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WRITE TO THE EDITOR

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

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

Letters may be edited prior to publication

From the editor

Trust and credibility

All industries receive bad publicity periodically and it should not be viewed as a bad thing. This is a basic human right - the freedom of expression. It is also the key driver to improvement and development. Aquaculture is no different and the recent issue to come across the scientific publications is that low fat fish such as catfish and tilapia are unhealthy! Fish and fish oil have long been touted as beneficial to the human heart and health because of the high levels of polyunsaturated and highly unsaturated fatty acids (PUFAs and HUFAs). Thus, this report in the Journal of American Dietetic Association was a surprise. It implied that eating tilapia and catfish with a higher n-6 PUFA than n-3 PUFAs and HUFAs is risky to health. The tilapia community was fortunate as other researchers in the scientific community have refuted this and the discussion today has largely been confined to the industry.

However, there is a major risk of this news being sensationalised by the media and sending the wrong message to the consumer and the general public. This is where the scientific community, who is perceived as unbiased and knowledgeable, should take on the responsibility of addressing any misinformation with timely response and evidence-based research information. Tilapia producers should be thankful to 16 researchers and cardiologists who said that the tilapia story is way off base. This was reported in the tilapia discussion group (please read http://www.sanfordhealth.org/VisitorsPatients/HealthResources/HealthArticles/ and http://www.mayoclinic.com/health/tilapia/MY00167). Industry associations should also be proactive and work with the scientists. The 'jury may still be out' on the conclusion but by being proactive, this can only help to build trust and credibility within the industry.

The Pangasius catfish is no stranger to negative publicity. There have been internet messages circulating showing the unhygienic methods in the culture as well as post-harvest processing. No one outside Vietnam had heard of the 'panga' a decade ago but in less than 5 years, this fish is today competing with cod and pollack as the 'other white fish'. It is easy to blame the competition (other species of catfish) for the bad publicity but we should take a step back and look at this as a natural progression. The unhygienic backyard operation is giving way to a credible farming industry today that complies with the strict food laws based on the 'farm to fork' approach of several markets. Flavio Corsin, who is handling the WWF initiated catfish dialogues said that these are not intentional but due to the farming structure, dominated by small scale and resource limited producers. However, we can see that the negative publicity has unwittingly helped push the industry forward. Perhaps unknowingly, the Vietnamese catfish industry has been building up its trust and credibility faster than expected.

The shrimp industry has had a slightly longer history of negative publicity and unfortunately has not been able to shake off the 'high cost of cheap shrimp syndrome'. Even today, the open media writes about the mangrove destruction of shrimp farming and its environmental impact hence questioning the issue of sustainability. How can we educate consumers that shrimp farming is no longer the same as it was in the early 1980s and, with new culture technologies and consumer demands, some of the comments are outdated. Some have gone further to recommend eating wild caught shrimp over farmed shrimp but this is not the answer as the wild population declines while overall shrimp consumption increases. Global Aquaculture Alliance has taken the correct route through their Best Aquaculture Practices and developed a certification that promotes sustainability. This self-regulation goes a long way in building an image of trust and credibility amongst the consumers.

It is apparent that the industry tends to overlook consumer education in the zeal to increase sales and profits. This is, in fact, a prerequisite for any industry to sustain itself in the long term. The earlier this is done in the industry growth cycle, the longer the industry will sustain itself. A study by AgroMilagro research shows the importance of credibility and perception in the marketing of organic products (page 13) and the same principles apply to the aquaculture industry. By focusing on consumer education and building a good level of trust and credibility with consumers, increased consumption and market expansion fall into place.

Zuridah Merican

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Second review of US shrimp antidumping tariffs

Major gain for India

The review covered the period from February 1, 2006, to January 31, 2007. Some 319 exporters and producers from India had requested for the review but several did not respond to the additional information requested by the US Department of Commerce (DOC). In its decision in July, the DOC brought down the average duty for the majority of Indian exporters to 1.69% at the end of this second administrative review. In this first administrative review, it was 7.22%.

Companies that did not respond for additional information were hit with a rate of 110%. The 70-odd companies, which had responded but did not undertake significant exports during the review period, have 10.17% duties. Devi Sea Foods Ltd and Falcon Marine Exports have individual rates of 0.35% and 1.69%. With this rate, Devi Sea Foods Ltd, will no longer be subjected to tariffs. India had earlier won the case at the World Trade Organisation (WTO) on the US customs bond but the US has until September to appeal against the judgment.

Ecuador and Brazil

In July, the DOC decided on a rate of 0.64% for 42 Ecuadoran exporters. Promarisco S.A. received a rate of 0.46%. The latter will no longer be subjected to tariffs and can recoup the cash deposits it paid to export shrimp to the US. Seven Brazilian exporters received a rate of 48.6%, while eight companies received a rate of 67.8%. Last year, Brazil did not export any shrimp to the US although it was the top shrimp supplier in 2003 before the US antidumping petition was initiated, according to SeaFood Business.

WTO ruling brings optimism in Thailand

The positive ruling from WTO in an appeal against a US Continuous Bond (C-Bond) requirement for shrimp imports may suggest better times for producers in Thailand. Poj Aramwattananont, president of the Thai Frozen Foods Association said that shrimp production will be around 430,000 tonnes this year, a drop from 470,000 in 2007, because of rising raw material costs. The forecast is 350,000 tonnes of shrimp exports, worth THB 80 billion (USD 2.3 billion) in 2008. Thailand will also ask the US to return the C-bond worth more than THB 12 billion (USD 341 million) which Thai exporters paid to get access to the US market. It will also renegotiate import tariffs including the anti-dumping duty on Thai frozen shrimp, currently at 5.29-6.82%. The US is Thailand's biggest market for shrimp, comprising 42-43% of exports. Other major markets are Japan (20%) and EU (15%).

Australia to double shrimp output

Shrimp farmers in Queensland, Australia produce an average of 3,200 tonnes of farmed black tiger shrimp per year valued at AUD 50 million. In three years, they can double yields using technology available from the work on selective breeding. Dr Nigel Preston who heads the CSIRO Food Futures National Flagship marine shrimp domestication program said that breeding from the offspring of selected wild stock will enable farmers, to produce shrimp of the highest quality. The offspring are domesticated which means that for every generation, the best and healthiest performers are selected. The genotyping technology will be used to breed the ideal shrimp for the consumer. The Queensland state government has provided a grant of AUD 500,000 to CSIRO to expand its work with Gold Coast Marine Aquaculture which has an annual capacity to produce more than 400 tonnes of prawns and two other farms.

Showing the Malaysian ornamental fish industry

Malaysia is currently the world's second largest producer of ornamental fish with 10% of the global demand. It is now set to achieve an annual output of 800 million pieces, valued at MYR 300 million (USD 88.71 million) by 2010. Producers in Malaysia have more than 550 local and exotic varieties for the domestic and export markets. More than 70% of production is exported to 30 countries. The major markets are UK, US, Germany, Italy, Hong Kong, Spain, Japan and Taiwan. The global trade in ornamental fish and products, estimated at USD2.24 billion, is expected to grow at 10-15% annually, of which 98% is trade in tropical fish.

The biennial trade show and conference, Aquafair Malaysia 2008 is dedicated exclusively to boost the export potential of Malaysia's ornamental fish industry including aquatic plants and supporting services. It is organised by the Department of Fisheries (DOF) Malaysia together with Fairs & Events Management. The four-day event is scheduled at the Kuala Lumpur Convention Centre from November 20 – 23. It is expected to attract more than 150 exhibitors from 10 countries.

At the soft launch of the show, the Agriculture and Agro-Based Industry Minister Dato' Mustapa Mohamed said, "The ornamental fish industry has the highest growth rate in the Malaysian agriculture sector. On average, the industry has shown a 25% growth in export over a 10-year period from 1990 to 2005. However, to achieve the expected annual output of 800 million fish by 2010, the ornamental fish industry needs to be prepared for changes, including the use of modern technology".

The Director General of Fisheries, Junaidi Ayub said, "In tandem with the growth of the industry, DOF will implement a system of traceability to ensure that breeders are able to meet the stringent international quality requirements of importing countries, especially that of the European Union".

In efforts to spur growth, the Government plans to establish three collection centres, in Johore, Kuala Lumpur and Perak. It is also planning to establish a collection and promotional centre in Frankfurt, Germany, to boost marketing to the European Union. This is expected to enhance the annual export potential of ornamental fish to EU markets from MYR 95 million (USD28 million) to RM200 million (USD 59 million) by 2010. More information: web: www.aquafairmalaysia.com; Email: philchan55@yahoo.com

SHRIMP 2008 – a landmark event for the global shrimp industry

In November, the world shrimp industry will converge on Guangzhou, "the southern gateway to China", for one of the biggest events for the shrimp industry. Scheduled to be held from 6 to 9 November 2008, SHRIMP 2008 - the Global Technical and Trade Conference on Shrimp is expected to draw major industry players from across the globe who will arrive seeking answers to the increasingly tough challenges faced by the remarkably resilient industry.

The four day event, comprising a 3-day conference and a day devoted to field trips and a buyer-seller meet, is organised by the Food and Agriculture Organization of the United Nations (FAO), the Chinese Ministry of Agriculture and the FISHINFONETWORK comprising the regional organisations of INFOFISH (Asia-Pacific), INFOYU (P.R. China), INFOPESCA (Latin America), INFOPECHE (Africa), INFOSAMAK (Arab countries), EUROFISH (Europe) and FIIU-GLOBEFISH. The conference programme is divided into four sessions.

Session 1 - Global Overview will address shrimp production from culture and capture; the international shrimp trade; technical, economic and marketing considerations with respect to black tiger and vannamei shrimp, and the impact of the global food crisis on the shrimp industry.

Session 2- Industry Situation and Outlook, will look critically at the industry in various parts of the world: Thailand, China, Vietnam, India, Indonesia, The Philippines, Latin America, Middle East, among others. It will also address the coldwater shrimp industry in Europe and in North and South America.

S**ession 3 - Markets and Marketing**, will investigate the main traditional markets in Japan, Europe and USA and will also take a look at emerging markets in Southeast Asia, China, the Far East, the Middle East, Eastern Europe and other areas. Specialised market segments such as the catering sector and the retail market will be studied in detail. The growing market for organic shrimp will also be given focus.

Session 4 -Technological Developments and Related Issues. Among the topics slated for discussion are developments in processing and packaging; value addition; organic shrimp farming; traceability and risk assessment; role of HACCP in assuring food safety; technological innovations for sustainable shrimp farming; certification in the shrimp value chain, and investments in the shrimp sector.

The field trip will be to farms, processing plants and markets. The conference is an ideal event to find out what is happening in the industry and what is likely to take place in the near future. International renowned experts will give presentations on the various topics. The conference is simply a must for all who have a stake or are planning to have a stake in the industry – be they industry players, exporters, importers, processors, traders, suppliers of goods and services, government officials, policy makers or environmentalists.

For further information, please contact: INFOFISH, P.O. Box 10899, 50728 Kuala Lumpur, Malaysia. Tel: +603 20783466, Fax:+603 20786804. Email: infish@po.jaring.my. Web: infofish.org.

RFID for shrimp in Vietnam

Radio Frequency Identification technology (RFID) will be applied to verify the origin of exported Vietnamese frozen shrimp, reported Vietnam Bridge Net. A cooperation project between the Vietnamese and Thai Ministry of Science and Technology, signed in June 2007, will implement this technology. This will trace the origin of frozen shrimp and meet technical barriers imposed by markets such as the US, Japan, South Korea and the European Union. Thailand has successfully applied origin information for its shrimp exports, called Trade Core. Frozen shrimp is a key seafood product, accounting for 40% of the total export seafood value. In the January-August period, Vietnam earned USD 3.7 billion from frozen shrimp and the country has targeted more than USD 4 billion for 2008.

Under this project, the Vietnam Technology Application and Development Agency will work with the National Electronics and Computer Technology Centre of Thailand (NECTEC). The former will develop criteria, regulations and input-output parameters suitable for Vietnam and shrimp-importing countries and work with some large seafood producers. According to NECTEC, the initial investment for an RFID is USD 3 and it is around USD10,000 for every 20 tonnes of shrimp. On average, spending on this task is less than one USD per kg of shrimp exports. Chipsets and cards can be used several times.

Third party certification

Global Aquaculture Alliance (GAA) has welcomed the US Food and Drug Administration's decision to launch a pilot program to test third-party certification of shrimp farms. It said this was an important step in promoting strict health and safety standards throughout the seafood supply chain. This pilot was announced in July.

Executive Director Wally Stevens said GAA will submit its Best Aquaculture Practices certification program for consideration as one of the pilots to be evaluated. The alliance was pleased that aquaculture and specifically shrimp was chosen to test its new plans for third-party certification. Stevens said. "We applaud the leadership of the department for pursuing voluntary third-party certification as a key element of its comprehensive Food Protection Plan. Partnerships like the one the secretary announced today are a great opportunity to highlight how effective public-private cooperation can be when it comes to food safety. Certifications such as Best Aquaculture Practices can complement federal regulation and exponentially increase the FDA's reach".

The BAP program is based on an independent audit of shrimp hatcheries, farms, feed mills and processing plants on food safety, environmental integrity, social responsibility and animal welfare. It also incorporates full traceability of the final product "from pond to plate."

News in brief

Sino-US food safety testing centre

The US Food and Drug administration (FDA) restricted imports of five types of seafood from China in June 2007, citing contamination with banned chemicals. Since then, China's government and seafood industry have stepped up testing and food safety controls. Shipments testing positive have dropped from 25% to less than 6%. The FDA exempted only one Chinese company, making good on its food safety measures.

In July, Tongwei Aquanews reported that the Sino-US food safety testing centre began operations in Zhuhai, Guangdong province. A first for China, the centre is adopting food safety standards required by the Chinese authorities as well as the FDA. The test results from the centre will be sent to the General Administration of Quality Supervision, Inspection and Quarantine of China. Products tested and qualified by the centre will be directly exported to the US and will be exempted from being tested again by the FDA. The new facility was jointly set up by the US Oregon Department of Agriculture and FDA has dispatched three experts to work for the center and supervise testing procedures. Other partners are the Zhuhai branch of China Certification and Inspection (Group) Co Ltd, the Peace Synthesis Market of Logistics in Zhuhai and South China Agriculture University.

Bangladesh warned on shrimp quality

The European Commission has warned local shrimp exporters of possible restriction on exports unless they strictly ensure quality, following a negative report by an EC delegation. The EU sent back 300 containers of shrimp in the last few months following detection of harmful antibiotics. Licenses of four shrimp processing factories have also been cancelled as a consequence. The EC also said it would launch a new system of testing shrimp to detect presence of chloramphenicol, nitrofurans, tetracycline and malachite.

More catfish meal to Japan

Japan External Trade organization said that fishmeal exports from Vietnam to Japan in 2007 totaled 13,538 tonnes, according to the Suisan Times. This was a 38.7% increase from the previous year, most of which was catfish fishmeal. In 2005, Japan imported 3,123 tonnes of fishmeal from Vietnam and this rose to 13,538 tonnes in 2007. Japan imports the total of 340,000 tonnes of fishmeal annually, of which 44% or 15,000 tonnes is from Peru. Since 2006 Japan has been purchasing more Vietnamese catfish fishmeal. It was a catfish processor located in the Mekong Delta that began to export production residue to Japan and triggered this new trend.

Tilapia with 'sea flavor'

HQ Sustainable Maritime Industries (HQSM) has signed a joint development agreement with the Beijing division of Newly Weds Foods Inc. to market the "sea flavor" tilapia which is processed to give it both the texture and flavour of wild-caught Alaska Pollock. Pollock is a north Pacific whitefish that is the favoured ingredient in fish sticks, fish fillets and similar products, as well as imitation crabmeat. The company will also market the artificially flavoured tilapia as an environmentally friendly alternative to other farmed or wild-caught fish.

Vitarich promotes pangasius culture

In the Philippines, this feed company is now offering a complete line of products and services for the farming of the pangasius catfish, a novel and unexplored area of aquaculture in the Philippines. Vitarich will provide fingerlings and feeds. This will be complemented with the required knowledge and technology to set up the farm and culture the fish.

New shrimp feed plant and farm in India and Vietnam

Charoen Pokphand (CP) will set up a shrimp feed plant in Gujarat, said Pinij Kungvankij, CP's senior vice-president and also a Vice-President of CP Aquaculture (India). It already has two shrimp feed plants on the East Coast of India. In Vietnam, CP Vietnam Livestock Company will invest some USD 6 to 9 million to set up a 136 ha farm vannamei shrimp farm in Phong Dien, Thua Thien-Hue province. This is expected to create 120 jobs, according to Vietnam News Agency.

Increasing production in Sabah

The largest producer of shrimp in Sabah, Asia Aquaculture Sdn Bhd, a subsidiary of the CP Group, will increase production to 1,700 tonnes of shrimp this year, 400 tonnes higher than in 2007. General Manager, Pornphot Churod said the company has six farms comprising 93 ponds in Sungai Abas which produced about 1,300 tonnes in 2007. It started its operation in Tawau in 2005. He added that the production target for 2008 could be achieved and if the current market price of RM10 per kilogram continues, its revenue will be RM170 million. He added that all the vannamei shrimp are processed and 80% is exported.

Tongwei launches Aquanews

China's largest aquafeed producer has together with the Sichuan provincial government launched Tongwei Aquanews. This is produced by the Sichuan Aquacultural Engineering and Technology Research Centre. The aim of Aquanews is to provide the latest information on aquaculture in China and promote information exchange among aquaculturists worldwide. The first issue reported on the damage to aquaculture from the recent earthquake in Sichuan, aquaculture and feed production and on China's efforts to increase quality of fish.

More bluefin tuna in Japan

One of the world's largest seafood companies Nippon Suisan Kaisha Ltd, Japan has announced that it plans to spend USD2.72 million by end 2008 to triple production of farmed bluefin tuna. Its subsidiary, Nakatani Suisan Co. grows tuna in three fish farms in Japan. It will also add three more large fish cages at its Kagoshima Prefecture farm, bringing the total to 18 cages. In another report, Nippon Meat Packers Inc. a major meat processor have set up a joint venture in Uwajima, Ehime Prefecture with a seafood processing firm and other local partners to grow bluefin tuna. This will be the first step for the company to enter into the farming of top-quality tuna.

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Gold Coin

55 years in feed production and more to come

Gold Coin, a leader in feed manufacturing in Asia, recently celebrated its 55th anniversary with a two day meeting of the company's management team on the island of Phuket, Thailand. Over 70 Gold Coin leaders from across the region attended this event. As the livestock and feed industries are going through one of their most challenging times, the meeting was an opportunity for the team to discuss the Group's future direction and key strategic initiatives.

JC Filippi (sixth from left) and team in Phuket

In recent years, Gold Coin's growth has been driven by species diversification and investing in the high growth potential markets of Vietnam, China and India. It will continue with both strategies but to achieve its growth ambition to double its business in the next 3 to 5 years, it plans to embark on acquisition activities.

"In the next 3 years we expect to realize 20% of our China volumes in the aqua feed sector. In this industry, we have already built a reputable brand name with our shrimp feeds in Asia. Now we are pushing for diversification to other species to buffer against fluctuation in livestock and poultry feed markets and within species in the aqua feed markets", said JC Filippi, Gold Coin Group CEO in Hong Kong in August.

