newsletter for Victam 2006.

At these trials in a Vietnamese feed mill, four types of shrimp feed products were tested on the equipment and on a post conditioner. The stability of the feeds were tested qualitatively (visual) and quantitatively.

Thanks to a patented device installed at the outlet of Stolz THCS, aquafeed producers are from now on able to adjust not only the right retention time according to the shrimps of fishes to be fed but also to chose the right temperature for the conditioning of the meal.

Not the least, when producing pellet for the aquafeed industry, a second major parameter after the retention time is the adjustment of the temperature of the meal during or even better just before either the pelleting or the extrusion phase.

Being in constant touch with the Aquafeed industry, Stolz have been able to develop and purpose its THCS, equipment which give a full scope to act on both the retention time and the temperature.

(Note: For more details, also refer to the article, "Superconditioner: an innovation in shrimp feed manufacturing by Louis Marie Tricot, Aqua Feeds: Formulation & Beyond, Volume 2, Issue 2, 2005.)

Louis Mourey, with THCS at Victam Asia

Environment is most important

by Zuridah Merican

This is according to Mr Chung, farm technician in Vietnam. He said that probiotics have played a large role in the success at Mo O farms. This was followed by the use of premium quality feeds.

This enclosure is to filter the incoming water as well as to prevent the entry of predators.

The Mo O group of farms is atypical in Vietnam where small owner operated shrimp farms dominate. In 2001, two brothers created a 54 ha farm in Soc Trang Province in Vietnam's Mekong Delta. This was then followed by another farm in the same area with 72 ha of land area. In 2005, a 142 ha farm, further south in Ca Mau was started. The conglomerate farm became one of the largest groups of farms in South Vietnam. Each farm is managed by a farm manager and 3 technicians.

Chung, the manager for the 54 ha farm in Soc Trang, said that the uniqueness of the farm has been its ability to culture black tiger shrimp *Penaeus monodon* without the use of antibiotics and to reach a productivity of 13 tonnes/ha/cycle. There are 68 ponds each of 3,500 m^2 to 6,000 m^2 amounting to 35 ha of water area at his farm. There is only one main culture cycle which begins in March and lasts for 4.5 months. The stocking density is high at an average of 60 PL/m^2. Harvest size is 30-35 pcs/kg and survival rates range from 75 to 90%. Weekly harvests of shrimp are sent to a processing plant, an hour away by road. In the second cycle, about 50% of ponds are stocked.

Nevertheless some ponds are stocked at a lower density of 30 Pl/m^2. Yields from these ponds are around 5 tonnes/ha. The target size of harvest will depend on demand from processing plants. "If the demand is for smaller shrimp, then we will increase the stocking rate", said Chung, a graduate in aquaculture from Nha Trang University in the central region.

The success achieved at this farm was also due to the use of enzymes added to feeds throughout the culture period. Feeds are coated with enzymes in a cement mixer prior to feeding. It is added at 0.5% of feed. The name and origin of the enzymes was not disclosed. The feed conversion ratio ranges from 1.3 to 1.5.

In the pond preparation protocol used at the farm, Chung stressed on the use of probiotics to support an ideal pond environment. Pond preparation begins with a dry pond bottom, followed by water filling and chlorine treatment. This is left for 15 days and then teaseed cake is added. The pond is left for ten days for the right water colour to develop. Probiotics of US origin is added prior to stocking with post larvae. Throughout the culture period, probiotics are added at every 15 days in the first month, every 10 days in the second month and every 7 days in the third month and every 5 days in the fourth month of the culture cycle.

Chung (centre) with Ngo Quang Truong (right)- sales manager of Uni-President VN, in charge of the shrimp feed business in the west of Vietnam. Chung graduated in aquaculture from Nha Trang University in the central region in 2000. He started work with Uni President Vietnam and moved to work in this challenging position in this farm in 2003.

In maintaining a consistent level of aeration, each pond has four long arm paddle wheels for surface aeration. In addition, in the ponds stocked at high density (60 PL/m^2), there is a centrally located bottom aerator. The aeration combination is a result of trials on aeration carried out at the farm and experiences of the previous year's culture are used to make improvements in the next crop.

These extra investments have helped the farm to gain high yields and shrimp which are 'bright and beautiful', said Chung. The cost of adding enzymes is high and increases the costs of production by 2,000 VND/kg to 40,000 VND/kg (USD 2.7/kg) but at selling prices of 80,000 VND (USD 5.3/kg) for 30pcs/kg it is worth the investment. However, Chung said that in other farms, production costs per kg such as at 45,000 to 50,000 VND/kg (USD 3-3.3/kg) are also high but this is because of poor management, use of antibiotics and supplements of additives such as vitamins and minerals.

Another success factor is the quality of postlarvae. The farm uses different sources of PL and currently, supply is from Binh Thuah in the central region of the country. On the contribution to his success, Chung said, "About 30% is from the La One Feed from Uni President. The major 50% is from the environment which probiotics play a role in controlling and 20% from PL quality".

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A smiling Khoa holding black tiger shrimp from one of the ponds.

The making of a shrimp entrepreneur

by Zuridah Merican

Two years ago, former rice trader, Bui Minh Khoa bought this forested land and developed it into a modern shrimp farm. Khoa attributes his success to the personal attention his gives to the management of Truong Thanh Farm and is pouring back profits to further improve production and acquire additional land.

Khoa's farm is located in the Long Phu District of Soc Trang in Southern Vietnam. This is a major shrimp aquaculture area of Vietnam. In 2005, marine shrimp production from the south totalled 230,000 tonnes and all of them, the black tiger shrimp. (In Vietnam the government has legislated that the culture of the white shrimp *Penaeus vannamei* is only permitted from Binh Thuan province to Northern Vietnam).

It is the higher profits from shrimp culture that attracted Khoa into marine shrimp farming. "If all goes well, I can expand with additional ponds and in the future also plan for a processing plant. I know that it is important to be in total control. I am here daily and oversee production from pond preparation to harvest".

It is not only pond management but details to pond construction which has set aside his farm from others in Vietnam. Khoa has invested 185 million VND (USD 12,000) for each pond. His total investment to date is 8 billion VND (USD 534,000) for the 25 ponds in the 30 ha farm. Ponds are 6,000 m^2 in size and 1.8 m deep. There is also a one ha pond. He uses HDPE liners on the slopes of the ponds and has perimeter nettings around the ponds to prevent the entry of disease carriers. Aeration is mainly with long arm paddle wheels. In addition, air is pumped and diffused into the water through small tubings which run lengthwise in the ponds at intervals of one metre.

Khoa gives personal attention to the management of the farm and oversees pond preparation to harvest. He has a staff of 3 technicians and 30 workers for the farm. One worker is responsible for one pond at the farm. He uses probiotics to maintain water quality once a week from beginning to the end of culture cycle. Khoa started by using feeds from two companies but is now using the UP feeds from Uni President Vietnam. Currently, feed conversion ratios are 1.3 to 1.5.

Unlike most farms in the area, Khoa has managed to have two culture cycles for some ponds. The first one is of 25 ponds and the second of 9-10 ponds. Stocking for the first cycle begins in November. Stocking density is 30 PL/m^2 and the total yield averages 120 tonnes/cycle or 8 tonnes/ha/cycle of 4.5 months. Shrimp is sold to a processing plant, one hour away by road.

Ponds also have bird deterrents above the pond water.

The average survival rate is 80% and costs of production range from 32,000 to 35,000 VND/kg (USD 2.13-2.3/kg). Current selling prices for *P. monodon* of 40 pcs/kg range from 85,000 to 90,000 VND/kg (USD 5.6-6.0/kg). However, the target is to produce 10 tonnes/ha from each cycle and Khoa may increase the stocking rate to 35 to 40 PL/m^2 to achieve this. If prices decline, such as to 90,000 VND for 30 pcs/kg, Khoa said that he will not stop culture activities but will merely reduce stocking densities.

When Khoa started farming, he found the technicalities of shrimp farming quite difficult. After all, previously, he was trading in rice. However, he was assisted by other shrimp farmers as well as associations. He continues to seek more information on culture technology and experiment on ideas which will work well for his farm.

Among the success factors, Khoa said that weather conditions, postlarvae quality, feed and management have equal importance. These support each other. Ultimately he said that, "You must have a love for shrimp farming to enter it and to continue to be in this business'.

The air pump used to diffuse air into the pond water.

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Exogenous dietary phytase- a reliable tool for increasing aquafeed efficiency and cost-effectiveness

Jacques Gabaudan, Wutiporn Phromkunthong and Brian Hunter

Aqua feed manufacturers are continuously innovating in order to provide their customers with the best possible nutritionally complete feeds at the least possible price. To date, these goals have mostly been met with least-cost formulations, incorporation of inexpensive novel ingredients and improved manufacturing processes. Another method which may be used to increase the efficiency of aqua feeds and its cost-effectiveness is the application of exogenous enzymes. They can increase digestibility and metabolism of nutrients locked in indigestible moieties within major dietary ingredients.

Plant products contain phytate, an indigestible form of phosphorus, which also binds protein, basic amino acids such as lysine and arginine and other cations such as iron and zinc. Plant products may also contain non-starch polysaccharides (NSP) such as cellulose that are indigestible by monogastrics. Animal protein products may contain the fibrous proteins collagen, elastin and keratin, which have limited digestibility in fish. The digestibility of all these components may be improved with the application of specific exogenous dietary enzymes to the diet.

Improvements in feed digestibility means that formulation requirements may be relaxed, formulating cost reduced and less waste ends up in the rearing water.

Of the classes of enzymes that have been tested for improved feed component digestibility in aquatic species, phytases have been the most studied and have provided consistent results. All finfish species tested have shown a positive result from dietary phytase addition. These include rainbow trout, common carp, Nile tilapia, red tilapia hybrid, channel catfish, Pangasius catfish, African catfish, sea bass and striped bass. In addition to increasing the usable phosphorus content in practical diets, typical results show increased protein digestibility and increased digestibility of zinc and other di-ionic cations. Physiological changes conferred by dietary phytase include increased vertebral ash, increased plasma phosphate, increased phosphorus gain per fish weight and increased nitrogen retention. Phosphorus and nitrogen loading of the water is decreased with dietary phytase application.

Phytase addition to the feed mash prior to steam-pelleting is viable for mild processing conditions. For processes involving higher temperatures such as extrusion, post-pelleting application with a spray applicator is required.

In addition to the large number of trials conducted outside Asia, a series of recent studies in Asia on the effect of dietary phytase on tilapia were conducted under the direction of Dr. Wutiporn Phromkunthong, professor at the Prince of Songkla University and one of the authors.

The balance of this article will discuss results of these recent trials and implications for feed-millers and farmers wishing to improve feed efficiency and reduce feed costs, as well as everyone wishing to reduce negative environmental effects of undigested phytate phosphorus and other undigested phytate-bound constituents that contaminate rearing and receiving waters.

Three trials were performed. The first was a phytase dose response trial using a diet consisting of soybean meal and rice products with added fish oil but no added fish meal. The second trial determined phosphorus and protein digestibility uplifts resulting from phytase application for commonly used Asian feed ingredients. The third trial examined the effect of phytase on growth and body physiology of Nile tilapia fed commercial type diets. In all these trials, the phytase used was Ronozyme P-5000, DSM Nutritional Products.

> Phytase is a valuable tool for fish feed manufacturers and fish farmers as it releases phytate-bound phosphorus and protein from plant-based ingredients. Commercially significant results include reduction or elimination of added dietary mineral phosphate, reduction of dietary crude protein, and reduction of phosphorus excretion into rearing water.

The dose response trial was conducted with Nile tilapia using a basal diet containing 67% soybean meal, 10% broken rice and 14% rice bran, along with supplements of fish oil, vitamins, minerals, and a chromic oxide marker. The diet contained 0.46% bound phytate phosphorus and 0.90% total phosphorus. Five levels of phytase were tested: 0, 500, 1,000, 2,000, and 4,000 FYT/kg diet. Phosphorus digestibility of the basal diet was increased from 45.9% with increasing phytase addition to a maximum of 63.9% (Figure 1). There was no improvement of phosphorus digestibility above a dietary phytase activity of 1000 FYT/kg which is in line with results reported for other species tested.

The digestibility of the five plant products with and without 750 FYT phytase/kg was determined in Nile tilapia. The feed ingredients tested were soybean meal, palm kernel cake, rice bran, corn meal and cassava

Figure 1. Effect of the dietary level of phytase activity on the apparent digestibility coefficient of phosphorus in a practical plant-based diet fed to Tilapia.

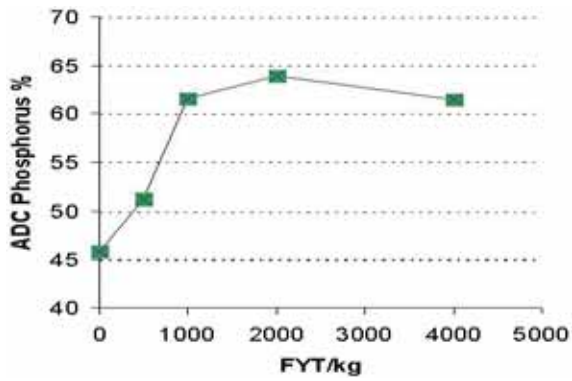


Table 1. Phosphorus and protein digestibility coefficients of feed ingredients with and without supplementation of dietary phytase in Tilapia diets.

	Soybean meal	Palm kernel cake	Rice bran meal	Corn	Cassava
Nutrient content %					
Crude proteins	45.0	15.99	13.5	6.9	2.7
Total phosphorus	0.77	0.55	2.04	0.25	0.07
Phytate phosphorus	0.40	0.42	1.29	0.20	0.02
Phosphorus digestibility %					
Control	47.9±1.2	25.5±1.3	35.2±1.0	23.6±0.7	72.4±1.6
Dietary phytase[1] 750 FYT/kg	77.0±1.2	50.4±1.1	59.5±0.2	58.3±1.0	92.6±2.2
Protein digestibility %					
Control	92.5±0.4	58.9±2.2	60.6±0.8	71.6±0.8	70.6±1.4
Dietary phytase[1] 750 FYT/kg	95.4±0.1	59.01±1.6	62.8±1.0	72.3±0.2	73.0±0.3

[1] *RONOZYME® P 5000 (L)*

meal. The basal diet used to determine the digestibility coefficients was composed of soybean meal, broken rice, rice bran, fish oil, and vitamins and minerals. The test diets were made of 70% basal diet and 30% ingredient under study. Phytate and non-phytate phosphorus in the ingredients are listed in Table 1. Phytase addition resulted in significant uplifts in phosphorus digestibility and also protein digestibility (Table 1) for all feed ingredients tested. The increased phosphorus digestibility of dietary ingredients resulting from phytase addition may be used to reduce di-calcium phosphate or other mineral phosphorus source. Cost savings depend on phosphorus uplifts for specific ingredients, dietary composition, costs of mineral phosphorus source used, and whether the formulation will be adjusted for increased protein availability.