"Our consolidation will have all factories as multispecies feed mills to optimize usage of resources and build economy of scale. In June, we completed a new floating fish feed unit for freshwater fish in Guangdong Province. Previously, we were producing only sinking fish feeds in China. A new mill is also planned there for 2010 and will produce poultry, pig, fish and shrimp feeds."

"In our acquisition drive, we will focus on companies with good development potential and that are suitable to be integrated into the Group. Acquisition is always a preferred option when compared with greenfield projects that normally take a few years to build and reach profitability. Gold Coin is not looking into vertical integration as a business model and will remain very much focussed to be the best in feedmilling. However if there are opportunities with possible synergies with our feed business, this may be considered".

In a number of countries, Gold Coin led the industry by being the first to be ISO 22000 and HACCP certified. In sustaining this edge in quality, leadership and efficiency, the company is intensifying its efforts on Continuous Performance Improvement to achieve its vision of being 'the most efficient and consistent producer of quality feed in Asia'. Through our continued research efforts in the areas of animal nutrition and food safety, Gold Coin will certainly continue to stay ahead in delivering value to farmers and consumers.

"I believe in efficiency which does not mean cutting costs but getting the best out of people and processes. Today, with scarcity of raw materials, fluctuating raw material quality and pressure to reduce costs without comprising quality, there are huge challenges in formulating feed. Our experienced technical team has once again proven that they are the best in the market to supply consistent quality feeds to Asian farmers".

During the meeting the management team also embraced new initiatives on Organizational and Management Development that focus on further developing skills and expertise as well as improving the Group talent pool. The results of these new initiatives will be to strengthen the HR platforms required to compete in the ever changing market environments.

Organic certification of aquaculture products – a chance for sustainable aquaculture development

By Marc Nolting and Mark Prein

An overview of organic aquaculture development activities which GTZ and its partners began since 1999 encompassing marine shrimp culture in Ecuador and Thailand and Pangasius catfish in Vietnam.

Over the past decades, global markets for fish and fish products have changed considerably and will continue to do so. Globalisation brings increased competition as well as important policy challenges for governments to ensure sustainable and responsible aquaculture development (OECD 2008). Globally, aquaculture continues to grow more rapidly than all other animal food-producing sectors.

This sector has grown at an average rate of 8.8%/year since 1970, compared with only 1.2 % for capture fisheries and 2.8% for terrestrial farmed meat production systems over the same period (FAO 2006). For developing countries the production of aquatic products is important from a trade, employment and nutritional point of view. The great majority of fish farmers are in developing countries, principally in Asia. Significant increases over recent decades, reflect the strong expansion of aquaculture activities. In 2004, the number of fish farmers accounted for one-quarter of the total number of fish workers.

In recent years the number of standards for food production and processing has increased substantially. Increasing international trade and the increasing awareness of consumers about social and environmental consequences or food safety/health risks connected to imported foods are one reason. Another reason is the standards' contribution to promote the efficiency of international trade.

Due to the variety of actors and interests involved in standard formulation and implementation there are large differences among standards in respect to their scope and objectives (Nadvi and Wältring, 2002). The benefits of aquaculture certification (such as eco-labelling) include: potential for premium market prices, access to new markets, safeguarding existing market channels, preferred supplier status and the potential to attract ethical investment of local community social and economic infrastructure (Blueyou and ENDA/REPAO, 2007).

The role of eco-labelling (including organic aquaculture)

From a development point of view, consideration of environmental and social issues in aquaculture is a particular challenge for developing countries and should be linked to gaining market access in developed countries. The Deutsche Gesellschaft für Technische Zusammenarbeit/ German Technical Cooperation (GTZ) is assisting several developing countries to move into organic production, e.g. through small and medium enterprises (SMEs) promotion programs.

Promoting organic aquaculture can be seen as an effective tool to implement and promote the articles and provisions that are made with the FAO Code of Conduct for Responsible Fisheries with regards to aquaculture. Under the framework of several projects and programmes GTZ supports the stakeholders' efforts with a broad array of services:

- advice to ministries and projects on the effective application of standards;
- information and training for personnel and cooperation partnerships with other German development organisations;

White leg shrimp from a certified organic shrimp farm in Ecuador.

- documentation and assessment of good practices in defining and implementing standards;
- facilitating and setting up strategic alliances among government, business and industry, non-governmental organisations, trade unions and development organisations;
- assisting disadvantaged groups in developing countries seeking to take part in defining standards;
- promotion and build-up of local advisory and auditing capacities;
- assistance in gaining economic benefits from standards, e.g. through contact management among actors in the supply chain and through marketing advice, and
- advising government agencies, business enterprises and standard initiatives on the participatory development and implementation of standards.

This article presents an overview of previous organic aquaculture activities which GTZ and its partners were engaged in since 1999, ranging from marine shrimp culture in Ecuador and Thailand to Pangasius catfish in Vietnam. A new initiative is underway in the Philippines, with milkfish, tilapia and marine shrimp farms with potential for certification.

All initiatives were established in collaboration with Naturland e.V. and implemented their guidelines (Naturland 2007). An independent third party organisation conducts the inspections and submits the reports according to Naturland. Following a schedule of successful inspections and meeting administrative requirements, the actual certificate is then finally issued by Naturland and is valid for one year.

Package of certified organic white shrimp from Ecuador (marinated and frozen product) marketed in Germany.

Certified organic white leg shrimp from Ecuador on display in a fish shop in Germany.

Organic Shrimp Farming – Ecuador

Between 1999 and 2001, a project was conducted involving stakeholders from the private and public sectors to initiate eco-friendly and profitable shrimp production as a first pilot activity (Nolting and Schirm 2003). New certification standards for organic shrimp (white leg shrimp *Litopenaeus vannamei*) aquaculture were developed and tested in cooperation with Naturland, selected shrimp farmers, importers from Ecuador and Europe and GTZ. As a result, the first certified, eco-labelled shrimp from Ecuador were imported to Europe in 2001. Today several certified shrimp farming companies in Ecuador produce white shrimp from aquaculture that is in compliance with the Naturland certification standards for organic farming. These shrimps from organic aquaculture are now being sold successfully in the European market.

Lessons learnt

With the application of standards and criteria for sustainable shrimp production, positive impacts on the production and management methods of these related businesses and industries can be observed:

- Shrimp hatcheries have given up the collection of wild shrimp larvae in order to meet Naturland standards for organic farming;
- Feed producers felt obliged to responsibly select and use appropriate raw feed materials and feed additives. In order to fulfill the certification standards they have abandoned the use of artificial feed ingredients and mixture of prophylactic antibiotics and chemotherapeutics.

Secured income and employment: For shrimp farmers and the associated industries, the production of eco-labelled shrimp offers an alternative to the normal progression to intensive farming systems. The production and export of high-value eco-labelled shrimp products from developing countries serves as an important source of income.

Success with small scale producers: Supporting small scale producers in developing countries has been identified as an appropriate strategy to introduce socio-economic and environmental standards in other farming sectors (e.g. for Mexican coffee production). However, in general, small scale farmers have fewer difficulties in adopting organic principles (due to previous extensive management).

Encouraging competitiveness: With the introduction of eco-labelled shrimp, increased competitiveness among shrimp producers can be observed. This has influenced the production techniques of related industries and businesses. Globally, this can contribute significantly to a product range diversification, which will drive competition among traders and markets for certified and non-certified shrimp products.

Organic Shrimp – Thailand

The well known expansion of the Thai shrimp farming industry into a globally dominant exporter of farmed shrimp and shrimp products is well documented. Until 2004, the endemic black tiger shrimp (*Penaeus monodon*), was the major species cultured. However, since the mid 1990s, as in other shrimp farming countries around the world, Thai shrimp farmers were faced with numerous diseases. These affected survival as well as retarded growth (e.g. monodon slow growth syndrome (MSG), and also caused hatchery survival problems (Nolting 2005b). Within this scenario, farmers introduced the white-leg shrimp (*L. vannamei*) to the country. This species was rapidly adopted by farmers and hatchery operators. In 2006 it made up 98% of the entire volume of cultured shrimp in Thailand.

A small number of farmers decided to continue farming black tiger shrimp, but faced difficulties in marketing them. One farmer, Mr. Prayoon Hongrat, owner of Sureerath farm with 30 years of experience in shrimp farming, decided to design and build a new farm which went against the common practice of increasing intensity. His new farm of 2.2 km^2 has 143 ponds (each of approximately 0.6 to 0.7 ha size, stocked at low densities of 13-15 post larvae per m^2) with settling ponds, canals and a large water storage pond replanted with mangroves. The entire water management system is such that it is completely recycled, and designed in such a way that gravity flow is used as much as possible to reduce pumping costs. Additionally, Hongrat grew filamentous algae (*Enteromorpha intestinalis*) in the ponds before stocking shrimp (similar to the function of a pasture) to feed shrimp in first 2 months after stocking, thereafter followed by low levels of additional pellet feed.

GTZ's country program on "Enhancing the Competitiveness and Eco-Efficiency of Thai SMEs" saw the opportunity for Sureerath Farm to explore new market avenues through organic certification because the farm had design and management features that had already complied in many aspects with organic standards. GTZ facilitated the certification by Naturland, which commenced in early 2006 and was completed in June 2007 (Klinkhardt 2007). Sureerath farm now serves as an example,

Large size certified organic black tiger shrimp grown on Sureerath farm in Laemsing district, Chantaburi province, Thailand

Booth of Sureerath farm (organic black tiger shrimp) from Chantaburi in Thailand at the world's largest organic food expo "BioFach" in Nuremberg, Germany, in February 2007, co-sponsored by GTZ. Delegation members: Mr. Kritsada Hongrat, Managing Director, Mr. Prayoon Hongrat, President, Ms. Kulchaya Temchavala, Marketing Manager, Ms. Sureerath Hongrat, Vice President, and visitor Mr. Achiravit Kiriruangchai of Thai Union Frozen Products (left to right).

and a program was launched by the Thai Department of Fisheries to assist other farms to remodel their operations and achieve organic certification. Several organic shrimp farmer groups and associations were recently formed (Ruangpan 2007, Ruangpan 2008).

Lessons learnt

Economics presently unclear: The farm is still in the process of scaling up its organic production and establishing market channels. The growth period until harvest will take longer (8 to 10 months) so that the farm will only provide 1.2 to 1.3 crops per year instead of two. The total production of the farm will be around 200 tonnes/year (compared to the pre-certification level of 800 tonnes). Overall farm profitability is expected to be reduced, despite the "organic price premium" of 20-30% envisaged by the farmers.

Problems: Despite the well-developed nature of the Thai shrimp feed industry and that of the Thai seafood processing industry, there were initial problems with sourcing a supplier of certified organic shrimp feed, and with sourcing processors to deliver the required services under certified conditions. This caused the farm owners to start to establish their own feed mill and processing facility on the farm premises, with enough capacity to handle feed requirements and processing volume of other members of the organic shrimp farmer association in their area.

Organic Pangasius catfish – Vietnam

In Vietnam, the export of aquaculture products (notably the catfish, *Pangasius hypophthalmus*, locally known as "tra") has exceeded USD 3 billion and the revenues from the sector, both from local sales as well as from export are an important part of the economy (Nolting 2005a). Particularly in rural areas, the income generation and value adding potential is considerable. However, concerns on the sustainability of the sector have been raised for several years. Local stakeholders, international buyers and consumer protection organisations are increasingly concerned on food safety issues and the impact on the environment given the intensive nature of production methods (Finkel 2005, 2006).

In 2004, GTZ initiated a Public Private Partnership (PPP) on organic catfish production. In this, GTZ and private sector companies engaged in jointly financed projects that had sound economic principles and at the same time high development potential. The overall objective was to establish organic catfish production with a small pilot group of Vietnamese producers and processors as a proof of concept (Finkel 2005, 2006).

The two German partners were an importer of seafood, Binca Seafood GmbH, a relatively small company which saw the potential for developing organic aquaculture fish as a high-end niche market and Naturland, a German non-profit organization established in 1982 to promote

Package of frozen certified organic Pangasius filets from Vietnam as marketed by Swiss retailer COOP.

certified organic food production and has developed standards for organic aquaculture (Finkel 2005).

The local partners in An Giang province in the Mekong Delta, are small-scale catfish farmers and processors, organized within the An Giang Fisheries Association. At times, when the traditional catfish export markets suffered from protectionism as well as food safety scandals, the organic catfish production represented a unique opportunity to open up new export markets (Finkel 2005).

Lessons learnt

As a result, 70 tonnes of organic Pangasius were exported to Germany in 2005, which increased to 400 tonnes in 2006, and is expected to have doubled in 2007.

Problems: Farmers were and still are faced with in sufficient amounts of certified feed. These were partly addressed by involving local producers of raw materials and feed, which is an ongoing process (Finkel 2006). The inavailability of sufficient amounts of certified organic aquafeed is a strong limiting factor for further expansion of organic aquaculture in general, not just that of Pangasius in Vietnam.

Further opportunities in exploiting alternative options along the value chain are the certification according to strict but non-organic standards, such as the GlobalGAP (formerly EurepGAP) standard, which has been on trial in with Pangasius farmers in Vietnam since 2006 (Van 2006) and is increasingly demanded by the large European food retailers. The GlobalGAP standard already exists for salmon and shrimp.

Next – in the Philippines

Aquaculture is one of the priority programs for development in the Philippines. Aside from the local supply of aquaculture products, the exported volume has been one of the top products in foreign exchange earnings for the country. Aquaculture development in the Philippines has experienced unsustainable practices, notably in the coastal shrimp farming sector. Diseases caused the near-collapse of the shrimp industry in the 1990s. Since 2007, GTZ through its Environment and Rural Development Program (EnRD) in the Philippines, and the German Development Service (DED), are supporting the Office of the Provincial Agriculturist (OPA) on the Island of Negros in the introduction of organic aquaculture to fish and shrimp farmers.

The first step was a scoping event involving all interested stakeholders, titled the "First Philippine Organic Aquaculture Symposium", held in Bacolod City in October 2007. This involved a range of local stakeholders, including farmers, processors and other service providers, as well as speakers from Naturland and from the successful organic aquaculture activities in Vietnam and Thailand.

Marketing of organic products

A new study by AgroMilagro research 2008 has given some important points on marketing of organic products. The authors said that it is important to understand that:

- The claim "**organic**" is insufficient to sell organic products successfully. Simply enhancing organic claims with such terms as "**organic + healthy, organic + tasty or organic + fair**" are also not sufficient tools to influence and to attract customers for organic products.
- Doubt and lack of credibility of organic claims on the show card or in labelling continue to be major issues.
- As consumers have had to face several sobering or alarming experiences in recent years, mistrust is correspondingly high in today's market.

Therefore, this study indicate that for companies producing, processing and/or trading organic products, the first priority must be credibility.

Credibility establishes the foundation for marketing strategies to win consumers over to organic products. In this age of internet, inconsistencies can immediately be revealed and spread throughout consumer markets.

Consequently, the focus lies in the perception of honesty and integrity in the eyes of consumers. Choosing a marketing strategy to reach this desired credibility will differ for individual companies and organic products.

However, the direction remains the same in all instances. Sustainability in its original intent is the goal and must give realistic consideration to environmental issues, social conditions, as well as moral and ethical issues, including the idea that business practices do not harm others. In order to enhance credibility of trading companies and their products, one idea would be to ***ethically certify organic products***.

The initial hurdle is that consumers are not always willing to pay a higher price for their noble demands. The major challenge will be to communicate global interrelationships in order to gain consumer understanding for a corresponding fair retail price. Without this comprehension, the system cannot work, as past experience has demonstrated.

Personal communication with the consumer is the most important strategy for marketing organic products. Studies revealed that the consumer was often not informed about other significant advantages of a particular product which had the potential to impact customer sales. *Therefore, price became the singular criteria for purchasing a product.*

Higher prices are often not the most significant barrier to increased organic product sales; but rather, it is missing "key" selling points. The current market trend is ideal as consumer change in values, product quality requirements and "key" buying motives all point to the potential for expanding this market.

The organic sector continues to set the standard without compromise which is what the consumer expects when being asked to pay the higher prices. Timing is clearly crucial to impact current market trends.

The total study can be downloaded http://www.organic-market.info/bio-markt/en_inhalte/inh_index.htm?link=Meldungen&catID=18&childrenID=70&docID=748

The second step was a survey on the suitability of existing farms for certification according to organic aquaculture standards, which started in December 2007 (Kühlmann et al. 2008). The aim of the process is to develop a gradual strategy towards successful implementation of organic aquaculture, learning from existing successful examples elsewhere. Presently, considerable interest exists among farmers of brackishwater milkfish in ponds, marine black tiger shrimp in ponds, tilapia in net cages and ponds and groupers in marine net cages.

Summary

Organic aquaculture of fish and shrimp caters to a high-end niche market which is constantly growing in volume but its market share is still expected to remain small in the future. In situations of increased competitiveness among producers, organic aquaculture leads to diversification of production techniques and products which leads to increased access to niche markets. Servicing these markets bears additional income and value adding potential and therefore can play an important role in development. The experiences to date with public-private partnerships (PPP) in the introduction of organic aquaculture show that this is an efficient approach that leads to win-win situations for stakeholders.

Inavailability of sufficient amounts of certified organic aquafeed is a strong limiting factor for further expansion of organic aquaculture in general. General advisory services, auditing and certification capacity are available in most countries. However, specific highly qualified and certified advisory services on details of organic aquaculture operations, and the issues of conversion from conventional, non-organic to organic production and processing are still lacking in many cases.

The strict standards of organic aquaculture may not be the only solution for farmers, and other non-organic standards may pose to be beneficial alternatives, as these also have strict requirements but not to the extent of the organic standards.

References are available on request.

All pictures courtesy of Mark Prein

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Part one: The role in shrimp reproduction

Review: Carotenoids in shrimp maturation and larval quality

By Regunathan

This is a two part article to increase awareness among shrimp hatchery operators on the importance of carotenoids in broodstock nutrition. The role of carotenoids in achieving reproductive success and larval quality, issues in supplementation of the various types of commercially available sources and future research needs to further understand its functional role at the molecular level are discussed.

The hatchery industry is trying to achieve production efficiency and cost-effectiveness while meeting market demands for high quality postlarvae. In the hatchery, broodstock and larval nutrition are the key elements supporting the progress for greater production control and domestication.

Broodstock nutrition has been shown to influence its reproductive performance and offspring quality. The initial larval stages (nauplii I to VI) are lecithotrophic (living off its yolk reserves without feeding), thus yolk and its associated compounds are a major determinant of egg quality and nutritional status of the larvae at first feeding (Harrison, 1997). Though broodstock nutrition is a widely researched topic as reviewed by Wouters et al (2001), substantial work still needs to be done on the role of different nutrients to approach the level of complete control and understanding of shrimp maturation.

Among the various nutrients (lipids, proteins, carbohydrates, vitamins, minerals, carotenoid pigments) demonstrated to be vital for shrimp reproduction, carotenoids have received much interest recently. Unlike with pigmentation, where the role of carotenoids has been well established, limited work has been done in assessing the role of these bioactive molecules in reproductive success and offspring quality. Efforts to reduce the heavy dependence on fresh feeds of variable nutritional quality for broodstock feeding by shifting to high quality artificial maturation diets has further reiterated the need for a better understanding of role played by nutrients such as carotenoids.

Carotenoids influence colour of cooked shrimps, but they play various nutritional roles too.

Carotenoids and shrimp maturation

Studies have proven that during the early maturation stage, free and esterified carotenoids accumulate in the hepatopancreas. During secondary vitellogenesis they are mobilized from the hepatopancreas via the haemolymph to the ovaries as carotenoglycolipoproteins to accumulate in the eggs as part of the lipovitellin protein (Vincent et al., 1988 Harrison, 1990 Quinito et al. 1990). Free astaxanthin was predominant in maturing ovaries (up to 80% of the total carotenoids), increasing from 2 to 34 ppm.

With maturation, carotenoids, especially astaxanthin, are strong antioxidants and probably play a role in protecting broodstock nutrient reserves and developing embryos from oxidation (Dall et al., 1995 Merchie et al.1998) such as the prevention of PUFA peroxidation in oocytes (Wouters et al. 2001). It was suggested that they act as pigment reserves in the embryos and larvae for the development of chromatophores and eyespots and as a vitamin A precursor (Dall, 1995).

Carotenoids are also suggested to play a role as fertilization hormone, reducing mortality rate during embryonic development, triggering vitellogenesis (Linan-Cabello and Paniagua-Michel, 2004) and may offer stability to egg proteins (Olson, 1993). With relevance to protecting embryos from oxidant damage, the role is vital in the late embryogenesis when organelles have become differentiated (Winston et al. 2004).

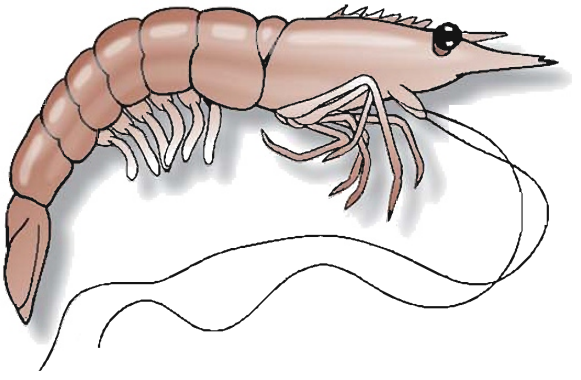
The influence of maternal nutrition on offspring for carotenoids has been well documented. The concentration of total carotenoids in *Penaeus semisulcatus* decreased from 19.3 μg/g in eggs to 4 μg/g in protozoea during a development time of less than 50 hours (Dall, 1995). This showed that carotenoids are vital for early larval development. Studies again suggest antioxidant systems are not well developed during the first stages of embryogenesis (Kim and Lee, 2004). Antioxidants found in early embryo stages are assumed to be from the maternally derived yolk. The carotenoid content of eggs has been proven to influence the quality of nauplii (Palacios et al. 1999 Regunathan, 2004) and even survival to zoea III substage (Palacios et al. 2001).

Form and function of carotenoids

Carotenoids are a family of nearly 700 natural lipid soluble pigments that are produced by microalgae, phytoplankton, zooplankton, fungi, photosynthetic bacteria and higher plants. Most carotenoids are polyunsaturated hydrocarbons, containing 40 carbon atoms, and comprising two terminal ring systems.

Carotenoids that are composed entirely of carbon and hydrogen are known as carotenes (e.g. β-carotene) while those containing oxygen are called xanthophylls (e.g. astaxanthin, zeaxanthin). Generally, carotenoids, as with fish cannot be synthesized *de novo* by shrimp. Shrimps contain a mixture of carotenoids in the carapace in addition to the blood, eyes, midgut gland, ovary and eggs. Astaxanthin and its monoester and diester forms have been found to be the dominant carotenoids in the body and in the mature ovary of shrimp (Dall et al. 1995). Other carotenoids reported include lutein, β-carotene, canthaxanthin, echinenone and zeaxanthin (Howell and Matthews,1991).

Carotenoids such as β-carotene, zeaxanthin and doradexanthin also have been reported from maturing shrimp ovaries (Miki et al. 1982 Vincent et al. 1988 Linan-Cabello et al. 2003). Carotenoproteins (carotenoids bound to protein) are present in a variety of shrimp tissues such as eggs, ovaries and the integument.



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One of the reasons attributed to poor larval performance of pond reared *Fenneropenaeus indicus* compared to wild broodstock of nearly same size is the poor carotenoid reserves in body that results in producing eggs with lesser carotenoid content (Regunathan, 2008).

According to recent studies, carotenoids such as β-carotene, alpha-carotene and β-apo-12 carotenol and astaxanthin in crustaceans have provitamin A activity and are bioconverted to retinoids (Linan-Cabello and Paniagua-Michel, 2004).

Retinoids are a class of molecules derived from vitamin A (= retinol + retinyl esters + retinal) and are believed to activate endocrine mechanisms essential for maturation and embryonic development and play a vital role in vision. The presence of all-trans retinal and 13-cis retinol in stage IV ovary of *Litopenaeus vannamei* has been reported (Linan-Cabello & Paniagua-Michel, 2004). It is said that retinoid metabolites induce growth and development by controlling the production of local morphogenic signals by a nuclear receptor signaling pathway which enhances maturation and associated processes (Paniagua-Michel and Linan-Cabello 2002).

The mobilization of retinol when *L. vannamei* was eyestalk ablated (Linan-Cabello & Paniagua-Michel 1998 Paniagua-Michel & Linan-Cabello, 1999) showed that retinoids are important metabolites in shrimp reproduction. Retinol palmitate injection enhanced ovarian maturation in *L. vannamei* (Linan-Cabello and Paniagua-Michel, 2004).

Although astaxanthin is the primary form of carotenoids present in shrimp ovary and yolk vitellin, studies have proven that shrimp are capable of transforming ingested carotenoids such as β-carotene, isocryptoxanthin, echinenon, canthaxanthin, phoenicoxanthin, zeaxanthin and 4-ketozeaxanthin into astaxanthin (Tanaka et al. 1979). The suggested metabolic pathway is shown in Figure 1.

This is further confirmed by the presence of oxygenic and nonoxygenic carotenoids in the ovary and digestive gland during the advanced stages of gonadic maturation in *L. vannamei* (Linan-Cabello et al. 2003). Linan-Cabello and Paniagua-Michel (2004) suggested efficient bioconversion of β-carotene to retinoids in *L. vannamei*.

Provitamin A carotenoids such is the case of β-carotene are converted to retinol in a process catalysed by β-carotene15, 15'dioxygenase resulting in two vitamin A molecules. In crustaceans, oxygenated carotenoids (e.g. astaxanthin, canthaxanthin) may be cleaved to a single molecule of retinoid (Olson, 1989 Scita et al. 1992 Dall et al. 1995) but compared to non oxygenated carotenoids, exhibit less bioconversion properties.

Supplementation effects

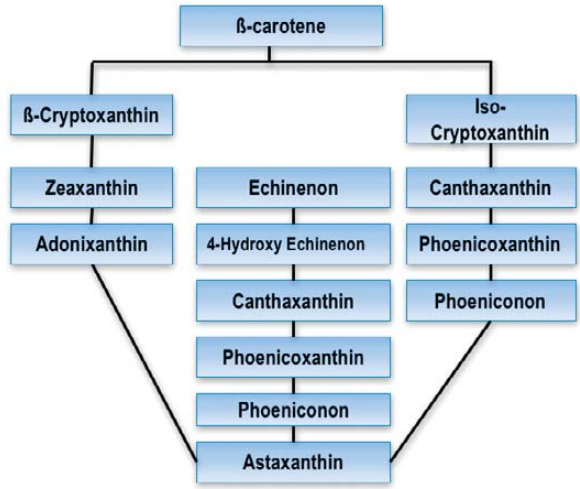
Limited studies have been carried out to evaluate different carotenoid sources as supplements in shrimp broodstock diets. None of the studies have attempted to find the optimum inclusion level of a particular carotenoid source or compared different sources or examined the influence of including two or more carotenoids in diet.

Pangantihon-Kuhlmann et al. (1998) emphasized the need for astaxanthin inclusion in *P. monodon* broodstock diets as its inclusion (100mg/kg) resulted in improved ovarian development and spawning. Another study by Pangantihon-Kuhlmann and Hunter (1999) reported that astaxanthin supplementation (50 mg/kg) of the diet resulted in increased egg production in *P. monodon*.

Paprika carotenoids

In another experiment by Wyban et al. (1997), paprika carotenoids at 2% level was used as a carotenoid source with a group of *L. vannamei* broodstock afflicted with 'Pigment Deficiency Syndrome' (PDS). PDS is characterized by bleached ovaries in mature female and yields eggs with less pigment levels, leading to production of poor quality nauplii and early larval performance. After four weeks of paprika supplementation, nauplii quality improved significantly with mean zoea II survival rate increasing from 25% to 83%. The percentage of larvae with full guts increased from 49% before paprika addition to 96%, and deformed larvae decreased from 21% to 4%. Interestingly, there was no significant difference between ablated and non-ablated females within the treatment groups. The authors suggested that paprika carotenoids (or at least some of them) were converted to astaxanthin.

Figure 1. Metabolic pathway of carotenoids in shrimp (after Latscha, 1991).



Spirulina carotenoids

Another study attempted to overcome PDS with pond reared *F. indicus* broodstock using Spirulina as a carotenoid source in diet (Regunathan and Wesley, 2006). Spirulina supplementation with PDS affected shrimp (for a minimum 23 days) resulted in reversal of the symptoms and significantly improved maturation performance (hatching %/spawn, nauplii/spawn), percentage of viable nauplii, nauplii to zoea II survival and zoea 1 quality. Analyses also indicated that carotenoid supplementation significantly improved total carotenoids and protein content in both eggs and nauplii, when compared to control. This study suggested the possible bioconversion of β-carotene and zeaxanthin in Spirulina to astaxanthin.

Synthetic astaxanthin

Carophyll Pink was used with *L. vannamei* male broodstock to assess its influence on sperm quality (Valezquez et al. 2003). However, dietary astaxanthin was not observed to influence sperm count, its abnormality percentage and survival. Thus, the role of carotenoid seems to be limited with the maturation process of male shrimp. Evidence of differences in nutritional requirements of male and female Pacific blue shrimp *L. stylirostris* has been reported earlier (Magarelli,1981).

Next issue: Part 2: Carotenoids in maturation and grow out diets will look at various carotenoid sources available commercially.

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Protein hydrolysis of PAP shows the nutritive value for shrimp feeds

By Eric De Muylder, Daniel Lemos and Geert van der Velden

Alternate protein sources such as Processed Animal Proteins (PAP) are renewable sources of nutrients increasingly used in shrimp feeds. Nutrient availability/digestibility is an essential criterion to be considered for feed manufacture in nutritional, flexible and cost-effective formulations.

The current production of more than 25 million tonnes of aqua feeds (Gill, 2007) faces global issues related to availability and cost of feed nutritional resources. Increasing competition and demand for ingredients, decreasing availability of key ingredients combined with unexpected increasing prices and market volatility have forced feed costs up and decreased margins (Tacon, 2008). The scenario may be further accentuated by decreasing prices of some aquaculture products leading to necessary reduction in feed cost per unit production.

Feed manufacture strategies should consider flexible, nutritional and cost-effective diet formulations which takes into consideration the presence and availability of indispensable nutrients as well as occurrence of potential anti-nutritional factors. Thus, several different types of nutritive feed ingredients are required to maintain the growth and supply of aquatic products from aquaculture.

Beyond sustainability issues, conventionally used fish meals have had inclusion levels significantly decreased due to economic constraints. As a key growth-related nutrient and usually a major fraction in diets, aqua feed producers are continuously searching for cost effective protein sources. At the same time, increasing global meat production generates additional volumes of by-products from animal stocks which are used as feed resources. These sustainable supplies of feed ingredients from terrestrial sources may assist in addressing nutrient demands from the aqua feed sector. Decrease in fish meal inclusion in aqua feeds will require up to three million tonnes of alternate protein sources in the next five years, as estimated by Hardy (2008).

Processed Animal Proteins (PAP)

These are valuable protein sources and have been increasingly considered as alternative protein sources in shrimp feed diets. They may provide a cost-effective supply of essential amino acids for shrimp. Moreover, since shrimp display a short digestive tract and the entire transit time is relatively fast, ingested feed must be readily digested by specific proteases to avoid poor nutrient assimilation.

The digestive capacity of shrimp enzymes seems to differ from other organisms as terrestrial or fish species so *in vitro* methods should consider the use of specific enzyme sources in the assessment of feed protein quality. The present survey has determined protein digestibility in vitro of several PAP using shrimp enzyme extracts from *Litopenaeus vannamei* in a simulation of digestion to assess their suitability for inclusion into shrimp diets.

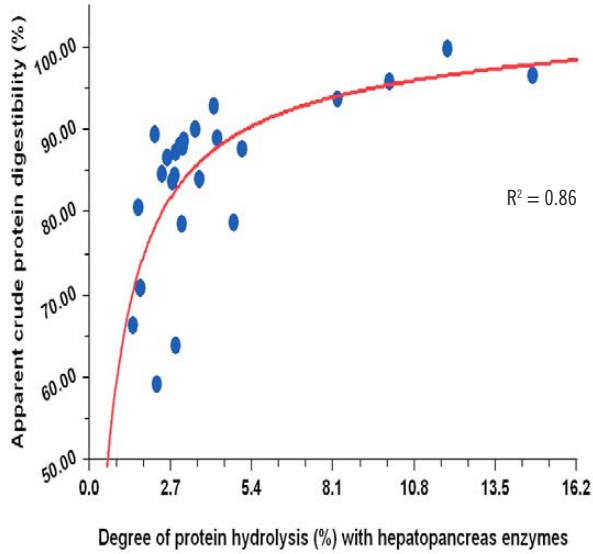
Methodology

Protein availability of PAP was assessed by the capacity of shrimp proteases to digest protein ingredients. Protein digestion in shrimp digestive tract was simulated through the reaction of ingredient protein and shrimp proteolytic enzymes under a pH and temperature controlled assay. Enzyme extracts from the hepatopancreas (digestive gland) of *Litopenaeus vannamei* with average weight of 6 gram were used in the present analysis. The assay is based on monitoring the breakage of peptide bonds of ingredient protein through digestive enzyme action. Under stable pH 8.0, protein peptide bond breakage results in the release of H^+ and medium acidification that is automatically neutralized by alkali (NaOH) titration (pH-stat reaction). The degree of protein hydrolysis (DH%) is the percentage of peptide bonds cleaved under the amount of enzyme used and is calculated by the volume of alkali spent during hydrolysis.

in vitro protein hydrolysis

The *in vitro* DH% was significantly correlated to the apparent protein digestibility determined *in vivo* (live animals, culture trials) of different ingredients and feeds (Figure 1). A prediction of protein digestibility by DH% may be a useful tool in the search for alternate feed ingredients and to manage for possible ingredient variation. It is also useful for the development of novel ingredient types (e.g. protein concentrates) and processing strategies, as well as for quality control of finished feeds. Shrimp performance (growth rates, feed conversion ratio) under high density laboratory trials was better correlated to protein digestibility (DH%) compared to amino acid profile *per se* with different commercial shrimp feeds (Lemos and Nunes, 2008).

Figure 1. Regression of *in vivo* apparent crude protein digestibility (live animals, culture trials) with in vitro DH% with specific enzymes from juvenile *L. vannamei* of different ingredients (animal, plant, fish meals) (from Lemos, Lawrence and Siccardi, 2008).



Digestibility of protein

In the following tables, the degree of hydrolysis (DH%) of various PAP (Processed Animal Proteins) were determined. These were compared with that of several other sources of protein, plant and marine meals. The processed animal products were manufactured by Sonac, BV, Netherlands. In general, the apparent digestibility coefficient of protein in these ingredients were calculated and ranged from 70 to 95% from Figure 1.

The DH% values of PAP in Table 1 are similar or higher than other conventional ingredients, such as soybean meal or fish meal.

Table 1. Degree of hydrolysis (DH%) of various meals.

Ingredient	CP(%)	Digestibility (DH%)
Poultry By-product meal (68 % CP)	68	5.33
Poultry By-product (74 % CP)	74	4.20
Porcine meat and bone meal (48 % CP)	48	4.36
Porcine meat and bone (64 % protein)	64	4.78
Porcine meat and bone (58 % protein)	58	5.24
Soybean meal (as reference)	46-48	3.38-5.16
Fish meal (anchovy)	64-69	2.70-4.40
Squid muscle meal	78-85	2.15-2.49
Corn gluten meal	67	1.85-3.20

Blood meals

Haemoglobin powder (spray dried) shows a higher digestibility than poultry blood meal and porcine blood meal. This is due to different raw materials and processing methods. However, when this product is extruded or pelleted, the digestibility might be negatively affected.

Table 2. Degree of hydrolysis (DH%) of various blood meals.

Ingredient	CP(%)	Digestibility (DH%)
Poultry blood meal	89	1.71
Porcine blood meal	95	1.45
Haemoglobin powder	88	9.76

Feather meal

Feather meal samples (Table 3) result in reasonable good digestibility values. Extrusion did not affect the DH%. (either negatively or positively) Feather meal has a higher DH% than blood meal, but a lower DH value (%) than poultry by-product meal and porcine meat and bone meal.

Table 3. Degree of hydrolysis (DH%) of various feather meals.

Ingredient	CP(%)	Digestibility (DH%)
Feather meal (sample 1)	85	2.89
Feather meal (sample 2)	87	2.85
Feather meal (sample 3)	89	2.55
Extruded feather meal (sample 3)	75	2.59

Meat solubles

Meat solubles (Table 4) show a very high digestibility for shrimp. This digestibility is even higher than that for most fish meals. Flash drying improves digestibility slightly.

Table 4. Degree of hydrolysis (DH%) of meat solubles.

Ingredient	CP(%)	Digestibility (DH%)
Meat solubles (liquid)	32	8.34
Meat solubles (flash-dried)	73	8.74

Gelatin

The in vitro protein digestibility value (DH%) in Table 5 can be considered elevated and a high apparent crude protein digestibility (ACPD) is also expected. So far values above this were only found in purified sources as casein. According to the predictive model, ACPD of gelatin binder would correspond to more than 95%.

Table 5. Degree of hydrolysis (DH%) of gelatin.

Ingredient	CP(%)	Digestibility (DH%)
Gelatin (binder Pro-Bind Plus)	94	9.77

Conclusion

The processed animal products studied here showed good digestibility values, in the following order: gelatin, meat solubles, poultry by-product meal, porcine meat and bone meal, feather meals, haemoglobin powder and blood meals. The digestibility of an ingredient is an essential quality parameter and may result in better feed conversion. These are renewable alternatives for shrimp nutrition and may be important supply of nutrients for sustainable growth of aquaculture.

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Dietary potassium diformate in fish feeds

By Christian Lückstädt

Preliminary studies on potassium diformate as feed additive in fish feeds show the benefits of dietary organic acids in feeds for tilapia in Asia.

Growing awareness from consumers and producers of aquaculture species has resulted in a demand for responsible and sustainable aquaculture. The regulatory authorities in most exporting countries now focus on the misuse of antibiotic growth promoters (AGP) in aquaculture, while public attention has shifted towards sustainable production methods.