A performance trial with about 80% of the protein coming from plant sources showed the effect of dietary phytase on tilapia growth, body composition, apparent phosphorus digestibility and phosphorus loading of rearing water. In this experiment, phytase effectively replaced the 1.5% di-calcium phosphate addition based on equivalent growth, resulted in equivalent serum phosphorus levels and increased dietary phosphorus digestibility compared to mineral phosphorus supplemented control diet (Table 2).

Table 2. Phosphorus digestibility, phosphorus concentration in serum and relative growth rate of sex-reversed red tilapia fed diets containing DCP, phytase or DCP and phytase as sources of available phosphorus

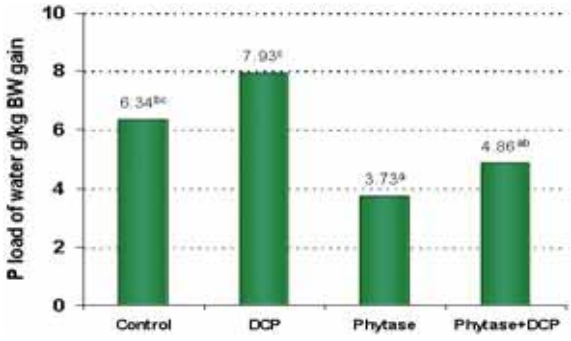
	Dietary treatments			
	Control	DCP (1.5%)	Phytase[1] (750FYT/kg)	Phytase[1] + DCP (750FYT/kg; 0.5%)
Total dietary phosphorus (%)	0.79±0.03	1.11±0.05	0.82±0.06	0.88±0.05
Digestibility of phosphorus (%)	41.2[a]	49.9[b]	62.9[a]	63.5[a]
Serum phosphorus (mg/l)	19.0[a]	25.2[b]	27.9[b]	27.9[b]
Weight gain/8 weeks (%)	290.7[a]	307.2[b]	312.7[b]	309.5[b]

[1] *RONOZYME® P 5000 (L)*

Available phosphorus determined by multiplying total phosphorus by its digestibility coefficient was 0.33% in the control diet and 0.52% in the diet supplemented with phytase only. Therefore, by releasing phytate phosphorus from plant ingredients, phytase increased the level of available phosphorus by 0.19 percentage points. At the same time, phosphorus loading in the rearing water was reduced (Figure 2).

Phytates are recognised as anti nutritional factors and since they are present in most plant ingredients they are a nuisance in fish diets. The implications in the Thai tilapia studies and scores of other phytase trials with cold water and warm water, salt water and fresh water fish species,

Figure 2. Phosphorus load of the receiving water over an 8-week period of feeding diets containing DCP, phytase or DCP and phytase as sources of available phosphorus to sex-reversed red tilapia



is that exogenous phytase is an effective tool to degrade phytates and release phosphorus which otherwise would not be available to the fish.

Consistent positive phosphorus and protein uplifts occur with proper phytase dietary application to diets containing substantial amounts of plant based ingredients. These uplifts allow reformulating of diets with reduced mineral phosphorus and crude protein. Inclusion levels of low cost plant by-products can be increased and provide the farmer with more digestible, more cost effective feeds. At the same time, less eutrophication of the rearing water occurs.

Digestible phosphorus and digestible protein uplifts conferred by phytase may be used to calculate reformulations and cost savings over existing formulations. Diets with the highest proportion of plant-based ingredients benefit most from the phytase application. The percentage of bound phytate phosphorus in whole grain and whole bean feed ingredients generally varies between 50% and 75% of total phosphorus.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Hydrolysed poultry protein in diets for white shrimp *Penaeus vannamei*

By Peibin Wang, Zhigang Zhou, Huiyuan Lv, Yang Deng and Franz-Peter Rebafka

A dietary inclusion of 6% spray dried hydrolysed poultry meal replacing 18.3% of fish meal in diets can significantly improve growth and survival of juvenile white shrimp in trials in Hainan, China.

White shrimp *Penaeus vannamei* is a widely cultured species in China due to its fast growth rate, good disease resistance, and strong international market demand. The output of white shrimp was 350,000 tonnes in 2004. With the practice of intensive culture with high stocking density, its culture is consuming more and more formulated feed and thus fish meal. A number of non marine protein sources are being tested in feeds for the marine shrimp. One of these is hydrolysed and spray-dried poultry protein from fresh poultry by-products, AquaTrac® sol SD which has beneficial physiological (high amounts of highly digestible crude protein), technical (strong binder properties due to functional proteins) and palatability effects (attractants) for crustacean and fish diets. The purpose of the following research was to investigate the effect of dietary inclusions of this poultry protein on the pellet stability, feed conversion and growth performance of white shrimp *Penaeus vannamei*.

Experimental trials

Juvenile white shrimp *Penaeus vannamei* was obtained from a local aquaculture farm in Haikou city, Hainan province, People's Republic of China. After a two week acclimation in a recirculation aquaculture system in the CAAS aquaculture station in Hainan Island, the shrimp (initial weight 0.77±0.01g) were bulk-weighed and randomly distributed into 12 tanks of 0.5m x 0.5m x 0.5m at a density of 30 shrimp per tank.

During the experimental period, 20% of the water in each aquarium was exchanged daily. Aeration was supplied in all the tanks. Water quality was monitored throughout the feeding period and water temperature range from 22 to 26°C and pH was 8.2 to 8.6. The amount of ammonia nitrogen (NH_3-N) was less than 0.2 mgN l^{-1}, dissolved oxygen was above 7.0 mg/l and salinity averaged 18 ppt.

Table 1. Ingredients and chemical composition of the experimental diets (%)

Ingredients	Diet 1	Diet 2	Diet 3
Hydrolysed and spray-dried poultry protein [1]	0.00	2.00	6.00
Soybean meal	30.00	30.00	30.00
Fishmeal	35.00	32.86	28.59
Wheat flour	28.00	28.00	28.00
Cellulose	0.40	1.18	1.75
Soybean oil	2.60	2.46	2.16
$Ca(H_2PO_4)_2$	2.00	2.00	2.00
Choline chloride(50%)	0.20	0.20	0.20
Coated vitamin C	0.10	0.10	0.10
Vitamin premix[2]	0.20	0.20	0.20
Mineral premix[2]	1.00	1.00	1.00
CMC[3]	0.50	0.00	0.00
Chemical composition			
Moisture (%)	6.52	5.40	7.45
Crude protein (%DM)	46.76	46.41	45.09
Crude lipid (%DM)	4.60	4.36	4.24
Energy (kJ/d DM)	18.27	18.50	17.99

[1] *AquaTrac sol SD manufactured by GePro Geflügel-Protein Vertriebsgesellschaft mbH & Co.*
[2] *According to NRC, 1983.*
[3] *Carboxymethylcellulose as the binder in the practical shrimp feed.*

Diets

Three experimental diets with different inclusion rates of the hydrolysed poultry protein (0, 2%, 6%) were formulated (Table 1). The diets were pelleted into 1.5mm pellets with a pelletiser after pulverizing the feed ingredients into 250μm particles, fan-dried and stored in sealed bags for use. The chemical composition including the moisture, crude protein, lipid, and crude energy of the feedstuffs and the experimental diets were analyzed according to Zhou *et al.* (2003).

The diets were randomly assigned to the tanks. There were four replicates for each treatment. Shrimp were initially fed at 6% body weight, four times/day at 06:00, 11:00, 18:00 and 23:00, and the feed ration was adjusted weekly.

Water stability of pellets

The water stability of pellets was evaluated by assessing the dissolving rates of the experimental diets. Weighed pellets (W_o) were placed in the aquarium without shrimp for 30min, 60min, 90min, and 120min respectively. Residual feed was collected, dried and weighed (W_t). The dissolved rate of pellets from diets 1, 2 and 3 was calculated as DR %=100 x (W_o-W_t)/W_o.

Feed intake

The feed intake of the experimental diets was determined by the percentage of non-consumed pellets. This was measured by the amount of feed left over every 20 min within 2 hours after feeding four times/day during the experimental period. The non-consumed pellets (NCP, %) was calculated as % NCP=100 x N_n/N_f; where N_f and N_n were the number of fed pellets and number of non-consumed pellets. Differences of all the data were analysed by one-way analysis of variance (ANOVA).

Growth performance

At the end of the 8 week feeding trial, shrimp from each tank were bulk-weighed after a one day starvation period. Data on the weight gain, specific growth rate and survival rates were obtained. Other data included daily feed intake and feed conversion ratio. Duncan's multiple-range tests were used to compare the differences among the means.

Results

Table 2 showed the variation in dissolved rates of the pellets in the aquarium tank. Significant differences ($P<0.05$) were found in the dissolved rates of all three diets after 30min and only between diet 1 and 2 at 60min ($P<0.05$). It was clear that the rate of disintegration

Table 2. The dissolved rates (%) of the experimental diets in aquarium without shrimp *

Time (min)	Diet 1	Diet 2	Diet 3
30	9.18 ± 0.22^a	9.60 ± 0.03^b	11.68 ± 0.39^c
60	9.07 ± 0.06^a	10.19 ± 0.16^b	11.15 ± 0.44^b
90	10.11 ± 0.45^a	10.50 ± 0.45^a	13.74 ± 0.53^b
120	11.26 ± 0.37^a	12.91 ± 0.43^b	19.90 ± 1.54^c

** Values are means±S.E. of triplicate samples. Means in the same row not sharing a common superscript are significantly different ($P<0.05$)*

Table 3 Non-consumed pellets (% NCP) of the experimental diets during the feeding period (%)*

Time (min)	Diet 1	Diet 2	Diet 3
0	100.0±0.0	100.0±0.0	100.0 ±0.0
20	86.6±10.4[a]	77.5±13.5[b]	45.3±19.5[c]
40	80.2±12.5[a]	67.8±20.1[b]	24.2±24.7[c]
60	74.3 ±13.8[a]	58.3 ±24.2[b]	15.7 ±22.1[c]
80	68.7 ±16.7[a]	53.7 ±25.6[b]	13.0±21.4[c]
100	64.8 ±19.2[a]	49.6 ±26.7[b]	11.5 ±20.0[c]
120	60.6 ±19.9[a]	46.0 ±27.3[b]	10.4 ±18.7[c]

**Values are mean±S.E. of triplicate treatments. Means in the same row not sharing a common superscript are significantly different (P<0.05)*

was less than 14% for all diets with the exception of diet 3 at 120min. This demonstrated that the hydrolysed poultry protein has good binding properties and closely similar as carboxyl methyl cellulose or CMC, which is commonly used as a binder for aquafeeds in China.

Table 3, Figure 2 showed that the inclusion of hydrolysed poultry protein in the practical feed of white shrimp obviously improved the palatability of diets, as the % of non consumed pellets (NCP) of 2% and 6% groups were significantly lower than that of the control treatment at 20min, 40min, 60min, 80min, 100min, and 120min after feeding ($p<0.05$). The 6% group showed the best palatability to white shrimp ($p<0.05$).

In Table 4, it was shown that dietary hydrolysed poultry protein at 6% inclusion level clearly improved the weight gain, survival rate and specific weight gain. These were significantly higher ($P<0.05$) than shrimp fed diet 2. It is recommended that 6% is the optimal inclusion level of hydrolysed poultry protein in the practical feed of white shrimp.

Feed conversion ratio was also high at 1.60:1 as compared to 2.75:1 with shrimp fed diet 2. Daily feed intake of diet 2 and 3 was higher than diet 1 but was not significantly different ($P<0.05$).

Table 4. Growth performance, survival rate and feed conversion ratio of white shrimp *Penaeus vannamei* fed the experimental diets

	Diet 1	Diet 2	Diet 3
Initial body weight (IBW) g	0.78±0.01	0.76±0.02	0.78±0.01
Final body weight (FBW) g	1.76±0.13[a]	1.76±0.23[a]	2.48±0.06[b]
Weight gain (%)	127.14±17.66[a]	129.70±27.28[a]	217.88±7.57[b]
Specific growth rate (%/d)	1.45±0.15[a]	1.45±0.22[a]	2.06±0.04[b]
Daily feed intake (g/d/shrimp)	0.037±0.003[a]	0.042±0.002[ab]	0.049±0.002[b]
FCR	2.22±0.27	2.75±0.60	1.60±0.07
Survival rate(%)	38.34±2.89[a]	40.00±3.60[a]	70.83±5.99[b]

**Values are mean±S.E. of triplicate treatments. Means in the same row not sharing a common superscript are significantly different (P<0.05)*

Figure .1 The dissolved rates (%) of pellets in aquarium without shrimp *

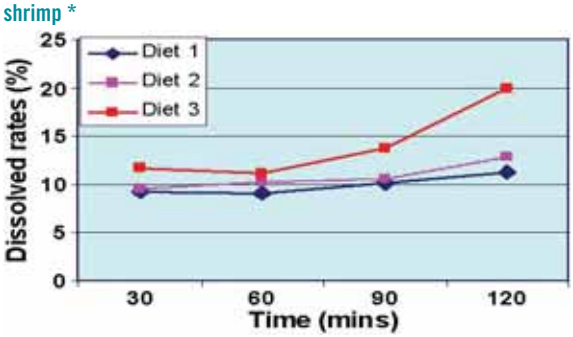
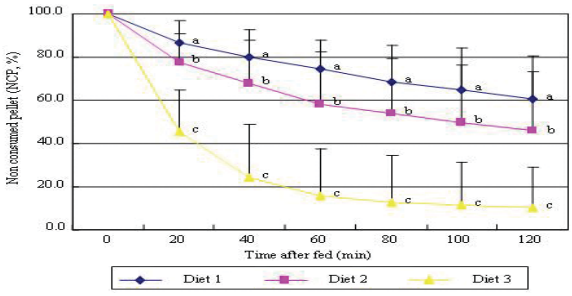


Fig. 2 Non-consumed pellets (NCP) of the experimental diets during the feeding period (%)

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Implications of mycotoxins in aquafeeds
– Evidence from research

By Pedro Encarnação*

An overview of current information available on the effects of various mycotoxins in feed on the marine shrimp, tilapia, carp and catfish.

Mycotoxins are secondary metabolites produced by fungi, commonly referred as moulds. Most of the mycotoxins that have the potential to reduce growth and the health status of fish and other farmed animals fed on contaminated feed, are produced by *Aspergillus*, *Penicillium* and *Fusarium sp.* The major classes of mycotoxins include the aflatoxins, trichothecenes, fumonisins, zearalenone and ochratoxins (CAST, 2003).

Mould toxins vary in their toxicity on different animal species and while the effect of mycotoxins is well known in most terrestrial farm animals, the effect of mycotoxins on aquaculture species has not been studied extensively. Nevertheless, several studies reported pathological signs of mycotoxin poisoning in fish and shrimp which can cause economic losses to the industry.

Given the trend and the economical need to replace expensive animal-derived proteins, such as fish meal, with less expensive plant protein sources, the relevance of mycotoxin contamination in aquaculture feeds may increase since feed ingredients of plant origin, have higher susceptibility for mycotoxin contamination. Moreover, mycotoxin contamination is often an additive process, beginning in the field and increasing during harvest, drying, and storage. In tropical and subtropical conditions the potential for mycotoxin contamination is further increased due to storage under humid and hot conditions, favourable for fungi contamination of stored feed and grain (CAST, 2003).