Several feed additives, including acidifiers consisting of organic acids and their salts may be promising alternatives to the use of antibiotics in aquaculture feeds. Acid preservation of fish and fish viscera to produce fish silage has long been a common practice and the final product has been widely used in fish feeds with beneficial effects, such as reduced levels of total volatile nitrogen. This is a key indicator on the freshness of fishmeal. The beneficial effects of acid preserved products have also prompted the scientific community to investigate the effects of applying these short-chain acids directly onto fish feed (Lückstädt, 2008).

In-feed acidifiers are currently applied to temperate and tropical fish species, such as trout (*Oncorhynchus mykiss*), charr (*Salvelinus alpinus*), salmon (*Salmo salar*) and tilapia (*Oreochromis niloticus*), as well as shrimp and abalone. In recent trials, the inclusion of potassium diformate in fish diets was tested in tilapia, *O. niloticus*, under laboratory conditions at the Bogor Agriculture University, Indonesia and at the Chinese Academy of Agricultural Sciences, Beijing, respectively.

Potassium diformate (KDF) in diets for tilapia

In a university trial in Indonesia, 320 male hybrid tilapia were randomly allocated into 4 treatment groups (negative control and 3 acidifier groups, containing 0.2%, 0.3% and 0.5% potassium diformate (KDF), respectively). Fish were fed 6 times a day over an 85-day trial period with a pelleted diet containing 32% protein, 25% carbohydrate and 6% lipids. Beginning on day 10, all fish were orally challenged with *Vibrio anguillarum* (10^5 CFU/day) once a day for 20 days.

Results indicated significant improvements ($P<0.05$) in all treated groups. The 0.2% application of KDF in tilapia led to a significantly increased feed intake (8.6%), weight gain (18.6%) and a significantly improved feed conversion ratio (8.2%). Furthermore, mortality rates due to the *Vibrio* infection were significantly reduced (Table 1).

Table 1. Performance parameters of tilapia challenged with *Vibrio anguillarum* with or without KDF treatment (table modified from Ramli et al. 2005).

Parameter	Control Group	2kg/tonne KDF (0.2%)	3kg/tonne KDF (0.3%)	5kg/tonne KDF (0.5%)
Initial weight (g)	16.7	16.7	16.7	16.7
Final weight (g)	218[a]	258[c]	246[b]	252[bc]
Feed conversion Ratio (FCR)	1.34[a]	1.23[b]	1.25[b]	1.22[b]
Percent mortality rate for days 10 to 85	33.0[a]	20.8[b]	18.4[b]	11.0[c]

[abc] *Note: values with different superscripts within rows are significantly different ($P<0.05$)*

Similar results were achieved by Zhou et al. (2008) with hybrid tilapia (*O.niloticus* x *O. aureus*). In this study, they used fingerlings (2.7g initial weight) in a dose response study with KDF added at 0%, 0.3%, 0.6%, 0.9% and 1.2% in diets. The response was compared with fish fed an antibiotic growth promoter at 8 mg/kg Flavomycin. During the 56 day trial period, tilapia fed the KDF enriched diets grew faster at up to 11.6% than the negative control (without organic acids). Fish fed 0.3% and 0.6% KDF achieved better weight gain than the fish in the positive control group (Table 2). The authors speculated that dietary KDF could stimulate a beneficial bacterial colonization of the intestine.

Table 2. Effects of dietary KDF on growth performance, feed conversion as well as survival rate of hybrid tilapia (table modified from Zhou et al. 2008).

Parameters	0% KDF	0.3% KDF	0.6% KDF	0.9% KDF	1.2% KDF	8mg AGP
Initial weight (g)	2.7	2.7	2.7	2.7	2.7	2.7
Final weight (g)	9.6	10.5	10.4	10.0	9.7	10.2
Weight gain (%)	262.5	293.1	291.3	275.4	265.4	281.0
SGR (%)	2.30	2.44	2.43	2.36	2.31	2.39
Feed intake (g/d)	0.36	0.36	0.35	0.35	0.35	0.35
FCR	2.91	2.58	2.55	2.69	2.80	2.63
Survival (%)	96.3	95.0	98.8	98.8	100.0	95.0

KDF in fish meal

In another study, the objective was to investigate the effect of potassium diformate (KDF), added during fishmeal production, on growth and FCR in Atlantic salmon (*Salmo salar* L.) under Norwegian conditions.

The trial was carried out at AKVAFORSK research station in Sunndalsøra, Norway. Atlantic salmon with a mean weight of 270g were randomly distributed between 9 fibre glass tanks ($1m^3$), with 50 fish in each tank. The tanks were supplied with 20 litres/min of sea water (30-32â) for a total experimental period of 126 days. The average temperature during the trial was 10°. A 24 h light regime was used throughout the experimental period and the fish were fed continuously with automatic feeders with a commercial fish feed (40% crude protein and 30% fat) containing 0%, 0.8% or 1.4% KDF. The total biomass and the number of fish in each tank were determined at 0, 42, 84 and 126 days (Table 3). Data (mean ± standard deviation) were subjected to statistical analysis and a significance level of 0.05 was used in all tests.

Table 3. Performance of Atlantic salmon fed 3 different test diets for 126 days (Mean ± SD).

Treatment	Initial weight (g)	Final weight (g)	Body weight gain (g)	Specific growth rate SGR	FCR[1)]
0.0% KDF	276.0 ± 5.5	575.0 ± 37.0	299.0 ± 61.3	0.58 ± 0.08	0.83 ± 0.05[a]
0.8% KDF	275.1 ± 4.8	626.7 ± 14.8	351.6 ± 22.3	0.65 ± 0.02	0.77 ± 0.00[b]
1.4% KDF	258.6 ± 12.4	615.0 ± 12.9	356.4 ± 33.1	0.69 ± 0.06	0.75 ± 0.01[b]

[1)] *Means with different superscripts in each row differ significantly ($P\leq0.05$)*

Fish fed pelleted diets containing potassium diformate enriched fishmeal showed increased body weight gain (17% and 19% for 0.8%

and 1.4% KDF inclusion rate respectively). The SGR of fish fed 1.4% KDF tended to be higher (P=0.055) compared to the negative control. Furthermore, both groups treated with KDF had a significantly better feed conversion ratio. It was seen as well, that the uniformity of fish fed KDF treated fishmeal was improved (data from Christiansen and Lückstädt, 2008).

Conclusion

With the results shown above, it may be stated that the use of organic acid salts, such as potassium diformate, in tilapia as well as salmon aquaculture can improve the grow-out period in terms of performance and sustainability. However, more trials to validate these results are suggested.

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Improving growth performance and FCR in Pangasius catfish with a combination of probiotics and phytase enzyme

By Patcharaporn Wongsa and Pipat Werukhamkul

Fish fed diets containing probiotics plus phytase enzyme showed 35% higher weight gain and better feed conversion by more than 25% in comparison to fish fed control diets in this 3 month trial.

The catfish *Pangasius hypophthalmus* also known as "basa" in Vietnam, is an emerging and important substitute species for wild white fish. It has a unique texture, white flesh, and delicious taste. It is being marketed to more than 60 countries all over the world. The major areas for culture of the catfish are the farms along the Mekong River in Vietnam.

However, recently, the situation in the production of catfish culture has become difficult because of high cost of feed and other inputs. Generally, feeds for catfish are made mainly with soya bean meal, rice bran,fish powder and lipid. Some components in plant meals such as phytate and fiber cannot be digested by monogastric fish animals. Phytate is the main storage form of phosphorus in soya bean meal and rice bran. Phosphorus bound t o phytate cannot be released by the digestive system of fish and are excreted into the pond environment leading to a problem of algal bloom (Liebert and Portz, 2005). In addition, phytate has been shown to form insoluble chelate complexes with various minerals such as calcium, zinc, magnesium and iron as well as proteins. This results in a reduction of bioavailability of these nutrients (Papatryphon et al., 1999).

Phytase is an enzyme specific to hydrolyse indigestible phytate in plants. Supplementation of phytase in feed can increase bioavailability of phosphorus and also leads to improved availability of other minerals and trace elements (Cao et al., 2007).

Application of beneficial probiotics as feed supplement has been shown to improve growth performance by balancing microbial population, leading to improved food absorption and digestive enzyme activity (Yanbo and Zirong, 2006). Some species of Bacillus produce extracellular enzymes such as protease, lipase, amylase and cellulase which can promote digestion of animal hosts.

Based on the properties of phytase and probiotics, the research team at BioSolution International Co. Ltd., a Virbac joint venture company, has recently developed an innovative feed supplement consisting of two active ingredients, Probiotic Bacillus (BSI strains) and phytase enzyme (phytase BSI). This product (hereafter called Pro-phytase) was created to provide a synergy between enzyme producing probiotics and phytase. The efficacy of Pro-phytase on growth performance and feed conversion ratio (FCR) of *P. hypophthalmus* is demonstrated in this article.

Methodology

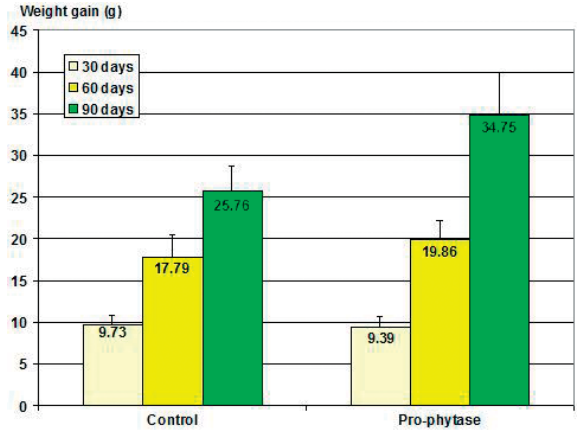
Catifish with average weight of 4.70±0.24g were divided into batches of 12 fish and stocked into tanks of 30 x 60 x 30 cm. Water in fish tanks was maintained by a recirculation system at pH of 7.4-7.7, ammonia and nitrite at 0-0.25 ppm and alkalinity at 85-102 ppm. There were three replicates for each control and treatment group.

The control group was fed a commercial feed which was the basal diet. The major ingredients of the commercial feed were fish meal, wheat flour, soya bean meal, rice bran, minerals and vitamins. Pro-phytase was mixed with the basal diet at an inclusion rate of 5g/kg feed to form the treatment diet. This was fed to fish in the treatment group. In all groups, fish were fed twice a day for 3 months. The growth performance of fish was monitored by measuring weight gain. FCR was also calculated.

Growth performance

Figure 1 shows the weight gain of the fish fed with Pro-phytase in comparison to fish fed the control diet at 30, 60 and 90 days. During the first month of culture, there was no statistical difference in weight gain between the control (9.7 g) and treated fish (9.3 g). A significant difference was observed after the second month when weight gain of treated fish increased to 19.8 g, as compared to 17.7 g in the control group. Fish in the treatment group continue to grow at a faster rate and by the third month, weight gain of treated fish increased to 34.7 g or 35% higher than that for the control group (Figure. 2).

Figure 1. Growth rate of *P. hypophthalmus* fed the control and treatment diets supplemented with Pro-phytase during the 3-month culture period.

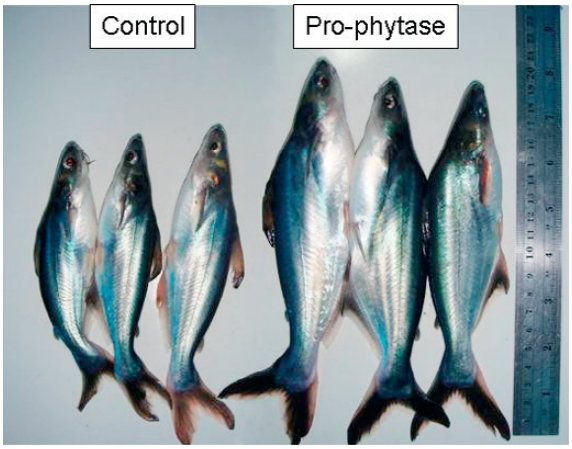


The survival rate of two groups of fish was also compared. Under similar water conditions, the survival rate of fish treated with Pro-phytase was higher at 96.7% as compared to 90% for the control group.

Feed conversion ratio

As expected (Figure 3), FCR of fish fed with Pro-phytase was significantly improved. It was 2.13 or 25% lower than that of the control (2.78). These findings indicate that the enzymes produced by probiotics and phytase

Figure 2. Comparison of fish sizes between *P. hypophthalmus* fed the control diet and treatment diets supplemented with Pro-phytase during the 3-month culture period. The largest size of fish from each experiment of 3 replicates was selected and demonstrated in this figure.



in Pro-phytase function well and help in the digestion of feed. Protease, lipase and cellulase produced by the probiotics help in the digestion of soya bean meal, fish meal and other components in the diet.

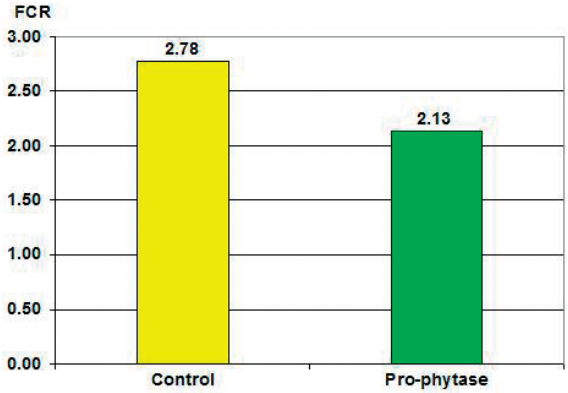
The phytase in Pro-phytase could digest phytate in soya bean meal and rice bran to generate available phosphorus that can be utilized by fish for growth. As such, the fish fed with feed supplemented with Pro-phytase can digest the feed faster and absorbed the obtained nutrients more effectively than those of the control.

The efficiency of Pro-phytase on fish performance was tested in the field. In grow-out in farms, the average FCR of catfish culture with the basal feed is found to be about 1.7. Based on our findings in these studies, it could be postulated that the FCR of the fish treated with Pro-phytase may improve by 25% to 1.3 in the grow-out farms.

Bottomline

A supplementation of Pro-phytase in fish diet could clearly enhance growth and improve FCR of this catfish. The actions of enzyme producing probiotics and phytase has helped fish digest ingredients in plant meal more efficiently. Overall, the supplementation of Pro-phytase may also shorten the culture period and most importantly, maximize the utilization of feed.

Figure 3. FCR of *P. hypophthalmus* fed the control and treatment diets supplemented with Pro-phytase at the end of the 3 month trial.



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Solid state fermentation enzymes unlock the hidden potential in aquaculture feeds

Alison Leary, Le Thanh Hung and Tran Ngoc Thien Kim

There are many challenges facing the aquaculture industry today and feed is one area of particular concern. Increasing raw material costs and the reduced availability and quality characteristics of certain ingredients has resulted in a fluctuating and variable market. Vegetable protein sources are no longer a guaranteed alternative with concerns on climate affects on production. Competition with the ethanol industry for biofuels has dramatically changed the cost structure of these ingredient sources. Alternative feed ingredients or technologies that can improve feed optimisation, animal production and reduce nutrient excretion and feed wastage have an increasingly important role to play into today's feed formulations for aquaculture.

The use of cheaper locally sourced fibre rich ingredients and co-products such as copra, rice bran and pollard are options for the feed industry. However the resulting feeds may contain high levels of fibre, be subject to variations in raw material quality and their use may also result in variable pellet quality. These ingredients and co-products can affect the nutrient density of the diet and the availability of energy, calcium and available phosphorous. In addition the higher fibre content may contain antinutritional factors resulting in decreased intestinal viscosity and bacterial loads affecting animal performance.

One solution for counterbalancing the antinutritional effects of such ingredients is to use enzymes which can improve the digestibility of substrates and result in higher nutrient availability thus improving growth, food conversion rates and therefore economic efficiency. Today a better understanding of how enzymes work in animal feeds and the increasing evidence of their ability to improve feed quality has allowed a more flexible approach to be taken by feed formulators.

Enzymes can be considered to be biological catalysts that are capable of accelerating, by several hundred or thousand fold the rate of naturally occurring biochemical reactions. Enzymes are produced from fungi using submerged liquid fermentation (SLF) or solid state fermentation (SSF).

Recent developments in solid state fermentation (SSF) technologies has enabled the production of enzymes specifically suited to feed substrates resulting in the development of commercial products containing natural combinations of enzymes designed to maximize digestion. These technologies allow the production of a natural enzyme complex with activity levels suitable for in-feed applications.

Enzymes from solid state fermentation

Allzyme SSF (Alltech Inc.) is produced by solid state fermentation using the naturally occurring non GMO fungi *Aspergillus niger.* As the fungus grows rapidly it secretes enzymes to break down the solid media substrate which then releases the nutrients it requires for subsequent growth. When this particular fungi is grown on wheat bran seven enzymes are expressed, α-amylase, cellulase, phytase, xylanase, (beta) β-glucanase, pectinase and proteases. In feed these enzymes work synergistically to break down different substrates such as protein, cellulose, pentosans, phytic acid and even starch and fat to effectively improve the overall diet digestibility and improve the availability for absorption of dietary nutrients.

The enzyme combination produced is unique to the production process employed. It is stable under a wide range of conditions and as the enzymes have been produced using solid state fermentation they have different physico-chemical properties to enzymes produced using SLF. This results in enhanced thermo tolerance giving them the ability to withstand a wide range of feed production and pelleting conditions. The resulting improved thermo stability characteristics has enabled the use of this enzyme successfully in commercial feeds for the poultry and swine industry and now in some aquaculture situations.

Enzymes in terrestrial animals

The use of enzymes in terrestrial animal feed has resulted in improved performance parameters. The efficacy of Allzyme SSF has been demonstrated in reducing phosphorous excretion and improved ileal digestibility for phosphorous, calcium, protein and energy in pigs (Park et al, 2003; Wu et al, 2004). In broilers fed corn and soy diets Peric et al, 2008 reported significantly better body weight with the same FCR and EPEF in the enzyme treated group along with a lower cost of feed per broiler and per kg body weight gain. They also reported similar production results with a low cost and reduced nutritive value feed when enzyme technology was employed. Shan and Feng, 2008 reported that Allzyme SSF could improve the performance and reduce the mortality of broilers fed diets containing high levels of distillers dried grains (DDGS).

Enzymes in catfish feeds

In the aquaculture industry, the use of enzymes has been limited, in part due to issues with application in which problems have arisen with feed conditioning and pelleting. However recently SSF technology has been employed in the rapidly developing catfish industry in Vietnam and has been shown to provide significant benefits.

In Vietnam, the feed industry produces feeds for the catfish which usually contain local products such as rice bran, cassava meal and local fish meal to supplement imported ingredients such as fish meal,

Table 1. NSP content of cereal grains (Willamson et al, 2007).

	NSP (% dry matter)
Barley	15.9-24.8
Wheat	10.0-13.8
Oat	19.8-38.7
Sorghum	3.4-7.3
Rye	13.2
Triticale	16.3
Corn	8.1
Rice (pearled)	0.8
Rice bran (de-fatted)	21.8
Wheat pollard	35.3

soybean meal, fish oil, premixes and feed additives. The use of fish meal in catfish feed results in a high protein (50-60%), high energy (4500-4800 kcal/kg) and highly palatable and digestible (80-90%) feed with a corresponding high price.

Plant proteins and other ingredients can replace the fish meal component in catfish feeds but one of the major constraints to their use is the low digestibility of the plant proteins brought about by high levels of non starch polysaccharides (NSP), cellulose, hemicellulose, pectins and xylans which cannot be broken down by the digestive enzymes of the fish species. NSPs are associated with plant cell walls and are found mainly in the endosperm of grains but may also occur in the bran. The NSP content varies between different feed ingredients; pearled rice has about 0.8% and sorghum has about 5%, on a dry matter basis (Table 1). Other feed ingredients are generally higher, particularly oats and certain by-products of rice and wheat which may have a NSP content approximating 20-30% of dry matter.

However in recent trials, Hung and Kim (2007) demonstrated that the quantity of fish meal in Pangasius catfish feeds could be reduced by the application of external enzymes to improve the nutrient digestion in juvenile catfish.

Tra *Pangasius hypophthalmus* and basa *P. bocourti* catfish 5-6g average weight were fed six dietary treatments in triplicate. Diets had two levels of fish meal, low (5%) and high (15%), and 2 levels of the commercial enzyme Allzyme SSF (0.02 and 0.05 g/kg of feed) (Tables 2 and 3).

Table 2. Experimental diets showing two levels of fishmeal and three levels of enzyme.

Allzyme SSF (g/kg feed)	Low levels (5% fishmeal)	High levels (15% fishmeal)
0	L-0	H-0
0.02	L-2	H-2
0.05	L-5	H-5
Nutrient composition of experimental diet		
Nutrients	(% dry matter)	(% dry matter)
Protein	26.0	26.0
Lipid	5.15	7.00
NFE	47.55	50.57
Ash	8.28	10.17
Cellulose	2.87	2.48
Moisture	10.15	10.46
Lysine	1.68	1.72
Methionine	0.42	0.55

Table 3. Growth performance and feed utilization in tra catfish.

Treatments	L-0	L-2	L-5	H-0	H-2	H-5
Initial weight (g)	13.89^{a}	13.43^{a}	13.97^{a}	13.43^{a}	13.87^{a}	13.4^{a}
Final weight (56 days)	35.8^{a}	49.33^{b}	70.13^{c}	44.9^{b}	67.17^{c}	72.5^{c}
Weight gain (g)	21.9^{a}	35.9^{b}	56.17^{c}	31.47^{b}	53.27^{c}	59.13^{c}
SGR (%/day)	1.69^{a}	2.33^{b}	2.88^{c}	2.14^{b}	2.82^{c}	3.02^{c}
Survival rates (%)	85.83^{a}	96.60^{b}	100.0^{b}	96.60^{b}	96.60^{b}	96.60^{b}
Feed Utilization						
FCR	2.29^{c}	1.58^{bc}	1.44^{a}	1.73^{b}	1.51^{a}	1.41^{a}
PER	0.84^{a}	1.38^{b}	2.16^{c}	1.21^{b}	2.05^{c}	2.27^{c}

In tra catfish all growth performance parameters (weight gain, SGR and FCR) significantly improved with increasing levels of enzymes in both the low and high fish meal diets. Indeed, the improvement in growth and performance was pronounced as the lowest level of inclusion of enzyme (0.02 g/kg) in the low fish meal diet resulted in a greater weight gain than obtained with the high fish meal control diet (35.9 g weight gain against 31.5g). The low fish meal diets with enzyme supplementation exhibited similar growth and feed utilization when compared to the high fish meal diets when they were also supplemented with enzymes.

Table 5. Growth performance and feed utilization in tra catfish.

	Rep.	W56	SGR	FCR	PER
Enzymes					
0	6	40.35^{a}	1.91^{a}	2.01^{a}	1.02^{a}
- 0.2 g/kg	6	58.25^{b}	2.57^{b}	1.42^{b}	1.79^{b}
- 0.5 g/kg	6	71.39^{c}	2.94^{c}	1.54^{b}	2.21^{b}
Fishmeal					
Low level (5%)	9	51.75^{d}	2.29^{d}	1.77^{d}	1.46^{d}
High level (15%)	9	61.52^{e}	2.66^{e}	1.55^{e}	1.84^{e}

Table 6. Growth performance and feed utilization in basa catfish.

Treatments	L-0	L-2	L-5	H-0	H-2	H-5
Growth performance						
Initial weight (g)	5.88^{a}	6.36^{a}	6.10^{a}	5.62^{a}	5.63^{a}	5.92^{a}
Final weight (56 days)	57.10^{a}	80.64^{b}	82.47^{b}	62.17^{b}	68.18^{b}	68.20^{b}
Weight gain (g)	51.21^{a}	74.28^{c}	76.37^{c}	56.50^{ba}	62.28^{b}	62.28^{b}
SGR (%/day)	4.05^{a}	4.55^{b}	4.65^{b}	4.29^{ab}	4.44^{b}	4.37^{ab}
Survival rates (%)	100.0^{a}	100.0^{a}	100.0^{a}	100.0^{a}	100.0^{a}	100.0^{a}
Feed utilization						
FCR	1.87^{a}	1.31^{c}	1.36^{c}	1.75^{ba}	1.53^{b}	1.50^{b}
PER	2.27^{ab}	3.13^{c}	3.14^{c}	1.88^{a}	2.47^{b}	2.42^{cb}

Irrespective of the diet used (low or high fish meal) the addition of enzymes resulted in dramatic improvements of performance parameters. Growth reached approximately double that of the diet without the enzyme present. This indicates that enzyme supplementation in low and high fish meal diets has enhanced the availability of dietary nutrients and compensated for the poorer quality of the raw ingredient characteristics in the low fish meal diet and improved the overall dietary performance. Enzyme supplementation can therefore help to reduce the percentage of fish meal in the diet for tra catfish and has a positive effect on fish growth and feed utilization efficiency.

In basa catfish, the effect of enzyme supplementation was similar to that of tra catfish with the low fish meal diets, however little difference was observed in the high fish meal diets groups in this case. Again low fish meal diets supplemented with enzymes outperformed the high fish meal diet control in all cases. Digestibility data for basa catfish indicated that nutrient digestibility was improved in fish fed diets supplemented with Allzyme SSF. Supplementation with 0.02% enzyme in catfish diets was sufficient to improve fish growth and feed utilization and enabled the fishmeal proportion to be reduced to a 5% inclusion rate in this species.

It can be concluded that the inclusion of Allzyme SSF in catfish diets enables the production of lower cost formulations which result in improved performance when compared to the more expensive higher fish meal content diets that are traditionally used. In the climate of increasing catfish production and decreasing market value and profit margins for these species this technology offers farmers and feed manufacturers a significant commercial advantage.

Table 7. Growth performance and feed utilization in basa catfish.

	Rep.	W56	SGR	FCR	PER
Enzymes					
0	6	59.63^{a}	4.17^{a}	1.81^{a}	2.07^{a}
- 0.2 g/kg	6	74.41^{b}	4.49^{b}	1.42^{b}	2.78^{b}
- 0.5 g/kg	6	75.33^{b}	4.51^{b}	1.43^{b}	2.80^{b}
Fishmeal					
Low level (5%)	9	73.40^{c}	4.41^{c}	1.51^{c}	2.84^{c}
High level (15%)	9	66.18^{c}	4.39^{c}	1.59^{c}	2.26^{c}

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Table 8. Digestibility of nutrients in diets for basa catfish.

	Total digestibility	Protein	Lipid
Enzymes			
0	77.2[a]	89.9[a]	89.3[a]
- 0.2 g/kg	78.4[ab]	90.6[ab]	90.8[ab]
- 0.5 g/kg	78.5[b]	91.4[b]	91.5[b]
Fishmeal			
-High level (15%)	78.3[c]	91.0[c]	91.3[c]
-Low level (5%)	78.1[c]	90.3[c]	90.6[c]

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A herbal preparation for growth and disease resistance of juvenile shrimp

By Wang Guang-jun, Pang Shi-xun and Liu Qing-shen

Diets containing 1g/kg of a locally produced herbal preparation were effective in improving growth of juvenile *Penaeus vannamei*. The mortality rate of shrimp infected with WSSV was reduced in the group fed diets containing 1.5g/kg of the preparation.

The white-leg shrimp *P. vannamei*, together with *P. monodon* and *Fenneropenaeus chinensis* are three marine shrimp species commonly cultured in China. *P. vannamei* has the advantage of rapid growth, strong anti stress ability, high meat value as well as its amenability to intensive culture practices. Since its introduction in southern China in 1998, this shrimp has become the most popular species in coastal areas.

The huge economic benefits in the culture of this shrimp have stimulated its further growth. There are reports of its culture, from the south to the north, even in Qinghai, Gansu, and other Northwest highland areas.

In the intensive culture of *P. vannamei*, disease is becoming a serious problem causing large economic losses. Using chemicals and antibiotics to rid certain diseases in shrimp is no longer an option as the demand is for safe and quality aquatic products. Enhancing the immune capacity of fish and shrimp is key to solving this production problem in aquaculture.

Certain medical preparations from Chinese herbs used in human health are already widely used in aquaculture. (Liu Hong-bai, et al, 2004; Ying Hui-fang, 2006; Shen Chao-ping, 2006; Hou He-ju, 2006; Sill Hui-lai, et al, 2007; Zhong Qing,et al, 2007). These have been shown to be more effective that similar preparations from the Western Hemisphere used for the prevention of the disease (Wang Wei-lin, 2002), accelerating growth (Chen Cheng-xun, 2002; Hu Xian-qin & Hou Yong-qing, 2005; Liu Bo, et al, 2006; Sill Hui-lai, 2007) and improving the quality of aquatic products (Zu Guo-zhang, 2008). Most of these preparations usually maintain their natural structure and biological activity and as such are acceptable for the treatment of aquatic fish and shrimp.

Moreover, these herbal preparations have so far showed no effects of drug resistance. Small side-effects (Tao Gui-fang & Zhou Jun-feng, 2005; Cao Gong-feng et al, 2006; Li Qiao-yun, 2006) have been reported mainly because there are some unknown ingredients in the preparation. In some cases, the effect is slow. Nevertheless, its use is attracting attention in line with current calls for "green, environmental non-polluting" products.

In the following trial, we tested the immunostimulant effects of a herbal preparation developed in our laboratory. The main ingredients are astragalus, glycyrrhiza, atractylodes, vitamins and plant extracts. The trial was carried out at the Shenzhen sea water testing base of the Pearl River Fishery Research Institute. The trial lasted for 60 days, beginning on August 20 2007 and ending October 19 2007.

Growth trials

Shrimp were collected from the aquatic breeding base of the Shenzhen Municipal Agricultural Centre. The average body length of shrimp was 47.5 ± 5.1 mm and the average body weight was 0.77 ± 0.24g. Before the trial began, shrimp were reared in a pond for one week. Following this, individuals of similar sizes were selected for the trial. Thirty (30) shrimp were randomly selected to determine the body length and body weight. This was used as the average initial body weight. Each tank was stocked with 100 shrimp. There were three replicates for the control and treatment groups.

The mixture of astragalus, glycyrrhiza and atractylodes in the herbal preparation

The experimental system comprises 500 litres circular tanks with recirculating seawater. During the trial, the effective water volume in each tank was 400 litres. In order to prevent shrimp from jumping out of the tank, the tanks were covered with mesh netting. Natural sea water flowed into a sand filtration unit before entering the tanks. Water was exchanged at 30-40% of volume every two days. Salinity of the water was 32 to 34 ppt. Under ambient temperature, the water temperature was 25-28°C. Throughout the trial, continuous aeration was provided. Dissolved oxygen was above 6.0 mg/l.

Growth performance

The basal diet was formulated with fish meal, shrimp shell meal, flour, soy meal, yeast, fish oil, vitamin and mineral mix, feed attractant etc. The herbal preparation was added to the basal diet at three levels: 0 g/kg of diet in the Control, 0.5g/kg for Group A, 1.0g/kg in Group B and 1.5g/kg in Group C, respectively. The proximate composition of the feed was 40 % crude protein, 4% crude fat, 15% ash, 12% moisture, 5% crude fiber, 4% calcium and 1% phosphorus.

The feeding rate ranged from 6-8% body weight. Shrimp were fed three times daily at 8:00-9:00, 16:00-17:00 and 23:00-24:00 to apparent satiation. Water temperature, pH, and dissolved oxygen were recorded twice daily at 9:00 and 15:00.

Table 1. Mean final body length and weight (±SD) of experimental shrimp fed diets containing the herbal preparation for 60 days.

Treatment diets	Inclusion rate of herbal preparation (g/kg)	Initial body lenght (mm)	Initial body weight (g)	Final body lenght (mm)	Final body weight (g)
Control	0	47.7±5.3[a]	0.79±0.23[a]	64.8±5.9[a]	1.56±0.50[a]
Group A	0.5	47.3±4.2[a]	0.75±0.29[a]	64.4±4.7[a]	1.58±0.35[a]
Group B	1.0	48.1±6.0[a]	0.78±0.18[a]	65.7±4.3[ab]	1.76±0.44[b]
Group C	1.5	46.7±4.7[a]	0.77±0.21[a]	66.3±3.7[b]	1.73±0.47[b]

Means with the same superscripts within columns are not significantly different at P<0.05.

Table 2. Mean (±SD) of daily weight gain, relative weight gain, FCR and survival rate of experimental shrimp fed diets containing the herbal preparation for 60 days.

	Daily weight gain rate	Relative weight gain (%)	FCR	Survival rate (%)
Control	0.013±0.0008[a]	48.81±5.13[a]	1.93±0.21[a]	86.67±4.99[a]
Group A	0.014±0.0011[b]	55.23±4.56[b]	1.78±0.32[b]	89.33±5.52[a]
Group B	0.016±0.0012[c]	63.02±3.33[c]	1.69±0.42[b]	94.00±2.70[b]
Group C	0.016±0.0010[c]	62.35±4.88[c]	1.71±0.36[b]	95.67±3.47[b]

Means with the same superscripts within columns are not significantly different at P<0.05

After 60 days of culture, the test results are seen in Table 1. In these studies, it was observed that the growth performance in test tanks was relatively lower than that usually observed in pond culture. In these trials it was only 0.013-0.016g per day. We attributed this to the lack of natural productivity, size of tank and instability of the environment. FCR was also relatively higher than what would be observed in pond culture. (Note: In commercial culture, the current stocking densities are typically between 80,000-100,000 postlarvae/667m^2 (119-150 postlarvae/m^2). Shrimp reach 20g (50 pcs/kg) after 4-5 months of culture and average survival is 50%. However, a majority of farmers noted that the growth of shrimp is slower due to a degradation of stock).

Nevertheless, these studies in the tanks showed differences between groups, emphasing the effects of adding the Chinese herbal preparation to diets of juvenile shrimp. In terms of enhancing growth performance, the appropriate dosage was 1.0g/kg of diet. Observations on growth performance showed that mean final weight of shrimp in B group was highest but this was not significantly different from shrimp in group C.

In Table 2, it was shown that adding the herbal preparation in the shrimp diets could significantly improve daily weight gain, relative body weight gain and survival rate. The results also showed that adding the herbal preparation in shrimp diets could reduce feed conversion ratio (FCR). The FCR of group B was the lowest but there was no significant difference among treatment groups (Table 2).

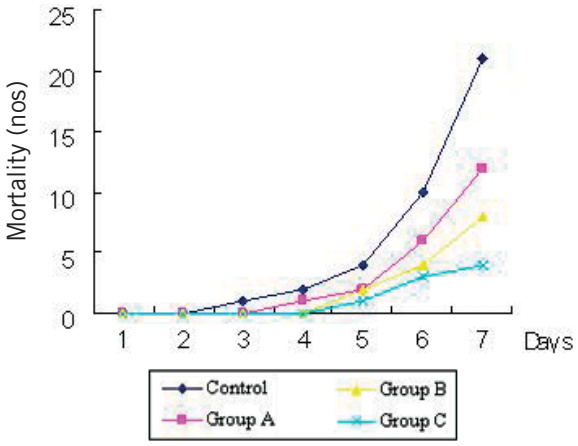
Herbal preparation and WSSV

After the culture experiment, the disease prevention effect of the herbal preparation was evaluated. Thirty shrimp were randomly selected from every group and were infected artificially with White Spot Syndrome Virus (WSSV). The WSSV crude extract was provided by the Research Center of Commercial Aquatic Animal Disease of Pearl River Fishery Research Institute.

The steps for infection were as follows: The WSSV crude extract was diluted 100 times with PBS buffer. The extract was injected into shrimp abdominal muscle of shrimp at a dosage of 100 μl per shrimp. The mortality rate was measured for 7 days.

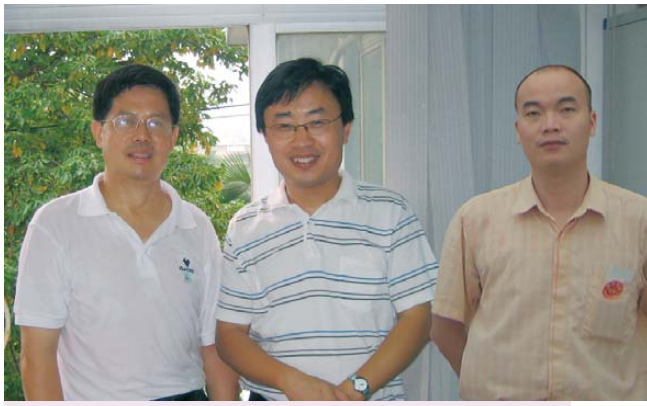
Research has shown that certain vitamins, extracts, herbal medical preparation could enhance the non-specific immunity of crustaceans, such as *Fenneropenaeus chinensis* and *Macrobrachium rosenbergii*. From the artificial infection results it could be seen shrimp in the control group began to die on the 3rd day.

Figure 1. Results of artificial infection.



However, shrimp in group B and C began to die on the 5th day. By day 7, the total number of individual death was far less than the control group. It was concluded that adding the herbal preparation in the diet at 1.5g/kg could increase disease resistance of *P. vannamei* as shown in Figure 1.

References are available on request.



From left Pang Shi-xun, Wang Guang-jun and Liu Qing-shen.

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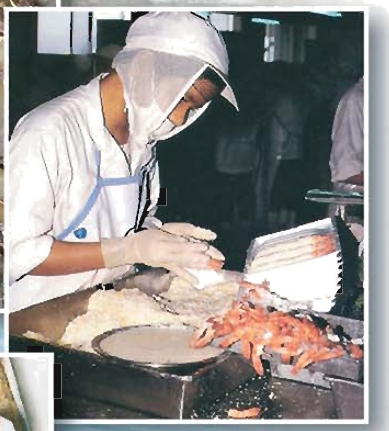

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Giant Malaysia Prawn 2008

Gridlock in freshwater prawn farming

Declines in production of the freshwater prawn in Malaysia and production challenges in India, China, Vietnam, Philippines brought farmers, researchers, government and international experts at this seminar in Kuala Lumpur to look at causes for this malaise in its farming. Industry believes that poor postlarvae quality and inconsistent harvest are the result of inbreeding.