A contaminated ingredient or feed is likely to contain more than one type of mycotoxin. Numerous researchers have reported that mycotoxins act synergistically so that the negative effects of two mycotoxins are worse than the effects of each individually. Mycotoxins also appear to be very heat stable and the pelleting and extrusion process of fish and shrimp feeds do not seem to reduce appreciable amounts of mycotoxins (Manning, 2001).

Aflatoxins

Aflatoxins are produced by *Aspergillus fungi*, which can infect feedstuffs as corn, peanuts, rice, fish meal and shrimp meals (Ellis et al., 2000). Aflatoxin B_1 (AFB_1) is one of the most potent, naturally occurring, cancer-causing agents in animals. Initial findings associated with aflatoxicosis in fish include pale gills, impaired blood clotting, anemia, poor growth rates or lack of weight gain. Prolonged feeding of low concentrations of AFB_1 causes liver tumors which can spread to the kidney (Manning 2001). These subtle effects often go unnoticed and profits are lost due to decreased efficiency in production, such as slow growth, reduced weights of the finished product, an increase in the amount of feed needed to reach market weight and increased medical costs.

The extent of disease, caused by the consumption of aflatoxins, depends on the age and species of fish. Fry are more susceptible to aflatoxicosis than adults and some species of fish are more sensitive to aflatoxins than others (Tuan et al., 2002). Warm water species seem less sensitive them cold water species. Nevertheless, they are still affected by aflatoxin contamination.

Feeding a diet containing 10 ppm AFB_1/kg diet to channel catfish caused reduced growth rate and moderate internal lesions over a 10-week trial period (Jantrarotai & Lovell, 1990a). However, Manning et al. (2005a) indicated that feeding diets containing aflatoxins from mouldy corn does not seem to affect channel catfish performance and survival.

Studies on the Nile tilapia showed reduced growth rates when tilapia was fed diets containing 1.9 ppm AFB_1 (Chavez-Sanches et al., 1994). In addition, tissue abnormality or lesions in liver showed the beginnings of cancer development. In another study, Nile tilapia fed diets with 0.1 ppm AFB_1 for 10 weeks had reduced growth, and fish fed diet with 0.2 ppm AFB1 had 17% mortality (El-Banna et al., 1992). Tuan et al. (2002) showed that acute and sub-chronic effects of AFB1 to Nile tilapia are unlikely if dietary concentrations are 0.25 ppm or less. Diets containing 100 ppm AFB_1 caused weight loss and severe hepatic necrosis in Nile tilapia.

Other studies have shown that tolerance levels for tilapia can vary with the production system. In green water and flow-through systems, the presence of aflatoxins at 25 to 30 ppm in the water decreased growth without any noticeable signs of mortality. However, in cage culture, concentrations of aflatoxins above 5 ppm caused an increase in mortality rates (El-Banna, 1992).

In marine shrimp, several studies showed that AFB_1 can cause abnormalities such as poor growth, low apparent digestibility, physiological disorders and histological changes, principally in the hepatopancreatic tissue (Wiseman et al., 1982; Bintvihok at al., 2003; Boonyaratpalin et al., 2001; Burgos-Hernadez et al., 2005). However, reports on the effect of AFB_1 in shrimp are inconsistent.

Bintvihok et al. (2003) reported that after 7 or 10 days of consumption of diets with AFB_1 levels below 20 ppb, mortality rate was slightly higher in AFB_1-treated groups than in the control group. Histopathology findings indicated hepatopancreatic damage by AFB_1 with biochemical changes of the haemolymph. In another study, Boonyaratpalin et al. (2001) showed that AFB_1 at 50–100 ppb gave no effect on growth in juvenile shrimp. However, growth was reduced when AFB_1 concentrations were elevated to 500–2,500 ppb. Survival dropped to 26.32% with 2,500 ppb AFB_1. There were marked histological changes in the hepatopancreas of shrimp fed diet containing AFB_1 at 100–2,500 ppb for 8 weeks, as noted by atrophic changes, followed by necrosis of the tubular epithelial cells. Severe degeneration of hepatopancreatic tubules was common in shrimp fed high concentrations of AFB_1.

According to Burgos-Hernadez et al. (2005), the toxicity of AFB_1 to shrimp is a modification of the digestive processes and abnormal development of the hepatopancreas due to exposure to mycotoxins. These effects might be due to alterations of trypsin and collagenase activities, among other factors, such as the possible adverse effect of these mycotoxins on other digestive enzymes (e.g. lipases and amylases). These results show that aflatoxin contamination in shrimp feed may cause economic losses by lowering the production of shrimp.

Ochratoxins

These are a group of secondary metabolites produced by fungal organisms belonging to *Aspergillus* and *Penicillium* genera. Ochratoxin A (OA) is the most abundant of this group and is more toxic than other ochratoxins. It contaminates corn, cereal grains and oilseeds. Ochratoxin A primarily attacks the kidneys of affected animals and can reduce the animal performance (CAST, 2003).

Very few studies have been conducted to determine the effect of ochratoxins in fish species. In juvenile channel catfish, diets containing levels of 1 to 8 ppm of OA resulted in the development of toxic responses. Significant reduction in body weight gain were observed after only 2

weeks in fish fed diets containing 2 ppm of ochratoxin A or above (Manning et al., 2003a). After 8 weeks, body weight gain was significantly reduced for fish fed diets containing 1 ppm OA or above. Additional toxic responses included poorer FCR for fish fed diets with 4 or 8 ppm OA, and lower survival and hematocrit count for fish fed the 8 ppm OA diet. Severe histopathological lesions of liver and posterior kidney were observed after 8 weeks for catfish fed diets containing levels of OA of 4 and 8 ppm.

Cyclopiazonic acid (CPA)

Cyclopiazonic acid (CPA) is a mould toxin produced by several species of *Aspergillus* and *Penicillium* fungi. Jantrarotai and Lovell (1990b) found that CPA, a neurotoxin frequently found in association with aflatoxins, was more toxic to channel catfish than aflatoxins. CPA is more frequently found than aflatoxins in feedstuffs in the southern United States. A dietary level of 100 ppb CPA significantly reduced growth, and 10,000 ppb caused necrosis of gastric glands. The minimum dietary concentration that caused a reduction in growth rate was 0.1 mg/kg for CPA as compared with 10 mg/kg for AFB_1.

Combating mycotoxins

Mycotoxin contamination of feed for aquatic species is common in humid tropical regions and can cause adverse effects on farmed fish and shrimp. For example, in Egypt high levels of AFB1 were found in commercial fish diets (749 and 3,388 ppb) but also in fish (tilapia 246-303 ppb) and shrimp (185-372 ppb) (Abdelhamid et al., 1998).

Fortunately, there are a number of options that feed manufacturers and farmers can take to prevent or reduce the risks associated with mycotoxin contamination. These range from careful selection of raw materials, maintaining good storage conditions for feeds and raw materials and using a good mycotoxin deactivator to combat the range of different mycotoxins that may be present.

Binders or adsorbents have been used to neutralize the effects of mycotoxins by preventing their absorption from the animal's digestive tract. The most common binders are clays, bentonites, zeolites silicas and alumino silicates. Unfortunately, different mycotoxin groups are completely different in their chemical structure and therefore it is impossible to equally deactivate all mycotoxins by using only one single strategy. Adsorption works perfectly for aflatoxin but less- or non-adsorbable mycotoxins (like ochratoxins, zearalenone and the whole group of trichothecenes) have to be deactivated by using a different approach.

Mycofix®Plus is a mycotoxin deactivator which combines adsorption and bio-inactivation to break functional groups of mycotoxins such as trichothecenes, ochratoxin A and zearalenone, and also immunostimulation with addition of selected plant extracts. Biotransformation is defined as detoxification of mycotoxins using microorganisms or enzymes which specifically degrade the toxic structures to non-toxic metabolites. Mycofix®Plus combines different microorganisms, live bacteria and yeast strains, expressing specific mycotoxin-degrading enzymes to successfully counteract all agriculturally relevant mycotoxins in a biological way. *BBSH 797*, a Eubacterium species, patented by Biomin®, produces enzymes, so-called de-epoxidases, which degrade the toxic epoxide ring of trichothecenes, *T. mycotoxinivorans* a yeast strain, successfully counteracts ochratoxin A and zearalenone by enzymatic cleavage.

Furthermore, all mycotoxins are known to have detrimental effects on the liver and cause immunosuppression in animals. The addition of plant and algae extracts to the animal's diet helps to overcome these negative influences. Special algae extracts, tested on their immune enhancing effect, support the immune system and thus overcome the immunesuppressive effect of all mycotoxins. The liver, the main target organ of mycotoxins, is protected by selected antiphlogistic plant extracts.

Fumonisins

The fumonisins represent a group of mycotoxins produced predominantly by *Fusarium moniliforme* species. Fumonisin B_1 has been found to be the major toxic component in naturally contaminated corn. The importance of fumonisins as toxic agents in fish is still poorly understood.

In one study, channel catfish fed *F. moniliforme* culture material containing 313 ppm of fumonisin B_1 (FB1) for 5 weeks revealed minimal adverse effects (Brown et al., 1994). Conversely, Lumlertdacha et al. (1995) reported that dietary levels of FB1 of 20 ppm or above are toxic to year-1 and year-2 channel catfish. After 10 and 14 weeks, respectively, year-1 and year-2 catfish fed 20 ppm or more of FB1 in the diet had lower weight gain compared to the control. Similarly, Yildirim et al. (2000) found that in channel catfish, diets containing 20 ppm of moniliformin (MON) or FB1 significantly reduced body weight gain after 2 weeks. It was deduced that FB1 is more toxic than MON to channel catfish.

Adverse effects of fumonisin contaminated diets have also been reported in tilapia. Tuan et al. (2003) demonstrated that feeding MON and FB1 at 70 and 40 ppm, respectively, adversely affected growth performance of Nile tilapia fingerlings. FB1 is slightly more toxic than MON to tilapia fingerlings as symptoms appear earlier in fish exposed to FB1. Nevertheless, neither MON nor FB1 caused mortality or histopathological lesions in the fingerlings. Compared to channel catfish, Nile tilapia appears to be more resistant to these two mycotoxins in the diet.

Trichothecenes

Trichothecenes are a group of mycotoxins produced by certain fungi of the genus *Fusarium* that infect grains, wheat by-products and oilseed meals used in the production of animal feeds. The type A-trichothecene T2-toxin is produced by the fungus *Fusarium tricintum*. Manning et al. (2003b) demonstrated that T2-toxin is toxic to juvenile channel catfish. Reductions in growth rate were observed after 8 weeks for fish fed diets containing levels of T2-toxin ranging from 0.625-5.0 ppm, compared to a control diet. Significantly poorer feed conversion ratio was found only for the highest level of T2-toxin (5 ppm). The survival of fish fed T2-toxin at 2.5 and 5 ppm was significantly lower than that of the control fish.

A recent study indicated that resistance to disease in juvenile channel catfish was reduced when fed feedborne T-2 toxin, resulting in significantly greater mortality when challenged with *Edwardsiella ictaluri* compared to a control group (Manning et al., 2005b).

Deoxynivalenol (DON), also known as vomitoxin, and other type B trichothecenes are produced by *Fusarium sp.* and can be an important contaminant of wheat. DON levels of 0.2, 0.5, and 1.0 ppm in the diet significantly reduced body weight and growth rate in white shrimp *Litopenaeus vannamei*. However, the effects of 0.2 and 0.5 ppm DON were manifested at later stages of growth. DON at 0.2 ppm affected only the growth rate and not body weight. Feed conversion ratio and survival of shrimp fed diets containing 0.2, 0.5, and 1.0 ppm DON were not significantly different from those of shrimp fed the control diet (0.0 ppm DON) (Trigo-Stockli et al., 2000).

References are available on request.

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The increasing importance of selenium in fish nutrition

By Philip Thomas and Peter Surai

Selenium (Se) is of great importance for the maintenance of fish health, in particular fish immunity, as well as for fish growth, development, reproduction and flesh quality. Similar to other food industries, organic Se is shown to be more effective in fish nutrition than sodium selenite.

Intensive farming represents the majority of aquaculture in developed countries and this strategy is rapidly increasing globally. Intensive production, using nutritionally complete feeds as the only source of nutrition, offers opportunity for increasing growth efficiency and controlling product quality through optimal nutrient supply.

Knowledge and techniques on fish nutrition are developing and considerable advances have been made in recent years. Major themes are on unifying the approach for nutrient requirement determination, the replacement of marine ingredients and in controlling product quality through nutrition.

The requirement for selenium

In most cases the physiological concentration of Se levels in tissues of wild fish is several times higher than those in farmed fish. It is interesting to note that it is difficult to achieve Se concentrations in farmed fish similar to that in wild ones when sodium selenite is used. In some cases the required level for supplementation of Se came even close to toxic levels when sodium selenite was used to raise eviscerated body Se concentrations to those present in wild fish. However, by using organic Se in the fish diet, it is much easier to bring Se levels closer to that seen in wild fish.

Similar to other animal species, the requirement of Se in fish varies with the form of Se ingested, polyunsaturated fatty acid and vitamin E content of the diet and concentration of waterborne Se. It seems likely that Se requirement in fish is similar to those established for various farm animals and is in a range of 0.3 ppm (Surai, 2006). Se deficiency in fish is associated with oxidative stress and causes similar general clinical signs as in various birds and mammals such as compromised immunity and increased mortality.

Health and immunity

Immuno-competence and disease resistance in fish can be substantially compromised by deficiencies of various nutrients, especially certain vitamins and minerals. Thus, adequate levels of these micronutrients must be supplied in prepared diets to support optimal growth and production efficiency of fish in aquaculture.

Furthermore, a dietary supplementation of some of these micronutrients in excess of minimum requirement levels has been shown to significantly enhance immune responses and disease resistance of various animals. Increased fortifications of such nutrients as vitamin C, vitamin E, and Se have shown positive influences on immunity and disease resistance in different studies.

Quality of cultured fish

It has been shown that carotenoid deposition in tissues depends on many different factors including diet composition, level of fat, fatty acid composition of the diet and the presence and concentration of various antioxidants, etc. It is well known that carotenoids, including astaxanthin are easily oxidized and need to be stable during absorption and after tissue deposition.

Under culture conditions, the natural colouring of fish can be easily lost resulting in a loss of market value. Maintaining natural skin pigmentation is of great importance from a commercial point of view, as it has a direct impact on consumer acceptance and the market price of fish.

For example, the addition of carotenoid pigments is essential to ensure that the characteristic pink/red flesh colour of wild fish is maintained in farm-raised trout and salmon. Natural skin colour is also important, for example, in red porgy (*Pagrus pagrus*), a species closely related to the widely cultured red sea bream (*Pagrus major*), that is highly appreciated for its attractive appearance, firm flesh and delicate flavour. Another fish flesh that is appreciated for its colour, flavour and texture is that of the Southern Bluefin Tuna (SBT) (Thunnus maccoyii).

Figure 1. Feeding baitfish to Southern Bluefin Tuna (*Thunnus maccoyii*) in Polar Circle type cages.