Industry at the show, from left: Soh Chee Weng, Texchem Food, Yuet Meng, Ir Liaw Boh Lai,Kg Chennah Agro Resort, Khoo Eng Wah, Today Aquaculture, Sunny Yang and Jiaxin Khoo

Subha Bhassu (left) and Dr Jane M Hughes

Tran Ngoc Hai (left) and Ong Kah Sin

The global production of the freshwater prawn *Macrobrachium rosenbergii* was 206,947 tonnes in 2006 (FAO Fish Stat Plus, 2008). In 2006, Asia produced 206,098 tonnes. The largest producer was China (52.5%) followed by India (14.6%), Thailand (14.3%), Bangladesh (10%) and Taiwan (4.8%). The value of this production was USD 934 million. China also produced 206,197 tonnes of *M. nipponense* and India, 4,039 tonnes of *M. malcomsonii* in 2006.

Malaysia, a small producer achieved its highest production of 1,338 tonnes in 2000 and subsequently this declined to 197 tonnes in 2007. This is a worrisome situation for both industry and government. Earlier the government had set a target of 10,000 tonnes by 2009 and industry is in dire straits on how to achieve this. It was for this reason that the Malaysia Fisheries Society decided to focus on this species at this annual industry seminar, held in Kuala Lumpur from 28-29 March 2008.

The seminar was co organized by University Putra Malaysia, University Malaysia Terengganu (UMT), Department of Fisheries Malaysia and Fisheries Development Authority of Malaysia. In the opening message, the Vice Chancellor of UMT said that it is timely to provide some stimulus for the industry and interest researchers to work on the species and revive it into a sustainable industry. Topics discussed included culture and nutrition, biodiversity, genetics, breeding and markets. It ended with a panel discussion with presenters, government and private sector from Malaysia and India giving their views on how the industry in Malaysia can forge ahead.

Early breakthroughs and constraints in Malaysia

Malaysia is proud that the early breakthroughs in the breeding of the indigenous were achieved in Penang in the early 1960s. Later, work on green water culture for larval rearing was also developed in Malaysia. Mr Ong Kah Sin, one of the early pioneers in this breeding work said the initial success in breeding of the prawn prompted research centres in many countries to work on this species. He narrated the history of larval rearing as it moved from outdoor to semi closed hatcheries. Research led to commercial scale production of postlarvae which in turn changed culture methods from extensive polyculture with fish to intensive monoculture systems. To start off culture, farmers were given a free initial batch of postlarvae and technical guidance from extension staff.

The culture of the prawn, locally known as udang galah began to experience cyclic declines in production from 1993. Dr Mazuki Hashim, DOF looked at the structure, culture practices and economics of production and discussed the slow pace of development of industry in Malaysia. He said that generally pond farms are small at 1 to 20ha and with 2 to 50 ponds. In a case of a commercial farm with 27 ponds of 0.2ha each, stocking density is 15-20 juveniles/m^2 after 45 days in nursery ponds. Survival is usually between 35-40% and yields total 700-1000kg/pond (2-3 tonnes/ha). Commercial feeds at MYR 2.7/kg (USD 0.82/kg) are used, alongside farm made feeds comprising corn with dried anchovy heads.

Partial harvesting is practiced, commencing with the first harvest on the fifth month and continuing to the tenth month. Each harvest contains 150-200kg of prawns. Aside from the initial costs of construction for ponds, electricity supply and fencing, a major expense is for aeration where the ratio is one paddlewheel/pond (0.3ha). Production costs are MYR 15-20/kg (USD 4.60-6.13/kg) and the main costs are in feeds (30%) and postlarvae at 25%. Ex-farm prices range from RM25/kg –RM38/kg (USD 7-10.8/kg). Profit margins are good in comparison to the marine shrimp.

Mazuki said that the main reason for the slow progress of the industry in Malaysia is the supply of postlarvae. In 2006, seed production from 3 government and 18 private hatcheries totaled 20.71 million postlarvae.The current production can only meet 40% of the demand. There is also the issue of inconsistent quality. Most hatcheries are small scale producing less than a million postlarvae/year.

Badariah Hj Ali, Department of Fisheries, Malaysia in her presentation on the status of farming in Malaysia, said that threats to the industry remain in inbreeding within same stock/genetic line in pond grown brood stock resulting in poor quality seeds and lower productivity in farms. Wild stocks are also declining due to habitat destruction and water pollution. Nevertheless, the government is drawing investors with stimulus packages for local and foreign entrepreneurs. These include fiscal incentives, income and investment tax exemptions, grants etc. Some development plans were outlined in the presentation. To resolve supply problems, DOF will set three new hatcheries with a total capacity of 1.5 million/cycle. Capacity of the existing hatcheries will be expanded.

The outlook for the domestic markets is promising, according to Mazuki. The demand is for live prawn at 25-30g per piece. In the menu, the prawn compliments other seafood. It only faces competition from the marine shrimp. The potential markets are both domestic and export. Ong is also optimistic for production increase provided constraints such as in the supply of quality postlarvae are resolved.

From left; Badariah Hj Ali, Dr Safiah Jasmani, Fisheries Division, Japan International Research Center for Agricultural Sciences, Shirlene M. Anthonysamy, Infofish and Maria R. R. Romana-Equia.

Reasons for China's lead

The species is not indigenous to China. The first stock was introduced from Japan in 1976, followed by subsequent stocks from Malaysia and Thailand in 1980. The newest stock was bought in from Burma in 2002. Culture is concentrated in the provinces of Jiangsu, Zhejiang, Guangxi and Guangdong. Producers are private enterprises, both small and large scale.

Chen Qing-chao

Dr Chen Qing-chao from the Chinese Academy of Science, Guangzhou in his presentation on culture practices in China said that interest in culture is due to its market value. Yields can be as high as 4.6 tonnes/ha with net profit of RMB 48,360/ha (USD 7,111/ha) but average yields are 2.3 to 3 tonnes/ha in monoculture and 1.2 tonnes-1.8 tonnes/ha in polyculture with carps. He gave two diverse examples of culture practices in China. In Jiangsu province, production is 160 kg/mu (2.4 tonnes/ha). At a market value of RMB 40/kg (USD 5.88/kg), the profit margin is RMB 21.25/kg or USD 3/kg). This contrasted with that in Guangdong where the market value is only RMB 14/kg (USD 2.05/kg) and net profits are only RMB 8.5/kg (USD 1.25/kg).

North of the Yangtze River, the culture period is limited to only 155-160 days whereas in the south, the available culture period is six to seven months from March to November. To maintain a higher temperature, plastic sheets are used to cover the ponds. In monoculture, stocking density is 12,000–15,000pcs/mu (18-22 juveniles of 1.5cm length/m^2) or 20,000 - 40,000pcs/mu (40-60 juveniles of 0.7cm length/m^2). In polyculture, the prawn is cultured with silver carp (14-16 cm) and common carp at a ratio of 3:1. Prawn is harvested after 5-6 months, commencing with prawn of 15g and above.

In 1999, China produced 37,363 tonnes and this rose to 128,338 tonnes in 2001. Production declined to 99,111 tonnes in 2005 but increased marginally to 108,592 in 2006 (FishStatPlus, 2008). Exports have dropped with decreasing market demand. Lower production was also attributed to inconsistent supply of postlarvae and disease outbreaks. Hatcheries are very small and localized. Farmed prawn is becoming smaller in size, possibly as a result of heterozygosity, said Chen.

Disease management included those for white tail muscle and yellow and black gills. The control and treatment of the fungus *Pseudosaccharomycete* have been developed. Monoclonal antibodies are used for treatment of nodavirus. The cause of brown shell disease has been identified.

Chen said that China has managed to produce large volumes in a short time because of support from several levels of government. Technical specifications have been established for each level of its culture, from broodstock culture to larvae transportation techniques. Government extension workers and academicians work hand in hand to support enterprises. Local level funding may also include pond construction aside from providing basic infrastructure. Ponds are leased to farmers to operate. China, as a vast country has problems in transportation. High mortality of postlarvae during transport from coastal hatcheries to inland farms is high and the high cost of transporting seawater favoured the setting up of inland hatcheries using reconstituted seawater.

Production woes in India

Freshwater prawn farming became popular in India in the mid 1990s after the collapse of marine shrimp farms, devastated by diseases, environmental and coastal zone issues. Some 92% of production is *Macrobrachium rosenbergii*. Production rose quickly from only 7,140 tonnes in 1999-2000 to peak at 40,000 tonnes in 2005-06. However, it declined to 30,115 tonnes in 2006-2007, said Dr C. Mohanakumaran Nair, College of Fisheries, Kerala Agricultural University. The commercial culture is well established with a general production of one tonne per ha. In 2006-07, exports of 6,128 tonnes were valued at USD 60.15 million.

The freshwater prawn section of a multispecies hatchery in Tamil Nadu which also produces black tiger shrimp postlarvae.

Seed production for culture ponds are from multispecies hatcheries. These have been constructed at costs ranging from USD 100,000 to USD 200,000. There are 71 hatcheries with a total annual capacity of 1.8 billion postlarvae. Some 60% of these are located in Andhra Pradesh. It is common for both coastal and inland hatcheries to use clear water systems for larval rearing. Stocking density ranges from 50-100 larvae/litre with a PL yield of 15-60 PL/litre. Inland hatcheries truck in seawater or use brine. Some of the recent challenges in the industry have been the low cost of postlarvae. The cost for 1,000 postlarvae was USD 30 in 2000 and USD 4-8 in 2006. (Note: Currently prices average USD 3.5 but may go as high as USD 7 with high demand, S. Chandrasekar, pers. comm).

Share of production of farmed freshwater prawns in India

	2005-06	2006-07
Total Production in tonnes	40,000	30,000
Andhra Pradesh	86.7%	79.88%
West Bengal	8.77%	14.85%
Orissa	1.59%	2.84%
Kerala	0.85%	0.29%
Tamil Nadu	1.41%	1.49%
Maharashtra	0.55%	0.38%
Karnataka	0.1%	0.15%
Gujarat	–	0.11%

Among the four types of culture systems, Nair said that pond culture in low saline water of up to 10ppt results in higher productivity and better count size. Survival is better in low saline culture systems (5 ppt) and the culture period is shorter. In contrast, he said that culture using ground water is now evoking environmental and social conflicts. There are objections from the government on excessive use of ground water. The change in using paddy fields for more lucrative prawn farming in Kerala is creating some social problems.

Monosex culture of males dominates in Andhra Pradesh with 60% of farmers practicing this culture method. In all-male culture, the stocking rate is 12,000 to 15,000 pcs/ha, culture cycle is shorter at 5-6 months and survivals range from 70-80%. Yields are higher with bigger size prawn. Feed conversion rate (FCR) is also better at 1:1.2, instead of 1:1.8 as in mixed sex culture which also takes 8-10 months. In all male culture, juveniles are segregated in three weekly sessions during 45-60 days. The margin of error is 5%. At present, female prawns, previously discarded, are cultured and apparently show uniform sizes and good survival.

In 2006-07, the area under culture also declined by 30%. In Andhra Pradesh, production declined by 35% from 37,143 tonnes in 2005-06 to 24,056 tonnes in 2006-07. Diseases such as White Tail Disease caused by MrNV (*M. rosenbergii Noda Virus*) and XSV (Extra Small Virus) were caused by poor nutrition, improper feeding and poor quality seed. The other disease is Balloon Disease (Branchiostegal Blister Disease, BBD), prevalent in Nellore. This was associated with poor water quality.

Despite current problems, Nair said that this is a more sustainable industry as compared to the marine shrimp with the advantage that it will not cause salination of culture areas. Future work will be on genetic manipulation to produce all male populations as sexing by hand is time consuming. Genetic sex reversal following a technology developed in Israel is being pursued. In selective breeding, the aim is to develop fast growing and disease resistant animals. Industry is also pursuing other species similar to the success of *M. nipponense* in China.

New industry for Vietnam

The culture began in the early 1980s but significant production was achieved in 1999 said Dr Tran Ngoc Hai, College of Aquaculture and Fisheries, Can Tho University. The government allowed rice and prawn farming in the Mekong Delta for income generation. At present, 5,000 ha are used for two types of culture variations; 2 crops of rice and one crop of prawn and vice versa or an overlap of rice and prawn in an integrated system. Stocking density ranges from 3-20 postlarvae/m^2 with optimum of 6 postlarvae/m^2 in alternative rice-prawn culture. Partial harvesting is practiced from the 4th month and continues to the 6th-7th month. Pelleted feed is usually used supplemented by golden snails. The main problems is white tail muscle disease.

Hai attributed the progress in industry in the Mekong Delta to efforts in research, extension and availability of hatchery seed stock. The annual production of postlarvae is 140 million from nearly 100 hatcheries. Some 67% use green water systems with 2-4 cycles per year. The capacity ranges from 0.5 to 12 million postlarvae/year.

In some studies on the best culture parameters in the hatchery, Hai said that postlarvae from brood stock cultured in tanks with specific diets performed better than postlarvae from wild brood stock and farmed broodstock. In experiments to find out the best algal species, they reported that larval rearing with green water from tilapia culture media inoculated once at the beginning of rearing cycle with density of 0.5-1 million cells/ml was the most appropriate. In a comparison of culture systems, they said that larval development and survival rate in the modified static green water systems were better than those in recirculating systems.

In 2005, studies were conducted in Vinh Long province to find out the optimal seed size for culture in integrated and alternative rice –prawn systems. They showed that yields were higher with PL15 (6pcs/m^2) at 1,245 kg/ha as compared to juvenile prawns at only 538 kg/ha in the alternative system. Post larval size did not affect survival in alternative culture systems. The gross income was higher with this system at USD3,420/ha.

Genetic diversity

Two divergent forms

Work on populations have shown that there are two divergent forms of the giant freshwater prawn, distributed either side of the Huxley's Line, according to Dr Jane M Hughes, Griffith University, Australia. The 'western' form is distributed in SE Asia and southern Asia and the 'eastern' form in Australia, PNG, West Irian, Eastern Philippines. There is also the possibility that the prawn from Palawan is of the 'western' form and thus the Philippines has both forms. She added that the giant prawn does not transcend riverine systems and is genetically different across distribution areas. For prawn breeders and farmers – this means

that the two taxa should be managed differently both in terms of wild stock development and culture. Which form should carry the 'rosenbergii' name is yet to be decided.

Wild and cultured stocks

Dr Peter B. Mather, Queensland University of Technology, Australia said that there are no gene flow studies of wild Asian populations. High levels of genetic diversity are usual in wild stocks because fry survival is low and breeding populations are high but these are yet to be sampled for the western stock, said Peter. Studies on the Hawaiian stock originally based on stocks from Asia and lines from Israel, Myanmar and India, showed that the allelic diversity in cultured lines is 50 to 70% below comparable wild stocks. This loss in genetic diversity from inbreeding is usually linked to poor growth and low survival rate. However, studies in Thailand on 5 culture stocks from Thailand ,Indonesia, Myanmar and India and two wild stocks from Thailand showed that both hatchery and wild stock had the same number of alleles and it was interpreted that the low genetic diversity did not result in low productivity. Peter added that in Thailand, there has been extensive wild stock enhancement and translocations.

In Malaysia, Dr Subha Bhassu, University Malaya used various markers to access the various wild and culture populations. She has developed 24 pleomorphic microsatellite markers to apply to wild populations and look at its genetic variability. In samples collected from 11 riverine systems in Peninsula Malaysia and Sarawak, there were decreasing levels of heterozygosity which supported farmer's reports that there were declines in performance in wild brood stock.

Data on levels and patterns of genetic diversity in wild and cultured prawn stocks are already assisting in current and future culture stock improvement programs, said Mather. An application of data on genetic diversity in the culture industry was shown in a recent work in Vietnam. This was to assess culture performance within and among lines. Genetic diversity studies identified 2 divergent Vietnamese wild strains (Mekong R. and Dognai R.) and Hawaiian strain. Production traits include standard length, carapace length, reproductive trends and percentage of female and body weight. One effect of crosses was that the Vietnam X Hawaiian strains appear to do better than Vietnam X Vietnam strains and show hybrid vigour. The female parent may affect response (maternal effect). This means that future studies should consider crosses among more divergent groups.

Stock improvement programs

In India, problems in production include low growth rate, large variation in size and viral disease such as white tail muscle disease have been reported in Nellore. These production declines are similar to depressions in production in Thailand and Taiwan, said Dr B.R. Pillai, Central Institute of Freshwater Aquaculture (CIFA), India. Since 2006, they have begun a genetic improvement program. They have collected populations from three locations, which are nearly 2000km apart. The best performing progeny from the cross breeding will be used for the base population. The selection criteria is weight.

In the Philippines, the constraints in the culture of the prawn are similar as in the rest of Asia. Early work on culture was in cages in the eutrophic Laguna Bay, said Maria R. R. Romana-Equia. In 2005, Seafdec and BFAR and Mindanoa State University began to collaborate on genetic and seed improvement programs. Together with Thailand and Indonesia, the Philippines has a project in collaboration with the World Fish Centre. Teams in Thailand and Indonesia are already into the genetic improvement stages but in the Philippines, it is still at the domestication phase. At the same time, Seafdec is looking at low input production schemes and bioeconomics of hatchery production using

Macrobrachium harvest in India. Picture courtesy of Dr C. Mohanakumaran Nair,

Frozen Macrobrchium tails in India. Picture courtesy of Dr C. Mohanakumaran Nair,

different production systems. In disease, there is a monitoring system based on that for the marine shrimp for WSSV and white tail virus.

The Malaysian program is a collaborative effort of three breeding centres of the DOF. Foundation stocks are from three different locations, Kedah, Johor and Pahang. The best progeny from the diallele crosses will be selected to form the base population. However, the simultaneous production of full and half sib families are beset by problems such as low survival during larval rearing and limitations of infrastructure for such a specialized breeding program. Work in China, India and Vietnam will also contribute to this undertaking in Malaysia, said Yee Hoong Yip, World Fish Center.

During the panel discussion on how industry can move forward, it was agreed that aside from resolving the immediate problem of supply and quality of postlarvae, the future will be with genetic selection for disease resistance, growth improvements and sex ratio.

Related article: Anthonysamy, S.M., 2008. Market potential for the giant freshwater prawn, AquaCulture Asia Pacific Vol 4 (4), July/August, pp 35-36.

These presentations are available in CD. More information: Malaysia Fisheries Society; web: http://www.vet.upm.edu.my/~mfs/ email: myfishoc@gmail.com.

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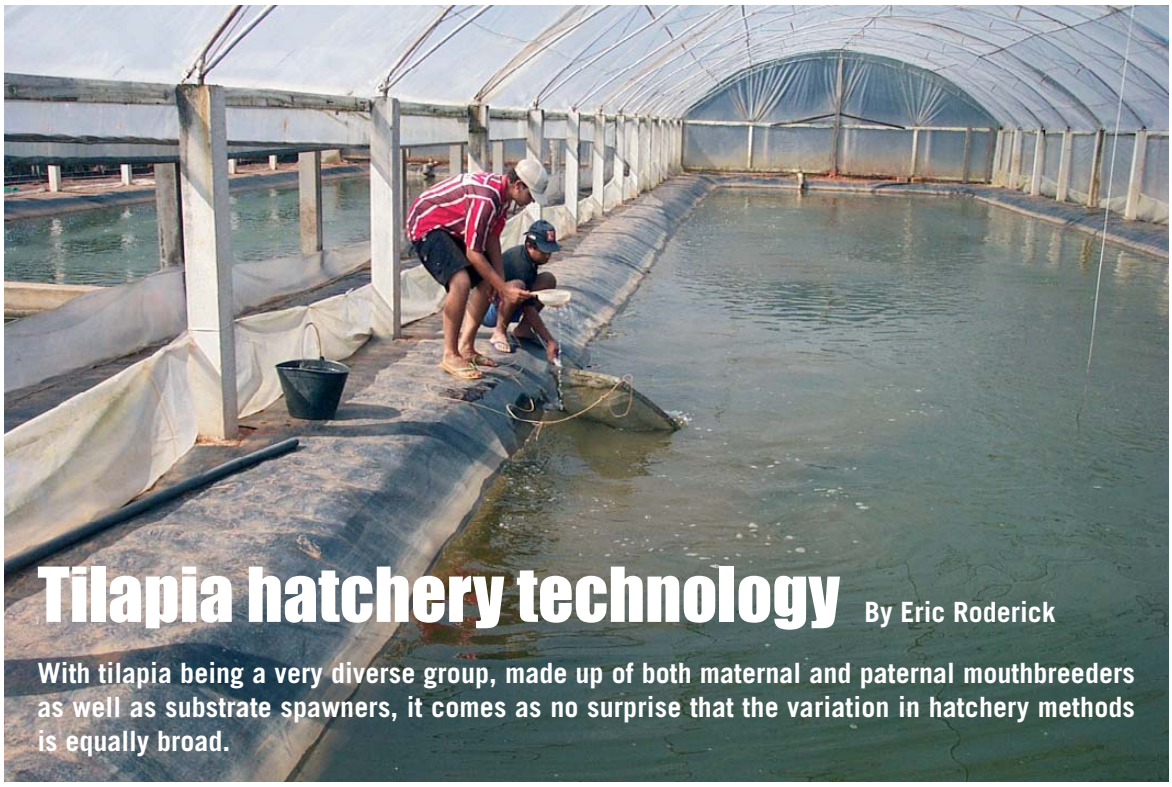

Tilapia hatchery technology

By Eric Roderick

With tilapia being a very diverse group, made up of both maternal and paternal mouthbreeders as well as substrate spawners, it comes as no surprise that the variation in hatchery methods is equally broad.

In Brazil, large lined broodstock tank inside polytunnel for increased biosecurity and added heating as required. Hatchery staff harvesting fry around the side with a specially made fry collector.

A large commercial tilapia hatchery using shallow trays for the hatched eggs in Thailand.

Tilapia incubators set up so as to overflow into shallow fry rearing trays. Free swimming fry flow into the tanks at Tiltech Aquafarms, New Orleans, USA.

With many forms of aquaculture, wild caught seed is often introduced into growing ponds and given suitable conditions, provide a food crop. Tilapia, in contrast to most other cultured species, suffer from precocious sexual maturity and with most tilapia species, breeding often commences before a suitable harvest size is reached. Combined with the very strong maternal care provided by most tilapia, in particular the most widely cultured species, *Oreochromis niloticus*, *O. aureus* and *O. mossambicus*, which exhibit maternal mouth brooding, high survival of fry is ensured. The females will incubate the yolk rich eggs for up to 10 days until the fry have absorbed the yolk sac and are free swimming. Then for many days afterwards, the fry are taken back into the female's mouth in response to any danger.

This is a highly advanced evolutionary trait, which also ensures a very high rate of survival in the young tilapia. All this means that farming mixed sex tilapia, especially in earthen ponds can lead to excessive breeding, with the new recruits competing for food with the grow out fish, resulting in well over 50% of the harvest made up of unmarketable stunted fish.

Male progeny for monosex culture

The tilapia industry, now farm, almost exclusively, monosex cultures, removing the breeding ability, and as males grow larger and faster than females, all male farming is the industry standard. This was initially achieved through manual sexing, and discarding the females, which was very labour intensive, not consistent, and very wasteful.

It was then found that certain hybrids between different species of tilapias gave very high % male progeny. The downside with this technique was that it required hatcheries to hold two separate stocks of tilapia species and as purity of stocks deteriorated, so the effectiveness of the technique became unviable.

The industry then discovered that tilapia fry, when fed male sex hormones for the first month after first feeding, were able to change

Concrete broodstock ponds (foreground) with fry rearing tanks in Zambia'

sex, from 50- 50 male to female ratio, to ratios of almost 100% male fry. This is a variable technique due to hormone purity, and not following protocols exactly. There are also environmental concerns about the use of methyltestosterone as a feed additive. Some of the best farms do provide consistently high male % fry.

The latest technology to effectively provide all male fry is the YY Male Technology developed by Fishgen for the Nile tilapia.After many years of research in the UK and in the Philippines, scientists were able to produce supermale tilapia which had 2 Y chromosomes instead of the usual single Y and X chromosome which is usually found in males as compared to two X chromosomes normally found in female tilapia. These supermales (due to the two Y chromosomes) are only able to sire all male fry.

Hatchery systems

Hatchery systems range from a simple broodstock pond often with a shallow area around the edge where the fry tend to congregate, once they are released by the females. This makes fry harvesting easier and fry are collected with large dip nets on a daily basis. After final release by the female, the fry tend to remain as a tight shoal, so with a little practice you can catch all the fry in one scoop. It is important in these types of systems to collect the fry regularly, as any uncollected fry will grow and start to cannibalise younger and smaller fry. These types of systems should be fully drained down once a month to collect any fry that were missed in the daily collections as well as to assess the condition of the breeders. Stocking ratios of one male to 3 or 4 females are most commonly used.

Many large commercial hatcheries operate a more refined method of this basic system, where large lined ponds in polytunnels give better temperature control, more biosecurity and protection from predators, and the ponds can be lined to give maximum harvesting suitability in terms of shape and ease of access. In all these types of systems, the fry are incubated by the female which is less efficient than removing the fertilised eggs from the female's mouth and using artificial incubators to hatch the fry.

Hapa-based production systems

Most of the large highly efficient tilapia hatcheries, especially in Asia, use the hapa-based production systems, where the broodstock are stocked in long hapas (net pens) and are harvested regularly depending on whether the hatchery is using incubators or trays for the larvae. If incubators are being used the hapas are harvested every 5 days, which results in harvests of eggs only, whereas if trays only are being used, then harvesting can be left for between 10 and 14 days resulting in hatched yolk sac larvae, or even free swimming fry.

Removal of eggs from the female's mouth is done by opening the buccal cavity of the female and gently rinsing the mouth out in a bucket of water. Water can also be squirted into the mouth dislodging any remaining eggs. It is important to ensure that all the eggs are removed otherwise the female will carry on incubating the remaining eggs, rather than getting back to feeding and regaining some of her lost condition. This is the main advantage of removing the eggs from the female's mouth, because the tilapia eggs are very high in yolk and regular breeding results in fairly rapid loss of condition and also explains the different growth rates between males and females, especially for the prolonged periods where fry remain with the females throughout the cycle.

A large scale genetic selection experiment using hapas as breeding pens at the Freshwater Aquaculture Centre in the Philippines.

A close up of the modified scoop net for harvesting fry around the sides of the pond.

Incubators

Incubators can be upwelling or downwelling, referring to the flow of water essential to keep the eggs moving, gently simulating what happens in the female's mouth. If water flow is interrupted, the eggs will die after only 15 to 30 minutes, due to a settling of the yolk. Once the fry hatch they can be transferred to shallow trays, again with gentle flows just to provide well oxygenated water while they absorb the yolk sac.

Many of the commercial farms sub-contract the harvesting and these skilled operators are paid on the basis of weights of eggs and fry. There are usually 3 categories of harvestable product, newly fertilised eggs, just hatched eggs or yolk sac fry which can wriggle around and free-swimming fry. These are stored separately, as they need different treatment back in the hatchery building.

A variation on this theme is to actually strip sperm from the males and ripe unfertilised eggs from the females which enable you to make specific crosses, as part of genetic improvement programmes. This also allows you to compare progeny sired by one male and several females to compare performances of different females. This technique is rarely used outside the laboratory, as it is much more complicated and labour intensive, and has potential to damage the parent stock. This technique is used routinely with seasonal spawners such as carp and salmon, but as tilapia spawns throughout the year, spawning can happen at any time.

On becoming free-swimming, these first feeding fry are transferred to the primary nursery tanks, and will require regular feeding, if they do not have access to phytoplankton and zooplankton in natural pond systems. Ideally, the primary nursery should be in shallow trays, or hapas which enable the farmer to observe the fry and determine when to grade them. If grading is left too long, several "shooters" or large individuals appear in the tanks, which start cannibalising their siblings resulting in lower fry yields.

Eric Roderick is CEO of Fishgen Ltd, and is a consultant with 25 years experience in the tilapia industry, having been involved in projects in over 30 countries.

Catfish galore at Vietfish 2008

Catfish producers in Vietnam may be facing difficult times with low prices but it is still full steam ahead in the worldwide marketing of the 'panga' or 'dory' at Vietfish 2008. The show featured 123 local and international companies.

Marketing the catfish was everywhere at this 10th anniversary of the annual show organized by the Vietnam Association of Seafood Exporters and Producers (VASEP), held from 12-14 June 2008. Pangasius hypothalamus was the focal species at the show, by established and new processors and exporters and in several product forms. In 2007, catfish exports totaled 386,000 tonnes valued at USD 979 million. Vietnam's production of catfish will continue to grow to an estimated 1.2 million tonnes in 2008. The target is to export USD 1.2 billion by end 2008.

Markets to develop an industry

Some 20 years ago, the fish was a poor man's fish. Today it is a global commodity present in 65 markets and the most successful whitefish of our times. For Vietnam, catfish farming has been a miracle with a significant social-economic impact on communities in the Mekong Delta.

During the early years, catfish was mainly exported to the US which then imposed country wide antidumping duties of up to 63.88% in 2003. Vietnamese exporters took this as a lesson to be less dependent on one market and directed marketing efforts on the EU and Asia. This lead to the development of an industry 40 times the size before the imposition of the antidumping duties. Although it can be seen that the catfish has a foothold in almost all markets, VASEP continues to seek new markets and open these to its producers. The newest market is South Africa.

In the first four months of 2008, total exports have increased by 25.2% in value and 38.5% in volume compared to the same period in 2007. In terms of volumes, the EU is the largest market at 38.8%, led by Spain, Poland and Holland. Russia which started importing catfish from Vietnam in 2006 is now the second largest market at 13.1%. Other major markets are the US, Ukraine, Mexico, China, Singapore, Thailand and Australia.

Target is quality fish

This creation of new markets has fast forwarded production using intensive culture practices and mainly in ponds. In such intensive systems, water and disease management have become critical issues. At the same time, attention is on product quality assurance vis-à-vis the use of antibiotics in disease management. The industry is gradually consolidating as processing factories undertake farming to control inputs and food safety from 'farm to fork'. In the case of antibiotic use, the farmer has to show a certificate that fish is clean of residues. The National Fisheries Quality Assurance and Veterinary Directorate - NAFIQAVED stringently controls processing and production processes, monitors the use of antibiotics and tests products for export. The processing factories also conduct tests on fish purchased from farmers and discard all positive samples.

Philippe Serene, General Manager of Proconco said that the latest issue is to reduce cost of production. Proconco Joint Stock Company is a market leader in feeds for the catfish. Increases in feed costs have been inevitable with rising raw material costs. As such, reducing costs of production will be through increasing fish survival. R&D efforts by Proconco will focus on using new functional ingredients such as nucleotides and glucans to strengthen fish immune system together

'Think of fish, eat panga' at the Hung Vuong booth

The Mekong Group and 'the legend of panga'

Catfish 'common food and health for everyone' at Anvifish

with using in feed beneficial bacteria. Besides this, the company has set a "Proconco sponsored supply chain" program to help farmers and exporters get better prices for their products. It will take part in financing cost of certification such as GAP and ACC and training of farmers on feeding management, health issues etc. Farmers and exporters participating in this program will be able to show transparency and traceability on catfish production, which means a better market price. Additionally, he said that Proconco will develop new enzyme technology which will allow processing plants to convert waste products into hydrolysed products for animal production or other agricultural use.

Cuu Long Fish Joint Stock Co (CL-Fish) based in the Long Xuyen, Mekong Delta was listed in the Ho Chi Minh Securities in 2007. Currently major markets are the EU, Middle East, Australia and USA. It expects catfish exports to go up and by end 2008, it will complete the setting up of a new factory with a 100 tonnes/day raw material capacity. The current processing capacity is 15,000 tonnes/year of frozen pangasius fillet. The new factory will increase its total production capacity to 35,000 tonnes/year of fillet. It will also set up a feed mill with 100,000 tpy capacity of fish feeds. This will reduce up to 20% of feed costs as well as ensure traceability in the production process.


Le Thi Mai Huan, CL-Fish

At the booth of CL-Fish, Ms Le Thi Mai Huan, Sales and Marketing Department said, "Prices are higher for high quality fillets for the EU markets. We work at keeping quality and this will allow us to choose markets. The close location of farms to the processing ensures that 100% of the fish transported are kept alive".

The company processes fish purchased from farmers aside from its own farms. It has 100ha of farms in Cho Moi and Tan Chau, An Giang provinces following the SQF1000 system. These provides for a production capacity of 150,000 tonnes of catfish. The current cost of production is VND 14,000/kg and the company pays VND 15,000/kg, allowing for VND 1,000 profit margins for the farmer.

The Mekong group has the biggest farming system since 2000 and the factory was established in 2006 as a union of companies in the delta. It is now the largest group farming, producing and exporting the catfish. Fish are produced in 150ha of farming area in the Mekong Delta. The major supplier of raw materials is from its own farms and only 10-20% is sourced from independent farms. Major markets are the EU, Russia, Middle East and Asia

"We believe that the future for the sector will be with large corporate entities", said Vu Tuan Phuong, Vice Director. He added that in the next few years, the Mekong Group will be consolidating their position through acquisition of smaller farms.


Vu Tuan Phuong

Hung Vuong Corporation now operates seven processing plants in Tien Giang, Vinh Long and Dong Thap capable of processing over 1,000 tonnes of raw material per day, with a total production capacity of 50,000 tonnes/year of fillet. Farms are in the provinces of Tien Giang, Ben Tre, Binh Long and Can Tho. In 2008, it plans to expand the current farming area of 80ha to 100-120ha. All farmers from farms operated by the company and farms supplying to the processing plants are required to attend training under the clean farming project to meet the SQF-1000 standards and those on food safety and the environment.

Recently, Hung Vuong together with Navico and Mekong Fish formed the Pangasius Triumvirate. The trio controls some 35% of the global pangasius catfish business. The aim is to streamline supply of raw material quality and create bottom-line pricing. It said that the catfish fish should be looked as a major white fish for the future, taking over the place of Alaska Pollack but it is sold at too low margins. Currently, the three companies are responsible for 400,000 tonnes of raw material and 180,000 tonnes of fillet. The target is to capture 40% of the market in 2008. Another target is to streamline the various marketing names the pangasius catfish is using and end the confusion in several markets.

Newcomer Bianfishco, producer of 'pure and safe' pangasius has 100ha of farming area. These are located in Tan An Thanh, Binh Tan District, Vinh Long and An Giang Province. The company produces only frozen pangasius fillet with 70% white and 30% white pink and light pink. It is now the 6th top exporter of catfish in the first quarter of 2008. Currently markets are Italy, Germany and the Netherlands. It is looking at exporting to Russia, Japan, Ukraine, France, UK and US to mitigate negative impacts of one or two markets.

It said that in 2008, the processing plant in Can Tho City will process 70,000 tonnes of raw material. To control and guarantee quality, the company will also set up a feed mill. Farmers supplying fish to the company has to comply with its requirements for the production of 'clean' pangasius. In January 2008, the company initiated the set up of the Vietnam Pangasius Institute, a first funded by a private seafood enterprise. This will be located in the Tra Noc II Industrial Zone in Can Tho City and will carry out R&D on fish culture and breeding, nutrition as well as technology in seafood processing. Company Chairperson, Ms Pham Thi Dieu said that although this will be privately funded, the research output will partly influence Vietnam's seafood development policies. The initial work will focus on R&D in pangasius farms providing fish to Bianfishco to ensure supply of safe fish.

Viefish 2009 will be held from June 12-14 in Ho Chi Minh City. At its new location in SECC, this promises to be a larger show.

References: Additional information on companies, production and export data, Vietfish International,, November/December 2007, January/February 2008 and May/June 2008; www,worldofpangasius.com

New

Consultancy services from VASEP

Vietnam Association of Seafood Exporters and Producers (VASEP) has started VASEPCO, a subsidiary company which offers various services in seafood processing and marketing. These include consultancy on quality management, renovation and rebuilding of seafood factories and products following international standards, HACCP, organisation of HACCP courses and on establishment of ISO 22000:2005 and BRC standards. It also provides consultancies in project investment, feasibility of projects and relevant information on food safety assurance, quality management and on markets. More information: www.vasep.com.vn

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Evonik Degussa

The growing importance of amino acids

The proliferation of fish farming brings also several critical challenges to the industry. Traditionally, fishmeal is a common source of protein used in aquafeeds. Its reduction in supply and increase in price is now a major constraint in aquaculture development. Together with the rising costs of some vegetable-based protein sources such as soybean meal, the need for more cost effective alternatives is becoming ever more important.

Water quality management is another aspect of aquaculture production that is of increasing importance as environmental regulators are concerned with effluent from aquaculture activity having a considerable impact on the environment.

Amino acids play a crucial role in helping to tackle these challenges. A better understanding of dietary nutrient requirements of the fish and information gathered from aquafeed raw materials will help to generate viable solutions using supplemental amino acids effectively as nutrients in aqua feeds.

"Amino acid supplementation can reduce the reliance of some of these costly raw materials such as fish meal. Appropriate use of amino acids helps to optimize protein utilization by the fish which translates not only to cost-efficiencies but also reduces the undesirable environmental effect of water pollution", said Lionel Niang, Market Development Manager, Aquaculture Health and Nutrition, based in Singapore.

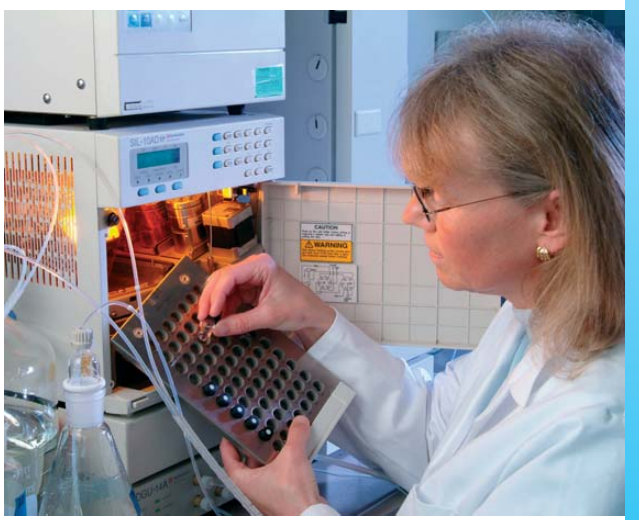
Lionel Niang

"In a span of nearly sixty years in the animal feed business, Evonik Degussa has accumulated extensive technical knowledge and experience in animal nutrition. The company employs the use of the most up-to-date chromatographic methods to support its customers in evaluating feed ingredients and compound feed. Each month, more than a thousand samples of raw materials and complete feed from all over the world are analyzed by our laboratories. Fast and reliable prediction of crude protein and amino acid content is also offered as a service to the customers using Near Infrared Reflectance Spectroscopy (NIRS). These services and our comprehensive amino acid database combine to improve the customers' knowledge in raw materials, helping them make better decisions in their diet formulation".