Figure 2. Colour shelf life is an important product quality feature of sashimi grade Southern Bluefin Tuna.

Southern Bluefin Tuna

The farming of SBT is relatively new and involves the capture a large school of juvenile tuna in open oceans. As described by Glencross et al. (1999), fish are then reared in Polar Circle type cages for on-growing (Figure 1). This culture operation places the tuna in a new environment that fish will need to adapt to. The culture environment also provides the opportunity to manipulate husbandry and nutrition farm practices in order to modulate and improve fish production and product quality characteristics.

Colour shelf life as fish flesh quality

As with terrestrial red meats, colour shelf life is an important product quality feature of farmed Southern Bluefin Tuna. In common with beef, the bright red colour of tuna muscle is due to the myoglobin content of the meat. During storage, the myoglobin is oxidised to met-myoglobin and gradually changes from red to brown. However, unlike beef, the high levels of highly unsaturated fatty acids found in the tuna meat provide a strong oxidative pressure that can increase the rate of post-mortem browning. By slowing the oxidation process in tuna meat it is possible to extend the window of sale opportunity at the market (Figure 2). This can be achieved by supplementing the fish diet with natural antioxidants vitamin E, vitamin C and Se.

Antioxidants to extend colour shelf life

Vitamins E and C are important to tuna because they are antioxidants. Vitamin E is a natural free radical scavenger and breaks the chain of lipid oxidation. Vitamin C is also able the scavenge free radicals and prevent lipid oxidation, but in addition, it has a role in replenishing vitamin E within the fish muscle. Se is important to fish as it is used in a large range of selenoproteins. These selenoproteins (there are at least 25 of them) are important in the management of oxidative stress.

Recently, it has been demonstrated that all antioxidants in the body are working in concert as a team called "antioxidant defence system". In the team, each nutrient has its own role in helping each other. Vitamin E is considered to be the head quarters of antioxidant defence, vitamin C could be called "special forces" of antioxidant defence and Se is indeed "the chief executive of the antioxidant defence". Selenoproteins connect different antioxidants into the antioxidant system making the system to be effective (Surai, 2006).

The importance of organic selenium

The monitoring of the muscle Se level of Southern Bluefin Tuna, over the short farming season, has given some indications that over six months of culture there may be a drop in concentration. Se has traditionally been added to fish diets as sodium selenate. However in farmed Southern Bluefin Tuna, sodium selenate added to the diet was not effective in raising muscle Se levels.

Alternatively organic Se did raise muscle Se concentrations. Additionally, in combination with increased levels of vitamins E and C, it has been effective in maintaining the exquisite red colour of this meat longer during cold storage and effectively extending the window of sale for the product.

These preliminary results of Thomas and Buchanan (2006) are promising as they indicate that the supplementation of diets, for farmed tuna, with organic Se can maintain muscle concentration at the level found in wild fish. If deemed necessary, levels can be higher than that found in wild fish. In addition the use of a combination of vitamins E and C and organic Se can be a useful dietary addition for tuna for maintaining the post harvest red colour of Southern Bluefin Tuna sashimi (Figure 3) for a longer period.

Se fish in human food

As consumers are becoming increasingly aware that 'you are what you eat', there is great interest in functional foods. Adequate Se intake is important for human health and Sel-Plex® supplementation of animal feeds represents one way to create functional foods. Functional food applications with Sel-Plex® exist with dairy products, pork, chicken and eggs. Information being actively accumulated indicate that organic Se has the same advantages in fish as it has been shown for other animal species.

Looking at levels of occurrence of cancer in countries such as Japan, Venezuela and the United States, there is a clear indication that high Se in blood (hence high Se in the diet) leads to a reduction in cancer. Healthy Japanese women have 3 times higher Se levels than women from the US and have significantly lower breast cancer incidence. There is a large body of scientific evidence indicating cancer-protective effects of dietary Se supplementation in humans. By using organic Se in the fish diet it is possible to achieve desirable Se concentration in the fish flesh. Thus, the production of Se enriched fish is a solution for this Se deficiency.

References are available on request.

Figure 3. The synergistic combination of vitamin C, vitamin E and organic selenium supplementation in the feed will maintain the post harvest red colour of Southern Bluefin Tuna sashimi for a longer time.

Why organic selenium?

Selenomethionine is the principal form of Se which occurs naturally in food and can be considered as an essential amino acid, similar to methionine. The major nutritional form of Se is L(+)-selenomethionine, which is synthesised by micro-organisms and plants (including yeasts), but not by higher animals and humans. Only selenomethionine can be incorporated into proteins, thus it is the storage form of Se (mainly in the skeletal muscles). In contrast, sodium selenite (an inorganic mineral salt) can be incorporated into active selenoproteins such as glutathione peroxidase (GSH-Px) but not into selenomethionine as storage protein in liver and muscle. Furthermore, vitamin C is compatible with organic Se but incompatible with selenate or selenite. Vitamin C adversely affects inorganic Se by converting selenite or selenate into inert metallic Se, which the body cannot use.

Figure 4. Methionine and Selenomethionine are both essential amino acids as neither is produced by the animal itself. Yeast cells normally form methionine using sulphur. When fed inorganic selenium, they form selenomethionine by using selenium in the place of sulphur. Located in the same group in the periodic table, the chemistry of selenium and sulphur are similar and the yeast cell does not know the difference. Selenomethionine is identical in all ways to methionine except for the substitution of sulphur by selenium.

CH3-**S**-SH2-CH2-CH-COOH Methionine
                |
               NH_2

CH3-**Se**-SH2-CH2-CH-COOH Selenomethionine
                |
               NH_2

Until recently, we relied exclusively on inorganic forms of Se supplementation, ie sodium selenite and selenate. While these forms are adequate to prevent complete deficiency in most species, Se in its natural form is better for animals to meet their physiological requirement including improvement in Se absorption, store and utilisation. Organoselenium from Sel-Plex® selenium yeast (Alltech Inc.) offers Se in its natural form and allows animals to form higher tissue reserves of Se in order to meet high production demands, especially in intensive culture.

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Dr Peter Surai was head of Department of Physiology, Biochemistry and Nutrition at the Poultry Research Institute and Professor of Human Physiology at Kharkov University, Ukraine. In 1994, he moved to Scotland to continue his antioxidant related research and was promoted to a Professor of Nutritional Biochemistry at the Avian Science Research Centre of the Scottish Agricultural College in 2000. Recently he joined Alltech Ltd as a Head of Antioxidant Research. His main interest is in antioxidant metabolism, including selenium, in relation to animal nutrition, reproduction and functional food production.

Part 2: Influence of harvesting methods on the final quality of shrimp

Quality issues in marketing white shrimp *Penaeus vannamei* to European markets

By Hervé Lucien-Brun and Frédéric Vidal

In issue May/June 2006, the authors discussed the importance of farming methods on the final quality of shrimp for the HOSO markets in Spain and France. In this second part, how harvesting methods influence shrimp quality specifications are explained.

The harvesting method has a direct influence on the shrimp quality parameter such as firmness of carapace and head, absence of morphological defects such as necrosis and/or malformations and absence of melanosis

Preliminary sampling is very important. Aside from determining the average weight and biomass in a pond, it also allows the farmer to check the condition of shrimp for deformities, black spot, injuries, etc. and ascertaining the stage of moulting cycle. Sampling takes place over the three days preceding harvesting. Harvesting is decided once the following factors have been observed:

- less than 5% of molting shrimp and less than 10% of shrimp with soft carapace.
- less than 5% of shrimp with defects as floppy head, necrosis and
- good odour and flavour (see part 1, pp32-34, May/June 2006)

During the pre harvest sampling, it is very important to determine the phase of the intermolt cycle by a microscopic observation of the telson tegument. The suitable periods to harvest are the stages C and/or D0-D1. If shrimp are in the phase 5, the shell is hard but any stress would induce molting during harvesting.

Once a decision to harvest is made, feeding is suspended for at least 48 hours before harvesting but not more than 72 hours. This is to prevent shrimp from having a full hepatopancreas which gives them an unattractive appearance and encourage the phenomena called “red head”. This phenomena has also been attributed to the use of low quality components in the shrimp feed, such as fish oil.

Organisation of harvesting

Harvesting can either be by manual or mechanical means. Two kinds of nets can be used in manual harvesting. The open tube type is simple to use but workers spend most of the time in the water and there is always a risk of crushing the shrimp. Apart from reducing labour costs, mechanical harvesting has the advantage of being continuous and shrimp do not accumulate in the net. This will avoid risks from deterioration or damage. Several types of shrimp harvesters exist, consisting of either, Archimedean screw, submersible or non-submersible open impeller pumps or spiral pump type machines. Submersible impeller pumps do not lose their prime and thus avoid untimely interruptions during harvesting.

Harvesting facilities include a tank for chilling shrimp and another for treating shrimp with an anti-oxidizing agent. The number of these tanks will depend of the speed with which shrimp are harvested. Generally, one chilling tank is used for each of two treatment tanks.

Harvesting facilities must be organised to take advantage of “forward flow” of a product without any crossing of processes, in accordance with HACCP norms. The course taken by shrimp from when they leave the ponds up to when they enter the vehicle transporting them to the processing plant must be well organised. This also applies to the movement of boxes and other equipment used during harvesting. It obvious that cleanliness and sanitary conditions must be controlled before harvesting commences.

Harvesting shrimp

Harvesting usually takes place at night to for a better control of product temperature. Nevertheless, daytime harvesting produces good results, as is the case where the location of the processing plant is close and allows for a continuous transport of the product. The lack of control of temperatures can lead inevitably to the "red head" phenomena which will downgrade product quality.

Shrimp are removed from the net once it contains approximately 20 kg or every 10 minutes at the most. It is important to handle small quantities at a time to avoid injuring or crushing them. Shrimp are then transferred immediately to the chilling tanks.

Post harvest melanosis and antioxidant treatment

Melanosis exists in all crustaceans and is the result of a natural bio mechanism. Thus it must not be considered as an indicator of bad post harvest treatment. It does not have an impact on the flavour of the shrimp and is not harmful to consumers. Nevertheless, the ‘black spots’ effect in shrimp severely affects consumer acceptability, causing significant economic losses. In order to control melanosis it is important to really understand the mechanisms inducing it (see box page 31).

‘It is very important to avoid this as it is very clear from our understanding that if melanosis starts to appear in shrimp, there is no way back!’

After harvesting the main problem is how to avoid the initiation of melanosis for as long as possible. There are many techniques which can be applied in processing (refrigeration, freezing, heating, dehydration or irradiation). However, none of the processing techniques which are acceptable (in terms of legal and sanitary reasons) are totally efficient in controlling melanosis. It is obvious that good harvest techniques

together with strict controls of the "cold chain" are basic requirements.

Through processing, it is possible to slow down or even temporarily stop melanosis but not without damaging shrimp texture. Freezing at -18°C does not destroy the enzymes but only stops their activity. They will be activated when the product temperature rises. Even freezing has a menacing effect. When a product is defrosted, the bacteria which colonises it, develops very quickly and a bacterial bloom is observed. The activity of these bacteria could be a factor causing the appearance of melanosis.

To be effective, cooking must be destructive. In most cases, shrimp are cooked in a 95°C bath for 3 to 4 minutes, depending on size. Experiments have shown that cooking should be at higher temperatures and for longer periods of time. But this will then exert a deleterious effect on the texture and taste of shrimp and would render the product unacceptable to the consumer.

This is why the most widely used method to control melanosis is through the use of inhibitors which intervene at the enzymatic level and more specifically on the substrate or the intermediate reactions which are involved in the process.

Postharvest treatment

Metabisulfite treatment is currently the best option for controlling post-harvest melanosis development in shrimp. The processing of shrimp with sodium metabisulfite must be carried out before post-mortem reactions leading to melanosis commence. Usually, post harvest treatment consists of dipping the shrimp immediately after harvest in two successive baths; first in clean chilled water and then in a chilled metabisulfite solution. Many methods for using metabisulfite exist but one of the most common consists of dipping the chilled shrimp in a 7 to 8% metabisulfite solution for 7 to 10 minutes.

The concentration of metabisulfite and the duration of dipping must be adapted as a function of the size of the shrimp. A small sized shrimp will absorb the product more quickly than large sized ones. It is therefore necessary to adapt the treatment to meet present conditions.

As harvesting progresses and the metabisulfite is gradually absorbed by the shrimp, the concentration in the treatment bath is diluted. To maintain the correct concentration, metabisulfite must therefore be added regularly in accordance with the quantity of shrimp treated, but at no time should it exceed the maximum approved by importing countries. It is imperative to precisely control the concentration and the duration of the baths and the subsequent metabisulfite addition to the treatment water.

A team from IFREMER, the French governmental research institute has developed a machine which sprayed shrimp with a solution of chilled water and acidic liquid sodium bisulfte (Chantreau et al, 1989). The

Figure 1. Post mortem biochemical mechanisms involved in the formation of melanosis (adapted from COBB, 1977)

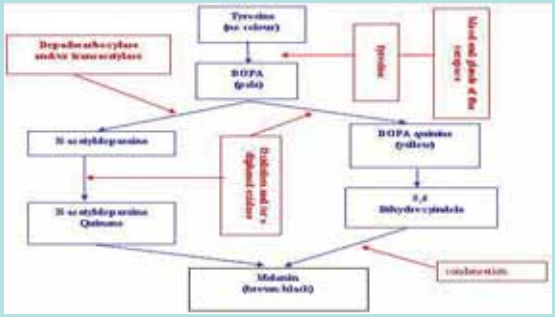
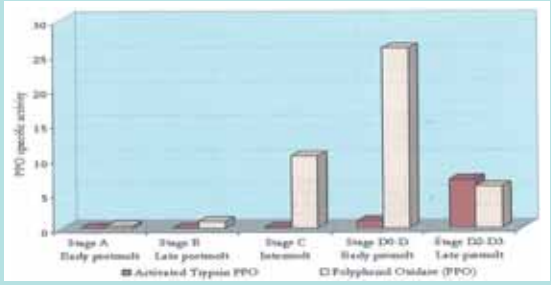


Figure 2. Polyphenol oxidase activity and trypsin activated polyphenol oxidase activity at various stages of lobster molting (M.R. Marshall & al, 2000).



How is melanosis induced

In shrimp, the black spots appear initially near the cephalothorax, appendices and inter-segments membranes. Melanosis is usually more severe on Head-on products. For HOSO shrimp, after removing the head, care should be taken to thoroughly wash the tail in order to eliminate proteases that could promote melanosis.

There are two separate biochemical pathways responsible for melanosis. The first is enzymatic where tyrosinase is the principal factor and the second is substrate dependent. In the first, under the action of proteolytic enzymes, tyrosine is released into the tissues. When tyrosine is in the presence of tyrosinase, it changes into DOPA which has a pale yellow colour. Tyrosinase is released into the haemolymph by glands located under the carapace. This explains why wounds to the exoskeleton or crushing of the animals cause blackening to occur rapidly. By enzymatic (polyphenol oxidase) and/or oxidative action, DOPA changes into DOPA quinone (yellow colouration) which is transformed into melanosis by condensation (Figure 1).

Enzymatic activity shows important variations during the intermolt cycle. However, the main role of polyphenol oxidase in the crustacean life cycle is probably related to the hardening mechanism of the shell in the intermolt cycle. Figure 2 shows that the highest level of polyphenol oxidase occurs during the stages C and D of the intermolt cycle. Considering the texture of the shell, the most suitable stages to harvest the shrimps are stages C and D0-D1

The oxidising and hepatopancreatic enzymes in dead shrimp seem to be main factors in polyphenol oxidase activity. Jiang et al (1991) identified 4 protease enzymes in the hepatopancreas of Penaeus monodon, of which three are trypsin-like and seem to initiate melanosis. These trypsin-like proteases could also be responsible for shrimp shell softening resulting in the degradation of the myofibril protein.

Stress could also initiate melanosis in shrimp. This melanosis is directly influenced by the general health of shrimp and also by wounds inflicted during harvesting. The mechanism of wound healing in shrimp and other aquatic organisms produces compounds as a result of the polymerisation of quinine which exhibit both antibacterial and antifungal activities. Nevertheless, the enzyme inducing this "tanning" effect does not interfere in post mortem processing.

Summarised, the key elements in melanosis are:

- The enzyme tyrosinase which is classified as a phenoloxidase. The action of tyrosinase on tyrosine is inhibited with a pH of 3.0 but this degree of acidity would denature the flesh of shrimp anyway.
- Oxygen, which acts directly in all reactions of oxidation. It is at this level that the antioxidant will be able to act.
- The presence of one or more suitable substrates such as tyrosine, DOPA, etc.
- Influence of several external factors, such as, biotic factors: molting stage, species, etc as well as abiotic factors such as temperature, wounds, etc. Low temperature slows down the enzymatic reaction but does not stop it. This effect is one of the aspects which make the early cooling of shrimp after harvesting extremely important.

Sodium metabisulfite and its alternatives

Sodium metabisulfite is currently, the most widely used antioxidant. Sulfites in various forms are not considered to be toxic substances. They are very irritant substances which could cause health problems for some consumers, especially people suffering from asthma or deficiencies of sulphite oxidase. As with all the additives used in processing, the label must mention clearly that the product contains metabisulfite.

Standards stating the authorized maximum rates are precise but vary from one market to another. The United States (Federal Register, 1985) and Japan accept a maximum of 100ppm of residues SO_2 in the flesh, but for the European Union the rate varies according to the size of shrimps as shown in Table 1.

Table 1. Representative inhibitors of enzymatic browning in fruits, vegetables anad seafood. (Adapted from McEvily et al. 1992)

Type of inhibitors	Products Family
Reducing agents	sulphiting agents ascorbic acid analogs, cysteine glutathione
Chelating aagents	Phosphates, EDTA< organic acids
Acidulants	citric acid, phosphoric acid
Enzyme inhibitors	aromatic carboxylic acid, aliphatic alcohols, anions, peptides, substituted resorcinols
Enzymen treatments	Oxygenases, o-methyl transferase proteases
Complexing agents	cyclodextrins

Table 2. Rules 98/72/EC of the EU defining the authorised maximum concentration of sulfides in crustaceans, Penaeidae, Solenceridae, Aristeidae family

Foodstuff per type and size	Maximum level (mg/kg or mg/l) as appropriate. Expressed as SO2*
Fresh, frozen and deep frozen	
Up to 80 units/kg	150
Between 80 and 120 unit/kg	200
Over 120 units/kg	300
Cooked	
All sizes	50

**1. Maximum levels are expressed as SO2 in mg/kg or mg/l as appropriate and relate to the total quantity, available from all sources. Note: The norms could change during 2006 (The European Commission is working to modify this rule especially for the authorised maximum residual concentration in cooked shrimps. Nevertheless this new rule is not published yet in the official journal)*

The official method for to determine the presence of sulphite in food is the optimised Monier-Williams method (AOAC, 990.28). The dosage must be done on tail flesh, excluding the inedible parts such as the shell or head. All the other methods do not give convincing nor consistent results.

The alternatives

Many teams have identified 4-hexylresorcinol, a derivative of resorcinol, as a potential substitute for metabisulfite in food. Several derivatives of resorcinol are industrially used today to control the browning phenomena in vegetables and potatoes. It has GRAS status and is generally considered harmless to humans.

There are two commercial preparations contain 4-hexylresorcinol: Everfresh in the USA and Sunny Fresh in Japan. Experimentally, the pure product gives good results in the control of melanosis development in shrimp and was even more efficient than metabisulfite. Nevertheless, the commercial products, and their application, did not show the same efficiency (Callega, 1992) as with laboratory grade 4-hexylresorcinol. This could be a result of an inferior concentration in the commercial mixture or a different grade of purity. Further testing should be conducted to verify the efficacy of the compound.

In the EU, 4-hexylresorcinol was provisionally included in the list of the authorized additives for seafood processing. Unfortunately, no establishment made the necessary administrative steps to obtain a definitive inclusion. Currently this product is no longer authorised in EU.

process was effective for melanosis, but the negative effect of the resultant sulfite vapour did not permit its development to an industrial stage.

Processing

This takes places in two consecutive stages: chilling and processing. The chilling process must be rapid and bring the temperature of shrimp down to around 4-5°C. This temperature can be achieved easily by using ice, but salt can also be added to increase salinity. By lowering the solution's freezing point, a bath temperature close to 0°C can be obtained.

Open PVC or plastic food quality boxes or totes are used for handling and loading shrimp of which 6 and 10 are placed in appropriately sized tanks. Upon leaving the pond, shrimp is placed into boxes and placed immediately in an ice bath. The immediate chilling of shrimp on leaving the nets is fundamental for maintaining top quality as it reduces the incidence of "red head" phenomena and slows down the appearance of melanosis.

Transport to the packing plant

For transport or hauling, plastic boxes or cases, able to hold approximately 20 kg of shrimp with a layer of ice at the bottom and another above, are used. As at the time of the harvest, it is necessary to always manage shrimp by small quantities to avoid the injuries such as scratching. The boxes must also allow surplus water to drain, to avoid a rapid deterioration. The firmness of the attachment between the cephalothorax and abdomen would soften quickly due to the absorption of water.

From this moment until the product is frozen, the main risk to the shrimp is the disruption to the "cold chain" which should be avoided at all costs. The "cold chain" is the subjecting of shrimp to a continuous and constant body temperature of 4-5ºC.

Bottomline

The shrimp harvested for a HOSO product requires meticulous attention than that for a product to be marketed as a tail on shell on. This is principally due to the delicate nature of the product, the consumers' demands for high quality and the need to use an antioxidant treatment. It is of utmost importance to establish precise protocols. A control of the variables at harvest can ensure the creation of an acceptable product in markets, even in those with the highest of standards.

References are available on request from the editor

Hervé Lucien-Brun is the General Manager of Aqua Techna. He has technical and commercial expertise in shrimp farming as well as shrimp processing units and commercialisation procedures. His experiences in shrimp farming were mainly in Ecuador where he worked for a large shrimp farm and hatchery . Hervé's expertise in quality control is mainly focused on the processing of whole shrimp for the European market. His experiences also cover lobster, shellfish and tilapia farming. Email: hlb@aquatechna.com

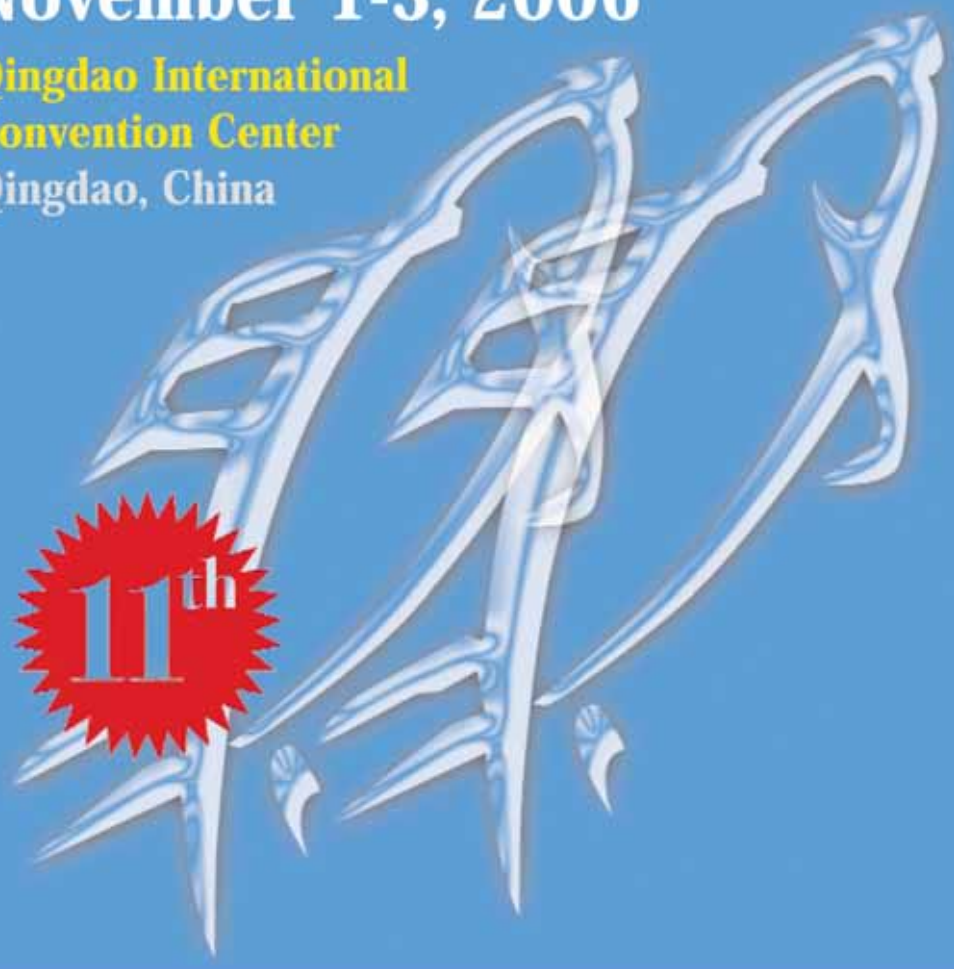
Fréderic Vidal is a technical expert in aquaculture, freshwater fish and tropical shrimp farming and is in charge of R&D of innovative products at Aqua Techna. His core expertise is in aquatic pathology. Between 1990 and 2000 he worked for various health organizations, large farms and shrimp incubation facilities. He also manages his own freshwater fish farm in Brittany since 1997, producing carp, roach, pike, pike-perch, sturgeon and silurids.

China's aquaculture industry is making substantial invesments in better equipment technology and services to increase its production of high-value aquatic products. Aquaculture China has been organized by China's Ministry of Agriculture to make it easier for China's aquaculture industry to purchase the latest products and services from Overseas Companies. If you want to increase your sales to the largest aquaculture industry in the world, make plans now to exhibit at Aquaculture China, China's largest international aquaculture exhibition.

Aquaculture China 2006

November 1-3, 2006

Qingdao International Convention Center
Qingdao, China



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2006 Seafood Technology China

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China Council for the Promotion of International Trade (Specialized Sub-Council of Agriculture)
Sea Fare Expositions, Inc.

Visit us online at: **www.aquaculturechina.com**

Sea Fare Expositions, Inc.
1111 NW 45th Street, Suite B, Seattle, WA 98107
Tel: 206-789-5741 Fax: 206-789-0504
Email: seafoodchina@seafare.com

Australasian Aquaculture 2006

The Asia-Pacific Chapter of the World Aquaculture Society will join the National Aquaculture Council and the South Australian Aquaculture Council for the Skretting Australasian Aquaculture 2006, to be held from 27- 30 August 2006 at the Adelaide Convention Centre, South Australia. Joint hosts are the Primary Industries and Resources, South Australia and the South Australian Tourism Commission. Organisers said that South Australia provides the perfect venue and location for this meeting as it leads the nation in aquaculture production. The diverse and active industry produces around 38% of Australia's aquaculture production.

The theme for the conference and trade show is "Innovation in Aquaculture" as maintaining or increasing profit, entering new markets, obtaining skilled labour are all aspects which will require a certain level of innovation. The 3 day conference and trade show will provide a forum for aquaculture farmers, processors, business operators, equipments suppliers, scientists, educators, students, consultants and government representatives to meet and discuss the latest advances and innovations in the industry.

Conference highlights

Marketing	Global marketing directions, the power of branding, how to make marketing work for you and buyers and producers sessions
Innovations for new products and new markets	Focusing on the development of high value markets ranging from sea urchin production for roe to anti viral drugs from algae
Offshore farming technology	Global experts will review the latest developments in offshore farming technology
The future in tuna farming	Farming issues to factors affecting profitability and managing risk for tuna farming and propagation issues
Recirculation systems	Innovations in the treatment of waste and recirculation systems for shrimp and marine fish
Health in aquaculture	Vaccines and new technologies and risk assessments and surveillance
Shrimp culture industry and its innovations	Reports on research on domestication and commercial trials with the black tiger shrimp, innovations in high density farming; recirculation production systems and organic farming and hatchery producers tell their story
Feeding and husbandry	Advances for marine finfish; nutrition and feed development
Shellfish	Propagation of spiny lobsters, rock lobster grow out and the international benchmark in oyster breeding

Trade show schedule

Monday 28 August	Tuesday 29 August	Wednesday 30 August
10.00-18.30	9.30-17.30	9.30-16.00

The last Australasian Aquaculture 2004 in Sydney in 2004 was the biggest aquaculture conference and trade show in Australia since World Aquaculture '99. It attracted 1,340 delegates from 49 countries with more than 200 presentations at the conference and 105 booths at the trade show. This year, the number booths have reached 105 at press time. A preview of selected exhibitors is presented below.

Feeds

Skretting, Australia
PO Box 117, Rosny Park, Tasmania, Australia, 7018
Tel: +61 3 6216 1200
Web: www.skretting.com.au; Email: enquiries.au@skretting.com
Booth Skretting
Contact: Tim Tayler, Customer Service Coordinator; Email: Tim.Tayler@nutreco.com
Dr Matthew Bransden, Technical Service Manager; Tel: +61 3 6216 1214; Email: Matthew.Bransden@nutreco.com

Skretting is a subsidiary of Nutreco, the world leader in the production and supply of feed for farmed fish. Its global annual production of high quality feeds is more than one million tonnes and provides nutrition to over 50 species of farmed fish and other aquaculture species. Skretting feeds conform to the world's most stringent food safety and quality criteria and include a level of traceability and reliability. Customers benefit from the global resources of Skretting which are used to assist in developing local solutions.

In Australia, the company delivers outstanding nutrition and services to fish farmers for the sustainable production of healthy and delicious fish, which includes barramundi, eels, salmon, trout, tuna, yellowtail kingfish and abalone.

"We are passionate about our feeds and your product. We invite all new and existing customers to come meet our customer service team at the Skretting stand - the heart of the trade show".

New Products: The Spectrum portfolio of hatchery feeds which includes live feed enrichments and culture products, Artemia replacement and weaning diets, as well as broodstock diets specifically developed for various marine finfish species, will be launched at the conference

Also new is the range of diets specifically developed for recirculation systems or for farms limited by nutrient outputs. These settlement diets (SD) help bind up fish faeces, resulting in significantly reduced nutrient leaching and a greater ability to remove the particulate faeces from the system.

Unique to Skretting is the new elliptical shaped, large pellet offered in the Nova range of marine feeds has many advantages for farmers growing large fish. Now available is the Nova range of winter feed formulated to improve the performance of yellowtail kingfish and barramundi during cooler water temperatures.

In Australia, it has recently launched its revolutionary abalone diet, Halo, which has triggered interest locally and from as far as Chile and South Africa.

Ridley Aqua-Feed Pty Ltd
PO box 187, Deception Bay, QLD, Australia 4508
Australia Tollfree: 1800 268 200; Email: aquafeed@ridley.com.au
Web: www.agriproducts.com.au/agri/aquaculture_landing_page.html
Booth 89,90,70 & 71
Contact: Mark Porter

Ridley Aqua-Feed Pty Ltd is a 100% Australian owned company providing feed to the Australian aquaculture industry. Our state of the art aquaculture feed mill located in Brisbane is the most modern aqua-feed plant in mainland Australia and produces a complete range of quality extruded and steam pelleted products for barramundi, mulloway, prawns, salmon, silver perch and other native species, trout and yellowtail kingfish. These complete feeds are for both domestic and overseas markets. All Ridley Aqua-Feed products are manufactured under strict ISO and HACCP certified procedures. Ridley Aqua-Feed has Feedsafe accreditation and as such has met the standards of the Australian stock feed manufacturing industry.

Primo Aquaculture P/L
PO Box 8007, Coffs Harbour NSW 2540
Australia Tollfree: 1800 024850; Tel: 61 2 6655 4463 Fax +61 2 6655 4988
Web: www.primo.net.au; Email: sales@primo.net.au
Booth 64 & 75
Contact: Rodney Evans

Primo Aquaculture is the manufacturers representative for INVE – the leader in the development, production and commercialisation of Artemia cysts, the Selco range of enrichment products, the Frippak, Lansy and Proton ranges of dry diets for marine shrimp and fish larval rearing.

New products: Sanocare MIC – microbial mixture for inhibiting pathogenic bacteria in shrimp hatcheries

Culture Systems

Cell Aquaculture Ltd
66 Bennett Ave, Hamilton Hill, WA 6163, Australia
PO Box 251, South Fremantle, WA 6152, Australia
Email: info@cellaqua.com; Web: www.cellaqua.com
Booth 68
Contact: Dale Harris; Mobile: +61 (0) 424 504 841;
Email: daleharris@cellaqua.com

Cell Aquaculture specializes in the design, manufacture, installation and support of recirculating aquaculture systems (RAS) for finfish. The company has designed a unique RAS for the culture of barramundi called the Cell™ System. Cell Aquaculture also sells individual filtration components for improvement of existing recirculating systems, as well as consulting on industry improvements and uptake of new technologies for increasing efficiencies in land based aquaculture.

New products:
Cell™ System – fully enclosed recirculating aquaculture system for barramundi
Passive Nursery System - for production of finfish
Belt Filter – for mechanical filtration in recirculation systems
Contact Chamber – for improved oxygenation in recirculation systems

Shellfish Culture Ltd
290 Bicheno St, Clifton Beach, Tasmania 7020, Australia
Tel: +61 3 6248 9441; Fax: +61 3 6248 9761
Web: www.shellfishculture.com.au; Email: info@shellfishculture.com.au
Booth 57
Contact: Richard Pugh, General Manager
Mobile: +61 4 0821 0672

Shellfish Culture Ltd, established in 1979, is Australia's largest supplier of Pacific oyster seed. The company also produces Blue mussel, commercial scallop and abalone seed. Shellfish Culture Ltd operates hatchery and nursery facilities in Tasmania and South Australia. Shellfish Culture Ltd invests strongly in R&D and operates a triploidy and selective breeding program for the Pacific oyster and Blue mussel.

New products: Triploid Pacific oyster and blue mussel seed.

Feed Processing

Allied Industries Pty. Ltd
12/12 Clarendon St. PO Box 767
Artarmon (Sydney), NSW 2064, Australia
Tel: +61 2 9437 0388; Fax: +61 2 9437 0399
Web: alliedindustries.com.au
Booth 33
Contact: Gary Pearse; Email: gary.pearse@alliedindustries.com.au

The Corporate Offices:
Wenger Manufacturing
Inc. 714 Main Street
Sabetha, Kansas, USA 66534-0130
Web: www.wenger.com

Extru-Tech Inc.
P.O. Box 8, 100 Airport Road
Sabetha, Kansas 666534, USA
Web: www.extru-technic.com
Contact: Joe Kearns Email: jkearns@wenger.com

Wenger Manufacturing, **Extru-Tech Inc.** and our agents **Allied Industry Pty. Ltd.** of Australia will have a booth with available brochures with regards to extrusion cooking, drying and manufacturing of all types of aquatic feeds as well as other feeds from the smallest 300 micron sizes as produced on the ET SAS system up to tuna sized feeds. All the possibilities of floating, sinking and semi moist feeds such as abalone and sea urchin feeds can be discussed. Both twin and single screw extruders as well as the advanced style of dryers such as the True Temp and Airflow II can be discussed from both companies with regards to all the advantages or our equipment.

In addition Allied Industries also specializes in additional process and packaging machinery for this industry such as Bauermeister of Germany, Cermex of France and Dynamic Inspection of New Zealand and Holland.

Special Announcement
Wenger and the south Australian Research and Development Institute (SARDI) will be sponsoring an open house at the University of Adelaide Roseworthy at the AESEC Centre in conjunction with Dr. Leong Wee (email: Wee.Leong@saugov.sa.gov.au), where Wenger equipment is installed for research and small production runs.

This will be held the day after the Australasian Conference on August 31st. If you wish to be a part of this open house including short lectures on extrusion and demonstrations of the facilities abilities, please let us know. Transportation and lunch will be provided.

Culture equipment

Rotomas Technology (M) Sdn Bhd
No 1, Jalan P6/2, Seksyen 6, Bandar Teknologi Kajang,
43500 Semenyih, Selangor, Malaysia
Tel: +60 3 8724 1633; Fax: +60 3 8723 3733
Web: www.rotomas.com
Contact: Bluey Chew; Email: blueychew@gmail.com

Rotomas Technology (M) Sdn Bhd manufactures, supplies and installs Australian designed equipment for recirculating systems. An intensive recirculating system complete with propeller wash bead filters for solid

filtration, gas stripping unit, foam fractionators etc is available. It also supplies tanks for raceways, hatcheries, Artemia culture, grow out and broodstock culture and other systems according to customer specifications. Rotomas is looking for distributors in Australia.

Aquasonic Pty Ltd
PO Box 311 Wauchope NSW 2446 Australia
14 Commerce St Wauchope NSW 2446 Australia
Tel: +61 (0)2 6586 4933; Fax: +61(0)2 6586 4944
Web: www.aquasonic.com.au
Booth 30, 31& 32
Contact: Susan Carson; Email: sue@aquasonic.com.au

Aquasonic Pty Ltd has been supplying quality products to the aquaculture industry for over 35 years. It is the largest aquaculture company in Australia and supplies products to aquaculture farmers, display aquariums, universities, research institutes and live seafood holding systems as well as many other organisations.

New products: Some of them are the Airsep PSA Oxygen Concentrators, DAN Wireless water quality monitoring system, OTOHIME Premium Japanese larval finfish diet, Kasco Aerators, extremely high O_2 transfer per horsepower, also used for display purposes with optional light packages and Pentair test strips. New ranges of Rietschle Thomas, Hamair and Hailia air pumps.

Scanz Technologies Ltd
P O Box 26 148, Epsom, Auckland 1344
New Zealand
Australia Tollfree 1 800 129 876
Tel: +64 9 520 2544; Fax: +64 9 520 4023
Web: www.scanztech.com; Email: info@scanztech.com
Booth 77 & 62
Contact: Tony Rumbold

Scanz Technologies Ltd will have an impressive display, comprising the new BioStream fish pump from Aqualife Products in the USA, Flowball Oxygenation System from Faivre of France, and U/V equipment from TMC of the UK. In attendance will be Louis Owens, President of Aqualife Products, Paul West, Managing Director of TMC UK, Aubert Faivre, Export Manager of Faivre Sarl, and Jens Olesen, Managing Director of Inter Aqua Advance of Denmark.

The Queensland Pavilion – Booths 94-125

Queensland Government – Department of State Development Trade & Innovation
PO Box 15168, City East, QLD 4002, Australia.
Web: www.sd.qld.gov.au/aquaculture
Contact: Aquaculture Team, Department State Development, Trade & Innovation
Tel: +61 7 3224 2076; Email: aquaculture@sd.qld.gov.au

The **Department of State Development, Trade and Innovation** works to support sustainable economic development in Queensland that will secure growth and employment. The Department contributes to economic growth by fostering a positive business environment for business and industry, promotes sustainable regional development, actively pursues strong partnerships with key industry sectors, aggressively seeks to identify major new opportunities to assist the State's future development and involves the private sector in capturing these opportunities, and strengthens the State's export performance. For further information on Queensland and its aquaculture industry come and visit us

Canadian Aquaponics Minisystem
A first at the show will be the Canadian Aquaponics Minisystem, developed by Dr Nick Savidov, Research Scientist and leader of Canada's greenhouse crops program. The system uses only one cubic metre of water for fish and plants growing on fish wastes. A half size (half a cubic metre) system will be on display at the **Queensland Department of State Development Innovationand Trade stand**.

Dr Savidov expects the Aquaponics Minisystem to be used more widely in aquaponics research in Canada and up to 60 Minisystems units are expected to be used in Canadian research into aquaponics within two years. At the conference, there will be a special session with six speakers on aquaponics.

Web: www.urbanag.info
Contact: Geoff Wilson, Editor "Urban Agriculture Online";
Email: Geoff@nettworx.info

Aquaculture Association of Queensland Inc.
PO Box 415, Childers, QLD 4660, Australia
Web: www.aaq.com.au
Contact: Bruce Sambell; Tel: +61 (0)7 4126 2226; Tel: +61 (0)407 797 149;
Email: bruce@ausyfish.com

The Aquaculture Association of Queensland, (AAQ) represents producers of freshwater finfish and crayfish. This includes hatcheries providing fingerlings and larvae, growers of table fish and the ornamental producers, both native and exotic. Some species include; Barramundi, Bass (Australian), Eels, Golden Perch, Jade Perch, Silver Perch, Murray Cod, Sleepy Cod, Red Claw Crayfish.

Queensland Government – Department of Primary Industries and Fisheries
Web: www.dpi.qld.gov.au/fishweb

The Department of Primary Industries and Fisheries assists Queensland food and fibre industries to increase productivity, sustainability, market growth and adaptability. We deliver world-class research and development, provide policy leadership, protect industries against pests and diseases and maintain animal welfare standards. Queensland aquaculture is estimated to be worth AUD 67.9 million in 2004/05. DPI&F is committed to working together with key stakeholders within the Aquaculture industry to ensure the vision of profitable primary industries is achieved.

Production, equipment & systems

Coral Coast Mariculture
PO Box 9046 (146 Buss Street) Burnett Heads, QLD 4670, Australia
Web: www.coralcoastmariculture.com
Contact: Clive Keenan; Tel: +61 7 4159 5691; Fax: +61 4 0248 2588;
Email: ccm@queenslander.net to check

Coral Coast Mariculture produces high quality seafood from 20 ha of HDPE lined ponds and its seafood processing and marina complex at the mouth of the Burnett River, adjacent to the pristine waters of Hervey Bay. Initial production is focussed on soft-shell crabs, with other exciting products planned for development including tropical abalone, cobia and barramundi fingerlings. CCM also supplies a wide range of aquaculture equipment, including aerators, paddle wheels and liners, direct from the manufacturer.

Aquaponics Network Australia
PO Box 5151, Mt Gravatt, QLD 4122, Australia.
Web: www.nettworx.info
Contact: Geoff Wilson; Tel: +61 7 3411 5424, +61 4 1262 2 779
Email: geoff@nettworx.info

Aquaponics is an innovative approach to the use of fish tank water and fish wastes, using them to grow vegetables, herbs or fruit. This technique minimises water loss and almost eliminates waste disposal problems. ANA will have the following items on display at the conference: Aquaponics Journal, Aquaponics books and CDs Latest research, educator and hobby aquaponics units Information on relevant courses and consultancy.

Orion Solar

23 Mudgeeraba Road, Worongary, QLD 4213, Australia.
Web: www.orionsolar.com.au
Contact: Richard Holliday; Tel: +61 7 5559 1666, +61 4 1498 2116
Email: richard@innotek.com.au

Orion Solar is the Australian distributor for Carmanah Technologies Corporation of Victoria, Canada. Carmanah are the world leading supplier of solar-powered LED lighting solutions designed for the marine market. Carmanah is considered an innovator and leader within the long established maritime "aids-to-navigation" industry. The company continues to be the major supplier of "aids-to-navigation" for Maritime Safety Queensland.

Seafood Innovations

72 Campbell Road, Sheldon, QLD 4157, Australia.
Web: www.seafoodinnovations.com.au
Contact: Bruce Goodrick, Managing Director
Tel: +61 7 3206 0777; Fax: + 614 3878 8218; Email: goodrickb@bigpond.com

Seafood Innovations are the inventors and world leaders in behaviour-based automated fish delivery systems and the flow-through fish stunners that form the basis of these systems. Our humane harvest technology and fish stunning and bleeding systems, now used by all the major salmon producers in Australia and internationally, deliver the ultimate in product quality and harvest efficiency. We can also provide the technical support and training services to ensure the optimum on-going performance of these systems.

Tooltech

PO Box 209, Carole Park, QLD 4300, Australia.
Web: www.ploma.com.au; Email: rbreakwell@tooltechservices.com.au
Contact: Reg Breakwell; Tel: +61 7 3271 1755, +61 40874 0883;
Fax: +61 7 3271 3298

Tooltech Pty. Ltd. (brand name 'Ploma') is a well established Australian plastic design and moulding company, producing many products and specializing in the Aquaculture Industry throughout the world. They manufacture the renowned Aquatray® and Aquapurse® Systems (trays, cages and accessories) used primarily for the farming of molluscs and crustaceans. These products have been well tried for many years, intertidally and subtidally in most sea-state conditions. They are considered to be the most comprehensive and versatile for their purpose in the world. The company welcomes any inquiries.

Disease Diagnostics

DigsFish Services

32 Bowsprit Cr, Bribie Island, QLD 4507, Australia.
Web: www.digsfish.com
Contact: Ben Diggles; Tel: +61 7 3408 8443; Fax: +61 4 0377 3592;
Email: ben@digsfish.com

DigsFish Services provides a private, independent, aquatic animal health service for Australasia's fisheries and aquaculture industries. If you require advice on issues related to disease risk assessment and prevention, or disease identification and control, or any other matter related to the health of your fish or shellfish, particularly in aquaculture or recreational fisheries, DigsFish Services is here to help.

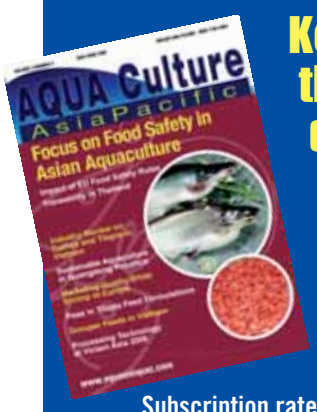
The Asian Pacific Chapter

From a small beginning, this chapter has grown to become the second largest chapter of the WORLD AQUACULTURE SOCIETY (WAS). It has 385 chapter members representing 42 countries. A membership to the chapter gives you

- Access to high quality research results presented at conferences and symposia around the world.
- Access to new products and suppliers through trade shows at regional conferences
- Access to a wider network throughout the Asia-Pacific region
- high quality research results presented at conferences and symposia around the world-the powerhouse of global aquaculture

The next Asian Pacific conference will be: Asia Pacific Aquaculture 2007, Hanoi, Vietnam, August 5-7, 2007

To be a member, log to www.was.org



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- SGD 70 for Asia
- SGD 100 for rest of world, Japan and Korea

Sept/Oct 2006 issue features

- ✓ Organic Aquaculture
- ✓ Feed Technology
- ✓ Disease Updates
- ✓ Show: Aquaculture China 2006, Qingdao, 1–3 November

Advertising Deadline
15 August 2006

Trade show at Aqua 2006

At the Aqua 2006 trade show, exhibitors were mainly from Europe and North America. The show was dominated by companies providing feeds and equipment suppliers.

Prof I Chiu Liao, Taiwan (third from left) and Edwardo Leano (fourth left) with Grace Huang, Carol Chong and Sunny Wang (middle) of Pioneer AE Company, Taiwan.

At the Sino Aqua booth, from left, Jennifer Yeh, Paula Liao and guest, Hou Hsu Kuang from Uni President Vietnam.

Carlos Unamunzaga Escosura and Eulaila Mantecón Gávez, fitoplancton marino, Spain

Marine algae

This is the first for the Spanish company **Fitoplancton Marino**. The company produces easy algae® in photobioreactors. The patented system of closed photobioreactors guarantees high quality production and prevents entry of contaminants. This is a freeze dried product from a preservation technique where no additives and no preservatives are added, said Carlos Unamunzaga Escosura from the Bioengineering Department. For the hatchery operator, this means a quick supply of algae and thus avoiding the time used for phytoplankton production. What is also important is that the traceability in the production process. After rehydration, both the nutritional value and the quality are as the fresh product. He added that research and scientific papers show there is no difference in using live algae or freeze-dried algae. For many applications freeze-dried microalgae gives higher yields. The uses of the algae are in green water larval rearing, rotifer culture, rotifer enrichment and for both mollusc and crustacean culture.

Shrimp maturation feeds

UK's **Seabait Limited**, a world pioneer in the sustainable mass culture of polychaete worms, has production facilities in Lynemouth, North England and in Maine, USA. In the last decade, there has been a global shift to the use of polychaetes as maturation diets for shrimp. The company's products are increasingly being used as broodstock feed in marine fish hatcheries fish culture. The worms are SPF (independently tested for WSSV, TSV, YHV and IHHNV) an essential biosecurity feature of shrimp culture.

Seabait Ltd views Asia as a large market for the polychaete worms, which are blast frozen on site. At the show, Stephen Craig, Aquaculture Development Manager, said that an important part of its sustainability concept is the use of purely terrestrial feed sources such as vegetable based meals and the use of less than 2% of fish oils in feeds. Feed development projects include enhancement of the polychaetes with selenium, lipid, pigments and vitamins. In addition the company's in house research is developing new products including 100% pure freeze dried cultured polychaete meal for both old and new market sectors. The freeze dried meal (the Lyo-P™ range) can be incorporated into numerous feeds and will be available to aquaculture markets and marine ornamental fish and crustacean sectors.

Aquaculture equipment, systems and services

Norwegian company **AquaOptima** introduced its new product- weaning tanks with rotating arm at the bottom which keeps the tank clean without manual vacuum cleaning. There is also an automatic discharge of waste from the centre of the tank. The company specializes in recirculation systems and has developed complete systems for a range of high value marine species from the halibut, sea bass to the puffer fish in Japan. The patented technology for solid removal called the eco-trap, brings the particles out of the tank by using only 1-5% of flow going through the tank and within a short time, 3-5 minutes after they settle at the bottom

Marketing its services in aquaculture was the **AquaBioTech Group**, a leading European aquaculture, fisheries and environmental consultancy. The company based in Malta also released information on **ABT Arabia**, a partnership with the Arab Fisheries Company, to provide aquaculture and development services to clients throughout the Arab world. ABT Arabia is based in Jeddah, Saudi Arabia to undertake all types of aquaculture operations from feasibility assessments to farm and hatchery design, construction and management. Work already assigned to the company include the design of a new shrimp farm, hatchery and processing facility in the south of Saudi Arabia, as well as projects in Yemen. Other works include various fish farm developments and production improvement, and the design and development of a new cage farming project, fish hatchery, tilapia broodstock development and biosecurity auditing/implementation.

Paula Liao, **Sino Aqua** of Taiwan, said that the show was a busy one for them with many enquiries on their products. It was an opportunity for the company to expand into the European markets. Most of their products are priced lower than those available in Europe. At the show, they introduced the AR series Aqua Rev aerators which supply oxygen directly from the bottom of the pond. This allows for a daily cleaning of the pond environment. Other products are the sea cage accessories. The company was established in 1997 and has a strong market for its paddlewheel aerators in Asia.

Also from Taiwan was **Pioneer A.E Company** which also markets equipment for pond culture such as pumps, HDPE pond liners, automatic feeds, power control panels as well as HDPE brackets for cage culture. They have an extensive range of paddlewheel and air injection aerators. The latter type allows for oxygen transfer into the water quickly and as the recirculating water will reactivate the pond bottom, it is proposed for use with the paddle wheel aerator.

Cage technology

There were several companies presenting cage culture technology. Italian company, **Refa Med S.r.l** develops fish farming technology for modern cost efficient off shore facilities. It has the tension leg cages (TLC). These are flexible and small in the upper section to brave the

The Welsh Group

Similar to the show in Bali in 2005, seven Welsh firms gathered in Florence to showcase their products and build international contacts under the stand of International Business Wales (IBW). In 2004, their participation at the show in Hawaii resulted in business opportunities in excess of £5 million.

According to Paul James, Export Assist project manager, "The World Aquaculture conference offers a platform for Wales to highlight its aquaculture capacities and the innovative technologies that it has developed".

Among the companies was **Dragon Feeds**, which has pioneered a new technology in the production of sustainable fish feeds. The company established in 1997 has commercialized the polychaete worm based maturation feeds for fish. At the show, the company showcased its shrimp maturation diets. Their latest development is the production of maturation feeds for shrimp. Their clients are global from South America, Europe and the Caribbean , according to Michael Owen.

Another company, **Ocean Sense**, has developed an inventive technology to help remove the destructive European Shore or Green Crab, which is threatening indigenous species across the globe including Japan and Australia. Lloyd Watkins, managing director of Ocean Sense, explained: "Travelling as larvae in amongst the ballast water tanks of today's super vessels, the European Shore Crab, which is only indigenous to European shores, has invaded shorelines across the world. It is particularly prolific on both coasts of the USA and in South Africa, Australia and its Mediterranean variety is prolific in Japan. In these environments, it is an extra predator".

Fishgen Ltd markets the fast growing all male tilapia strains globally. Erik Roderick, said, "Fishgen was extremely busy for the whole show with a large number of enquiries for the YY supermale technology. Many of the visitors simply wanted more information on this technology and how it replaces the need for hormone sex reversal in global tilapia culture. We have many offers from companies wishing to represent Fishgen and market this technology and products throughout the world. Many of them came from the Middle East which is seeing a sharp increase in aquaculture ventures".

He added that the company is working very closely with Dragon Feeds to market an organic tilapia, fed on the organic polychaete diets. This partnership has huge potential for the tilapia industry.

At the Welsh Booth, Bert Mayering and Michael Owen, Dragon Feeds and Erik Roderick, Fishgen UK.

Mon Aqua Tech (MAT) has a presence in Europe and S.E Asia on the development of technologies to improve the performance of recirculating systems. Currently, it is assisting with the development of a commercial scale culture of coral reef species in East Malaysia and has initiated similar projects in Thailand and South Pacific.

Llyn Aquaculture Ltd, based in Pwllheli in North West Wales, is a young, dynamic company specialising in the design and installation of recirculation system units, both hatchery and on-growing, for both marine and freshwater species. It owns and operates one of the most advanced closed system recirculation technology units in Europe and has worked on projects in Singapore and Australia as well as mainland Europe, Ireland and the UK.

Dr Mark Rigby, Llyn Aquaculture's technical director, said: "On St John's Island in Singapore we worked on a government-led project to design and build a complete recirculation system. Once we had designed it, I was then employed as the main consultant to the local engineering firm in charge of purchasing and supplying the equipment and overseeing its installation."

The company is currently providing technical consultancy to a large prawn farming project in Western Australia. Mark continued, "It is very important to us to be able to manage the whole project to ensure that it is environmentally-friendly and does not involve the destruction of the area's delicate coral reef and mangrove swamps."

impact of stronger waves. The cage will remain stable under all conditions. A feed buoy has been developed as a solution for automatic feeding for four TLC cage module. The services from the US based **OceanSpar** include pens for open ocean aquaculture, pens for marine and freshwater aquaculture and aquaculture engineering services. Their sea station line for open ocean aquaculture is customised to the unique site and species characteristics. **Advanced Aquaculture (adaq)**, an Italian company has square cages with full plastic construction and wooden walkways. It also supplies modular brackets, net washing machines and tubular service boats. Also at the show was **DSM Dyneema**, inventor and manufacturer of the **Dyneema**, the world' strongest fibre for nets (also see p 41).

Feeds production and additives

Wenger, USA introduced its new Magnum St Twin screw extrusion system (also see page 14). Besides promoting its Aquatrac range of poultry protein, Germany's **Gepro-Gefluegel Protein** introduced poultry fat with below 1% of free fatty acids produced through a new fat raffination process. The **European Animal Protein Association** promoted the use of natural animal proteins. It said that specialists in the European Union have indicated that animal protein products such as blood meal can be used in fish feed as these are produced from clean, fresh blood and processed by strictly specific techniques. These ingredients contained essential amino acids, vitamins and minerals and can easily be combine with other plant meals. Compared to fish meal, they contained low levels of environmental contaminants such as dioxins or heavy metals.

New in hatchery and starter feeds

Belgium based **BernAqua** bvba develops and markets hatchery feeds for shrimp and marine fish. The company has a range of larval and juvenile diets for the marine fish and shrimp. These include enrichment products for rotifers and arterial. At the show, it introduced the first commercial protein booster for artemia and rotifers which contains only polar lipids. This comprise of a total food concept as rotifers and artemia fed classic oil emulsion tend to loose part of their protein biomass before being consumed by fish.

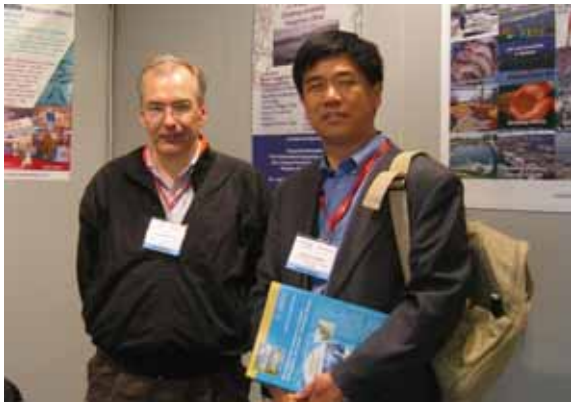
USA's **Cargill** promoted its new line of Aquaxcel starter feeds. The production of these feeds uses the latest technology in ingredients and manufacturing to increase stability and facilitate consumption. The features are water stability, shape, size and homogeneity. The company said that a well rounded shape with full oil coat is more resistant to water than crumble with non coated sharp edges. For ***L. vannamei***, particle sizes are 0.8mm to 2.0mm. The innovative formula for the marine shrimp and for warm water fish such as the tilapia and various topical marine fish, sizes are less than 0.4mm to 2.2mm.

Skretting, the global brand of Nutreco's fish feed activities was a major sponsor for the event. In the Asia Pacific region, it has production facilities in Japan and Australia (see page 34). **Ewos**, a major feed producer with mills in Norway, Chile, UK and Canada has a new promarin feed, a replacement for the live feeds. The company said that this has been a result of several years of research and is designed to replace artemia. Through the patented use of phospholipid, the feed has reduced levels of leakage of water soluble nutrients from the particle. The early weaning of the seabream on this feed showed fast growth and good juvenile quality.

Future Trade shows

The next meeting of the **World Aquaculture Society** and trade show will be held in San Antonio Texas, USA from February 26- March 2, 2007 and **Asia Pacific Aquaculture 2007** will be held in Hanoi, Vietnam in August 5-8, 2007. The **European Aquaculture Society** will hold its next conference and international exhibition on aquaculture in Turkey from 24-27 October, 2007. For more information on these conferences, web: www.was.org

At the ABT Biotech booth, from left Shane Hunter, Khaled Alaboodi, Arab Fisheries Co, Roland Wadge, ABT, Daniel W Power, Evolution Aquaculture, UK.



Dr Thomas Wilson, Thailuxe Feeds,Thailand (left) and Dr Qingyin Wang, Yellow Sea Fisheries Research Institute, China at the AAP booth.

At the Biomin booth, Pedro Encarnação with guest. His article on mycotoxins appears on pages 26-27

Bernard Devresse, General Manager of Bernaqua (right) and customers

At Aqua 2006 Trade show

A fibre for the new challenges in open ocean cage culture

In marine cage culture, the focus is on the culture of carnivorous species such as the cod and sea bass in Europe and cobia in Asia to overcome the dwindling supply of marine fish from capture fisheries. Culture is moving out into open oceans and for profitable operations, producers seek net fibres, which are not only durable and able to withstand extreme conditions but resist fish biting to reduce the percentage of escapees.

Jaco Fok, business manager DSM Dyneema said, "Today, the industry is looking for net fibres which can deliver significant economic and handling benefits, saving maintenance time and cost and at the same time, provide a healthier environment to promote fish growth". Already in 1990 DSM Dyneema, Netherlands, started the large scale production of Dyneema®, the world's strongest fibre™. The new fibre is 15 times stronger than steel (weight for weight), is durable and has a very low shrinkage and elasticity. The oldest cage structure by Ocean Spar, a cage design and engineering company, has been using this fibre for the past eight years. It is located in the waters off Hawaii for the culture of the Pacific threadfin Polydactylus sexfilis, or moi. The fibre is well used in the fishing industry but it was only three years ago, when DSM Dyneema began to focus on its use in net applications for cage culture.

Jaco Fok and André van Wageningen, with samples of the fibre at Aqua 2006

Jaco said, "Due to its exceptional bite resistance, it has become the standard for nets for biting fish in the Mediterranean cage culture industry. The farming of cod in Norway is much more economic with this fibre. Although the initial investment may be 2-3 times higher than for nylon fibres, it is more profitable as it has prevented losses from escapees, currently ranging from 10 to 40% for cage farms in Norway".

On the attributes, he added, "The fibre is so very light it even floats and does not take in water at all. This is vital as diameters of offshore cages usually range from 90-120m. Netting made with Dyneema® fibres weight only about 30% compared to those using nylon for equal breaking strength. Therefore, the same hauling equipment, can handle cages with larger diameters as compared to those using nylon netting. Another feature is the small twine size which gives the same strength as nylon with much larger twines. The smaller twine allows for a better water flow through cages, thus improving on the exchange of dissolved oxygen, better removal of waste material and better cage shape retention in strong currents, thus reducing fish stress. Another effect of the smaller twine is a saving in the quantity of antifouling material required for the smaller surface of the twine".

"One of the big problems in cage farming has been attacks from seals and sharks. Cages usually have a layer of outer predator nets. Because of its high strength and low elasticity, the fibre has been shown to prevent sharks from pushing into the inner nets and damaging the fish in them".

Jaco clarified that the company markets and manufactures the fibre and works with customers that design and fabricate the nets. He added, "With this fibre, the cage maker has not only a new choice of fibre but also a larger degree of freedom in net design".

In his presentation at AQUA 2006, André van Wageningen, market segment manager aquaculture DSM Dyneema, said that there is a drive for fish farming companies to move to more exposed areas, as well as increase the size of their cages and profit from the economy of scale in production. Both developments bring new challenges regarding the operational and technical aspects of fish farming. This raises the question how commonly used cage designs will behave in extreme conditions.

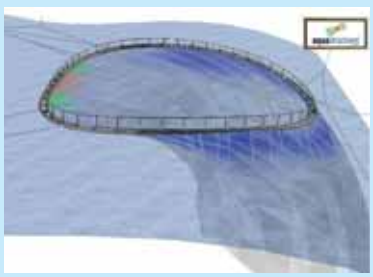
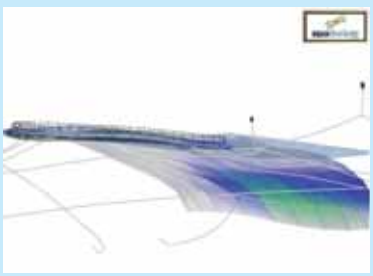
"Parameters such as the net shape and water throughput as well as the stress on the mooring system are important. In the case of cages with smaller twines and lighter nets, the shape of the cages using such nets is shown to be less influenced by currents, giving a higher residual cage volume. In studies conducted by Aquastructures AS, the residual volume of net cages made with this fibre remained at 95% at current flows of 0.3ms^{-1} as compared with 82% with nets made with polyamide. The residual volume differences further increase at flows of 0.7 ms^{-1}. This better net shape stability is a direct result of the better flow of water through the smaller twines of the net.".

More information: Web: www.asaferplacetogrow.com or Email: info.dyneema@dsm.com

Comparison of residual volumes with current speeds

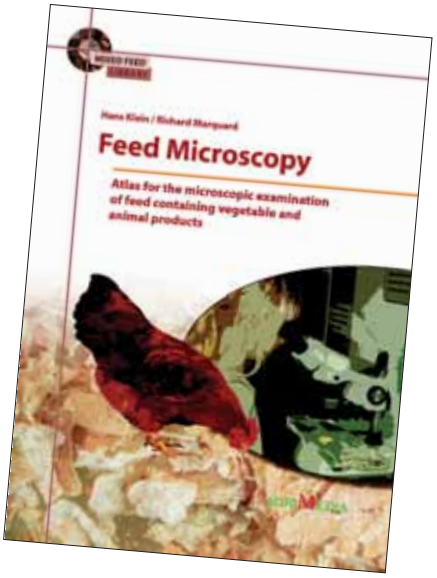
Water current (m/s)	Dyneema %	Polyamide %
0.3	95	82
0.5	74	52
0.7	54	34


The fibre



Graphic presentation on the residual volumes with Dyneema net at 0.7 m/s (left) versus a nylon net

Feed Microscopy

K. Klein, R. Marquard (2005)
AgriMedia GmbH, Bergen.Dumme, Germany. 307 pages. Hardcover.
Price: 149.00 USD. ISBN 3-86037-255-6.



Feed microscopy is increasingly a part of quality control of feed raw materials as well as compound feed. This atlas for the microscopic examination of feed containing vegetable and animal products contributes to the evaluation and improvement in the quality control of feeds.

The first part of the book gives information on techniques of feed testing such as:

- Quality control aspects of feed microscopy,
- Technical equipment and sample preparation,
- Structural characteristics of plant animal products and by-products,
- Structural characteristics of common impurities and contaminants.

In the second part the drawings show the morphological and anatomical structures of plants and plant products. It is, therefore, easy to identify parts of plants by comparing its structure with the same of the drawing of the respective plant. The same applies also for feed components of animal origin. Here the anatomical; structure and/or their fragments form the basis for the microscopic diagnosis.

The atlas contains more than 200 plants, plant and animal fragments. The comprehensive index in English and scientific names make the finding of a respective item easy. The atlas is a very useful aid for quality control staff as well as for research workers. - Joachim Hertrampf

Better production rate with pelleting enhancer

What does a feed processor do when he has problems in pelleting due to hard running ingredients or high compression dies? The usual option is to add fat or to reduce the thickness of the die but this can result in poorer pellet durability. In shrimp feed, maintaining pellet durability and stability is crucial.

Borregaard offers the non-nutritive PellTech range of pelleting performance ingredients used to pelleting efficiency. The product is based on lignin and is made from natural renewable resources. It contains no animal products and is non-GMO. It is used in the animal feed industry such as for cattle feed with molasses and baby pig feeds with sugars in Australia, India, Thailand, Vietnam and Korea.

"We have found that PellTech is very useful for production of shrimp feeds. The high compression required for these small pellets often restricts production rate or limits the types of ingredients that can be used. PellTech has been used successfully to increase production rate to meet seasonal demand. It has also allowed use of cheaper 'opportunity' ingredients that could otherwise not be used", said Tom Winowiski, Technical and Business Development Manager, Borregaard, S.E.A. Pte Ltd in Singapore.

A series of trials with shrimp feed production rations were completed in February 2006. In one set, Tom tested the pellet enhancer's ability to allow use of a cheaper 'opportunity' ingredient that had otherwise proved impossible to include in the formulation. Inclusion of this ingredient forced a reduction in conditioning temperature and caused a continuous increase in amperage that eventually would cause complete die blockage. Inclusion of 0.3% PellTech with the 'opportunity' ingredient caused an immediate reduction in amperage followed by a continued decline as the die holes continued to be cleaned and conditioned. The trials were run on a standard ring type die pellet mill with three conditioners and pellet diameter was 1.8mm and 3mm long. The conditioning temperature was 90°C.

In another trial, the level of improvement of the production rate of a 2mm pellet when the pelleting enhancer was added was determined. Production increased by 38% with addition if 0.4% PellTech. Tom said that the additional tonnage produced was virtually free of energy costs. Production rate increased by 25%, from 1.86 tph to 2.36 tph, when 0.2% was added with a corresponding decrease in power of 12%. Although PellTech is not a binder, visual inspection also showed that pellets had improved smoothness and reduced cracks.

More information: www.borregaard.com or email: tom.winowiski@borregaard.com

Innovations for aquaculture

In April, Aqua Techna from France, through its local distributor in Vietnam, Vinh Thinh, held a seminar for farmers to introduce its range of services and products. The areas of expertise of the group of consultants in the company range from the farming of several shrimp and fish species, environmental and coastal development, feed and additive manufacturing, product processing and quality control to markets commercialisation.

The company also supplies a wide range of premixes and nutritional additives for aquaculture. Some of these are Calci-S which is a combination of calcium, phosphorus, peptides and vitamins. It provides the essential minerals for shell formation and is recommended for use before harvest. Pigmentech-SF is plant extract concentrate which provides a very stable source of metabolisable pigments for shrimp and fish. It should be used when light colours of shrimps are observed and when fish do not have good pigmentation.

For fish, a combination of sorbitol, choline, inositol, methionine and vitamins E and C, help in fat metabolism. For the pond environment, it has water quality enhancers such as Water oligo-S/F which prevents the development of cyanobacteria. Water probiotics is designed to reduce organic waste. For shrimp and fish health, it markets two products with a combination of manno-oliogosaccharides and beta glucans. The company has a well balanced feed additive including a registered strain of probiotics (Pediococcus acidilactici MA18/5M), vitamins and selenium, the Perfostim, which has demonstrated is efficiency to improve growth and survival of shrimp.
More information: Web: www.aquatechna.com; email: hlb@aquatechna.com

Tsunami relief projects in Aceh completed by AwF

Kevin Frizsimmons

Mr Michael New, OBE, Chairman of Aquaculture without Frontiers (AwF) said that two of the tsunami relief projects in Aceh, Indonesia have been completed but several others are on-going or about to commence. One of them is in Kareung Village, Aceh Besar District involving a village inhabited by 127 people from 57 families of the population who survived the tsunami disaster. For this project, AwF bought 300 kg of seaweed as seed source from West Java province. In the first phase, the culture involved seed development for 20 days, which was subsequently used as a source of seaweed seed for the expansion of seaweed culture. AwF has also announced Dr Kevin Fitzsimmons, a Past-President of the World Aquaculture Society as a new Director of AwF (USA). This was confirmed at a meeting of the AwF (USA) Board on 10 May 2006. Kevin currently serves as an AwF volunteer in Indonesia.

Aquaculture without Frontiers (AwF) is an independent non-profit organisation that promotes and supports responsible and sustainable aquaculture, and the alleviation of poverty by improving livelihoods in developing countries. Formed in 2004, AwF is registered as a charity in the UK and as a non-profit organization in the USA. Check out the website at www.aquaculturewithoutfrontiers.org, if you are interested in volunteering your services to AwF or for donations to AwF.

Patrick D Vizzone

New regional head for Asia in Food & Agribusiness Research

Rabobank International ("Rabobank"), has announced the appointment of Patrick D Vizzone as Regional Head, Asia and responsible for the overall activities of Rabobank's Strategic Advisory and Research/Food & Agribusiness Research ("FAR") departments in the region. Based in Hong Kong,Patrick leads team of 20 food & agribusiness ("F&A") analysts and advisors throughout Asia.

Patrick brings 12 years of experience in agribusiness and strategic advisory to his new role. Since joining Rabobank in 2003, he has advised several of the world's largest F&A corporates on their business strategies, as well as a number of governments and public sector agencies in countries such as Canada, China, Singapore and South Korea, on issues such as industry/rural development, supply chain management, and the promotion of foreign direct investment in the F&A arena. Prior to joining Rabobank, Patrick also participated in a number of F&A ventures in both Australia and China.

Patrick holds a MBA from Manchester Business School, United Kingdom. Commenting on the appointment, Rabobank's Head of Asia region, Fergus Murphy said, "Rabobank is a niche knowledge based bank focused on providing value to its clients in its core sectors, including F&A. With this objective in mind, F&A advisory and research are now integral components in our business and key engines of our growth."

24- 29 July

Shrimp Health Management Training Workshop
Bangkok, Thailand
Contact: shrimp-school@alltech.com

25-28 July

14th Annual ASA Southeast Asia Feed Technology and Nutrition Workshop
Recent Advances in Aquaculture Nutrition and Feeding
Siem Reap, Cambodia
Tel: +65 6767 6233
Fax: +65 6737 5849
Email: asaspore@pacific.net.sg

27-30 August

Australasian Aquaculture 2006
Adelaide, South Australia
(see show preview pp34-36 & IBC)

6-8 September

ISTA7- 7th International Symposium on Tilapia in Aquaculture
Veracruz, Mexico
Contact: Kevin Fitzsimmons
Email: KevFitz@ag.arizona.edu
Web: http://ag.arizona.edu/azaqua/ista/ISTA7/ISTA7.htm

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: +1 979 458 0019
Email: mnriaz@tamu.edu
Web: www.tamu.edu/extrusion

1-3 November

Aquaculture China 2006
Qingdao, China
Contact: Seafare Expositions
Tel: +86 10 58672620
Fax: +86 10 58672600
Email: seafoodchina@seafare.com
info@seafarechina.com
Web: www.aquaculturechina.com
(see advert p33)

16-19 November

Malaysia AquaFair 2006
Kuala Lumpur
Contact: Yeo Moi Eim/Velu Murugan Ramasamy
Tel: +603 8870 4000
Email: aquafair@dof.moa.my
Web: www.agrolink.moa.my/dof

2006

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

ISTA VII

Boca del Rio, Veracruz, Mexico, 6-8 September 2006

ISTA VII is the Seventh International Symposium on Tilapia in aquaculture. This is the seventh of the highly successful series of symposia on tilapia in aquaculture that have brought together tilapia biologists to review the latest discoveries in tilapia biology, ecology, improvements in production systems and other fields related to tilapia and their use in aquaculture. This will be the first of the symposia to be held in Mexico after earlier meetings in Israel, Thailand, Cote D'Ivoire, US, Brazil and the Philippines.

It will have a special emphasis on the rapid advances in genetics, development of advanced breeds, the development of international markets and opening of new markets for Mexican produced tilapia products. A trade show will be included which will provide a forum for industry suppliers, seafood marketers and the aquaculture press to meet directly with researchers and producers. Field trips are being organized to nearby tilapia farms and a processing plant.

Three new reference books on tilapia will debut at the conference with an author signing event planned. Other social events will include a tilapia dinner and contests for largest tilapia, best tilapia artwork, and best tilapia dish at local restaurants.

The State of Veracruz and The American Tilapia Association will sponsor the meetings. Panorama Acuicola Magazine will be the host and organizer of the trade show. Other collaborators assisting with the symposium include the Latina American Chapter of The World Aquaculture Society.

More information: Kevin Fitzsimmons; Email: KevFitz@ag.arizona.edu or Web: http://ag.arizona.edu/azaqua/ista/ISTA7/ISTA7.htm

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*attending, *presenting, *sponsoring...
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www.australian-aquacultureportal.com
or contact the conference coordinator:
Claudia Metti
Tel: +61 (0)8 8226 2269
Email: metti.claudia@saugov.sa.gov.au

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27 - 30 August 2006
Adelaide Convention Centre
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AustralasianAquaculture

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furthur information:

www.australian-aquacultureportal.com

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Email: _____ Website: _____

Payment by credit card *(Note: your card will be charged in Singapore dollars)*

❒ Visa ❒ Mastercard

Credit Card No: _____ V Code No : _____ *(three digits after card number at back of card)*

Name of cardholder: _____

Expiry date: _____ Signature: _____

Billing Address (if different from mailing address) _____

Telegraphic Transfer: Email/Fax for details

Payment by cheque
We accept only cheques/drafts in Singapore dollars drawn on a Singapore bank.
Make cheques payable to **Aqua Research Pte Ltd**
❒ Please send me a receipt.