Raw material assessment including amino acid digestibility is vital to feed formulators since only those amino acids which are absorbed can be used for maintenance and growth. Undigested amino acids are directly excreted into the environment contributing to pollution. Moreover, surrounding organisms may feed on these pollutants and in turn compete with the fish for nutrients and oxygen.

Ideal protein concept

When formulating aquafeed, adopting the ideal protein concept will gain wider support as fish nutrient requirements become better known. This is based on the principle that fish do not have a specific protein requirement but rather a specific requirement for essential amino acids. Essential amino acids must be present in their diets because fish cannot produce them or do not produce them in sufficient quantities to meet requirements.



"When an aquafeed is formulated with an amino acid content that matches the exact amounts of the essential amino acid required by the fish species of interest, we would have created an ideal protein diet. Growing fish that is fed on this balanced diet is expected to show optimal growth and feed efficiency", added Lionel.

"Consequently applying the knowledge of amino acid contents in aqua feed ingredients, amino acid digestibility and the ideal protein balance in feed diet composition will contribute to the sustainable use of feed ingredients and aquaculture production systems. In this context it should be noted that any excess amino acids not utilized by the fish for protein synthesis will be used as an energy source and nitrogen will be excreted into the environment as a waste and pollutant".

Therefore, a diet with the lowest protein content but still meeting all the specific digestible essential amino acid requirements of the fish would reduce the environmental impact by minimizing nitrogen pollution, improving fish performance, feed utilization and as a result increase the profitability of the operation.

Optimizing fish diets according to these two concepts might be limited by the raw materials which are available for feed production. Supplemental amino acids including methionine, lysine, threonine and tryptophan will help to achieve this goal. While there is experience in amino acid supplementation in poultry and swine diets, recent analyses of compound aquafeed suggest that aquafeed producers are increasingly optimizing their feed this way. More information: email: lionel.niang@evonik.com; http://www.evonik.com

Immunocorp Animal Health
Now Brazilian owned

Norwegian Immunocorp Animal Health AS, leading producer of aquaculture immune stimulants has been sold to the Brazilian company Biorigin. The company has bought Immunocorp to acquire the leading Norwegian competence and establish a stronghold for growth in Europe. However, Immunocorp Animal Health will keep working out of Norway with the name and crew unchanged.

"This is the first step in internationalization for Biorigin", says General Manager Mario Steinmetz of Biorigin. "Our plan is to maintain Immunocorp Animal Health's existing organization and employees in Norway, while using its structure and technical knowledge to continue to support expansion of the position of Biorigin in Europe".

Immunocorp Animal Health develops and markets immune stimulating products for aquaculture and agriculture. Its patented beta-1,3/1,6-glucan MacroGard® is an ecological alternative to feed antibiotics and chemotherapeutics for livestock, pets and cultured aquatic organisms. In Brazil, Biorigin produces immune stimulating glucans for the South-American market. Founded in 2003, Biorigin produces yeast cell derivates for the food industry and animal nutrition. Biorigin is part of the Zilor Group, a leading producer of sugar, ethanol and bio energy. (More information: www.macrogard.no /www.biorigin.com.br)

SBAE
Second year and new products

The company celebrated its 2nd anniversary in July 2008. For this occasion and based on international demand, SBAE launched the GreenStim product line, the ideal micro-algal mix for a stable green water environment for marine fish, shrimp and for the culture of rotifer. All products are available in liquid (18%), paste (30%) and freeze dried (97%) form.

The company said that the GreenStim products are a true innovation on the classical Green Water Technique, providing aquaculture producers with the key to optimal results in the farms. The unique SBAE technology, based on controlled resources, controlled production and controlled harvest guarantees products free of harmful organisms with maximal purity and optimal fatty acid preservation. SBAE is able to guarantee full cell integrity resulting in an optimal nutritional value and a stable water quality in the rotifer and larval tanks.

GreenStim Roti and GreenStim Roti PLUS are for rotifer production. GreenStim Marine and GreenStim Marine PLUS are two products with a natural mix of micro-algae to create an optimal green water environment in marine fish larval tanks. The benefits of using the products include higher survival, better and faster growth towards weaning stages as well as a reduced use of expensive live feeds. GreenStim Shrimp and GreenStim Shrimp PLUS are a microalgal mix to create an optimal green water environment for the culture of shrimp larvae from nauplii 5 until postlarvae 8. The green water environment results in a faster growth, a higher survival and a faster migration from nauplii to post larval stage.

The company will be at Aquaculture Europe '08, Krakow, Poland (booth 10) and Future Fish Eurasia '08, Istanbul, Turkey (booth 104). More information: Email: sales@sbae-industries.com; Website: www.sbae-industries.com

Meridien Animal Health
Phytobiotics for aquaculture

The company has introduced a phytobiotics product for the aquaculture industry following the success of Orego –Stim® in the livestock industry since 2000.

Two specific formulations have been developed for aquaculture. These are Orego-Stim® AQUATRACT Liquid for use on extruded feeds. After dilution with fats, a coating can be sprayed onto the pellets post extrusion. The powder form will be of interest to end users at farm level, as this specific formula is intended for use not within a feed but as a powder to be coated onto a feed pellet at the time of feeding. The range is unique and is derived from *Origanum aetheroleum* from the company's oregano plantations. The oil of oregano contains two very powerful natural phenols which have medicinal properties that benefit livestock.

Trials have proven that Orego-Stim Aqua® can provide many benefits with productivity and health, which in turn make better profits and a higher return on investment for the aquaculture producer. Dr Claire Yew, based in Kuala Lumpur will be presenting the esults of these trials during a presentation paper, on behalf of Meriden Animal Health Limited at the 7th Seventh Symposium of World's Chinese Scientists on Nutrition and Feeding of Finfish and Shellfish, September 20-24, 2008 in Beijing, China. More information: www.orego-stim.com; email; sales@meriden-ah.com

BIOMIN
World Nutrition Forum 2008

In time for the next World Nutrition Forum that will be held in Mayrhofen in Tyrol from September 18th to 19th, 2008, the new WNF Proceedings book is now available. Following the success of the 2006 edition, the new proceedings book covers in more than 380 pages, the latest information on the scientific progress in healthy animal nutrition and improving animal performance. More information on topics is provided in the technical program, available at the World Nutrition Forum website. The booklet will be available from the 22nd of September 2008 through online or fax orders. (more information: www.worldnutritionforum.info)

Natural pellet binder

Sonac, Netherlands marketed natural products for the aqua feed industry at its booth during World Aquaculture 2008 in May. The company has Pro Bind Plus, a gelatine based binder, blood meal and haemoglobin powder as fish meal alternatives and MucoPro, a combination of natural proteins, peptides and amino acids.

At the Sonac booth, World Aquaculture 2008 in Busan, Korea. From left, Dr Chen Ming-Dang, CPF Thailand, Thanawart Dusadeewijai, Protector Nutrition Thailand Co Ltd and and Geert van der Velden, Sales Manager, Sonac.

The Pro Bind Plus is a gelatine based food grade pellet binder with 85% crude protein. This makes it a binder with a high nutritional value and with no digestion problems. It is used at 0.25 – 0.50% in feeds. In contrast with many other binders based on ureaformaldehyde and wheat gluten which are functional only once, gelatine as well as alginate based binders can be heated and cooled several times and will keep their functionality. The product can be used in different production conditions such as at high temperature at 80-95 °C preconditioning and post conditioning of 100°C at 20-30mins. It is also suitable for low temperature preconditioning of 60-65°C. The binder only needs a solubilisation temperature of 60°C. Studies have shown that the water stability with this gelatine based binder is comparable to the non nutritive lignosulfonate at 2% and carrageenan at 0.5%. However, the cost of using Pro Bind Plus is as low as using lignosulfonate.

An additional advantage of a gelatine based pellet binder is the inherent hydroxyproline. Work at the Research Institute, Fiskeriforskning, Norway showed that hydroxyproline improved feed conversion and growth in salmon as it is a building block for collagen formation. Feeds with more hydroxyproline caused fewer bone deformities. More information: www.sonac.biz

Bangladesh

Funding request for a seabass hatchery

Aquaculture is extremely vital to the economy of Bangladesh and is the second most important exportable commodity. In 2005, Bangladesh exported 46,533 tonnes of prawn and shrimp valued at USD 378 million (DOF, 2006). However, since the last decade, aquaculture production has been suffering from the problems with diseases, particularly in shrimp culture industry. *Penaeus monodon* culture started to develop in the early 1970s with extensive culture systems which gradually progressed to semi-intensive models. This covered about 0.143 million hectares of coastal areas.

Unfortunately, there were repeated production losses from 1994 to 1997, mainly because of epidemics of white spot syndrome virus (WSSV). This resulted in several semi-intensive farms stopping production.To compensate for the loss of income and more importantly, the loss of the use of land-water resources, species diversification is an alternative. The development of seabass (*Lates calcarifer*) culture holds great promise.

Das (2004) conducted community-based seabass culture using wild fry with tilapia off-spring as live feed in the Cox's Bazar coast of Bangladesh and recorded a maximum growth 1.45 kg in 120 days. The result was encouraging and established the prospects of seabass farming. However, the main handicap to the introduction of seabass culture is a lack of a dependable source of fry and fingerlings. Although the use of wild fry can be an option to start culture activities, the supply is insufficient and inconsistent. Therefore, development of culture systems and mass production for new species demands the setup of a hatchery system under controlled environment.

The Institute of Marine Sciences and Fisheries (IMSF) of Chittagong University would like to request a research partner to establish the first seabass hatchery in Bangladesh. It will greatly appreciate the technical and financial support to implement the project. The experience in Southeast Asian and Australian may be replicated in this regard. For more information, contact: M. Shahadat Hossain, Assistant Professor, Institute of Marine Sciences and Fisheries, University of Chittagong Chittagong-4331, Bangladesh, Tel. +88-031-710347/ 88-01711-720950, Fax: 88-031-713109 email: hossainms@yahoo.com

Trade at the 6th Philshrimp Congress

The 6th Philshrimp Congress was a biennial meeting of industry in the Philippines held on 28-31 May 2008 in Bacolod City, Negros Occidental.

At the accompanying trade show, the target of exhibitors were farmers operating small and large farms throughout the Philippines. Some of these farms have begun to culture the recently introduced vannamei shrimp, some are considering culturing both species whilst others have resolved to stay with the black tiger shrimp. At the conference and trade show, the first group needed information on culture technology and on inputs such as postlarvae from hatcheries such as Cruz Aquaculture and broodstock supplier, Kona Bay of Hawaii. Exhibitors such as Epicore, Spectrum International, INVE, Biostadt, India, Novus Aquaculture and Alltech offered a large range of products from probiotics, additives for grow out feeds, larval feeds to nutritional solutions.

Biosecurity

In the case of black tiger shrimp culture, the continuing devastation to the industry by shrimp disease, mainly by WSSV, has created a market for technologies on disease prevention and for disease detection. During the conference, Dr Supornchai Srinhonghang, Dupont Animal Health, Thailand said that this comprises a set of practices of exclusion of specific pathogens from culture stocks at facilities for the different stages during the production process. At the chemical precautionary level, there is the use of insecticide and water disinfection etc. The company offers Virkon Aquatic which is a pond disinfectant. It has been shown to be effective against a wide range of viruses, bacteria, fungal and microbial spores.

Another product which is useful during the early stages in the pond preparation process and also throughout the production stage is Dipterex Aqua. This works at eliminating unwanted crustaceans and other virus carriers. At the Bayer booth, these and important components of on-farm biosecurity are listed in the Bayer Biosecurity Program as effective management practices, use of clean shrimp stocks and disease prevention, containment and disinfection plans. To complete the biosecurity program and reduce risk to farmers, the detection of WSSV positive post larvae was suggested by Simon Chung, GeneReach Biotechnology, Taiwan with I-screen test, an instant and accurate detection system that can be used at the pond site.

Immunomodulation

Neil Raphael S Jamon, Schering Plough Aquaculture introduced algal based products which works on the immune systems of crustaceans during the hatchery to grow out stages. The total protection strategy introduced at the show involves the use of AquaVac Ergosan. This shrimp hatchery formulation is a polysaccharide based immunomodulator from extracts of marine algae (*Laminaria digitata* and A*scophyllum nodosum*). These components are known to strengthen the natural defence system of the shrimp. He said that it is already accepted that immunostimulants improves the non specific immune response in shrimp. The product must be used at zoea 1 stage to PL25 with increasing dosage as the shrimp grows for maximum effectiveness. At the grow out stage, the product is used as an immune enhancer, mixed in feed. The regime for feeding changes with the stage in production and is divided into day 1-30, day 30-90 and day 91 to harvest.

Biostadt, India's pioneering biotechnology company is beginning to market aquaculture inputs for industry in the Philippines. Dr Sanjeev Bambi (left) presented the current scenario in shrimp culture in India at the conference.

Patricia I Rico, Santeh Feeds Corp (middle) with guests from Bicol, Josefino Curioso (left) and Andy Genio.

At the Spectrum International Booth, Standing (from left): Marten van Schoonhoven (INVE), Jake Jacinto, Patricio Raphael (INVE), Ann Solis, and Archie Tabi, Sitting: Jun Zamora (left), Denny Chavez (INVE)

Aqua feeds

The major feed companies, Hoc-Po Feed, Santeh Feeds, Cargill, Feedmix, CP, Vitarich, B-Meg and Ocean Feeds also supported the show. Many of them have gone into upstream integration with either grow out of the black tiger shrimp only or a combination of black tiger and vannamei shrimp. A smaller number will start hatchery production of vannamei post larvae soon. Hoc Po Feeds Corporation, established in 1989 is now an industry leader for shrimp feeds in the Philippines. It has farms culturing both black tiger and vannamei shrimp. It also produces floating and sinking fish feeds for milkfish and tilapia and customised feeds for several species of marine fish.

Santeh Feeds Corporation which began in 1990 is a pioneer in the Philippines for the production of feeds for the vannamei shrimp. It worked hand in hand with the Bureau of Aquatic Resources and the National Fisheries Research and Development Institute (NFRDI) and was ready with feed specifically formulated for the vannamei shrimp during the trials on vannamei culture at NFRDI. The feeding management recommended by Santeh Feeds for vannamei shrimp in Mindanao was presented by Diomede C Bucog Jr. at the conference.

William R. Kramer (middle) and his team from Hoc Po Feeds Corporation, a major sponsor of the event

Workshop on reducing the cost of shrimp feeds

As ingredients and energy costs have spiralled upwards, nutritionists and feed formulators have the task of managing the cost of feeds without compromising on performance.

In this workshop jointly organized by the Department of Fisheries in Brunei and Integrated Aquaculture International (IAI) to be held from November 4 to 6, 2008 in Brunei Darussalam, international experts will address key aspects of managing costs. The workshop will be unique in that it will involve leading commercial feed manufacturers. It will also have an integrated perspective in considering the entire value chain of aquaculture, in particular that of shrimp production. In addition, the participants will have a tour of the world-class facilities established in Brunei for the development of specific pathogen free shrimp and understand technology and investment opportunities provided by Brunel Darussalam in aquaculture.

The program will include two days of presentations and discussions on;

- The latest and emerging approaches in aquatic animal nutrition research and how they relate to feed cost management
- New developments in plant and animal protein utilization in aqua feeds
- Feed processing technology as a tool for cost management
- Formulating for cost management: technology, tools and experience
- Feed management for optimizing costs

International experts who will provide the lectures include:

- Dr Ronald Hardy, Aquaculture Research Centre, University of Idaho who has made vast advancements in the way new ingredients are valued and used.
- Mr Don Lindsey from Solae, a company that is showing the way soy is used to create novel ingredients including solutions for fish oil replacement. Lindsey will handle topics related to plant proteins and oils.
- Dr Sergio Nates, Fats and Proteins Research Foundation has access to the latest information on the value of animal proteins and fats in aqua feed formulation.
- Dr Peter Coutteau, INVE Feedmill Solutions will look at R&D and formulation related to ingredient and additive use in commercial aqua feeds.
- Mr Paul Chen, Wenger, USA will speak on new developments in extrusion technology that provide low cost feed formulation solutions through increased flexibility in raw material choices in shrimp feeds.
- Mr Richard Rossi, Feedsoft, a mathematician by training and a software expert will talk about advances in feed formulation software technology that can be applied to effectively manage feed costs.

In addition, Mr Sabri Taha from the Department of Fisheries, will speak on aquaculture, feed industry and feed management practices of farmers in Brunei. The speakers and topics of IAI speakers are:

- Dr George Chamberlain on solutions provided through integration for cost effectiveness.
- Dr Victor Suresh on formulation approaches to lower feed costs.
- Dr Kumaraguru Vasagam on research conducted at the SNRC and on ways to use research to achieve feed cost reduction.
- Thomas James on feed management in shrimp farms and its importance in cost reduction.

More details on the workshop will be available in the second announcement to be released in September. More information: email: VictorS@integratedaquaculture.com

Book Review

Economics of aquaculture feeding practices in selected Asian countries

FAO Fisheries Technical Paper 505,
Edited by Mohammad R Hasan
Published by FAO, Rome 2007
ISBN 978-92-5-105874-7

This report covers six surveys conducted in Bangladesh, China, India, the Philippines, Thailand and Vietnam from 15 October 2005 to 14 February 2006. The aim was to assess the economic implications and reasons for adopting various feeding practices. The book starts with a synthesis of the case studies by the editor and Walfredo R Rola, University of Los Banos, Philippines. This gave details on the survey and methodology and description of the farms and respondents in each case study. Three categories of feeding practices were covered; extensive or traditional, semi-intensive and intensive. In each survey, 20 respondents were interviewed for each feeding practice with the exception of India, where forty respondents were interviewed for two feeding practices. The case studies covered the culture of various species of catfish and carps with the exception of the Philippines, where milkfish and marine shrimp farms were surveyed. To study the results on profitability and feeding regimes, cost benefit ratios, break-up prices and break even production were calculated.

The summary on the survey showed some clear patterns such as that 92% of respondents started farming in expectation of large profits. Most (70-80%) share concerns on the high cost of manufactured feeds. Traditional farmers recognised the importance of commercial feeding but the high unit cost and limited technical information has deterred them from buying these feeds. Results did not indicate any clear pattern on feeding and economically sound aquaculture. Nevertheless, data from China, Thailand and Philippines supported that intensified feeding leads to more efficient aquaculture.

The value in this report is also the unique situation in each country and conclusions derived by respective authors. In the case of the study on the feeding strategies in farming Pangasius catfish in Vietnam, Nyugen Thanh Phuong and colleagues, found that a combination of pellets and farm made feeds yield the highest production and that feed cost reached 92% of production costs. They added that the cost to the environment with the use of on farm feeds could not be assessed as the study did not look at parameters such as water quality and stocking density. In Thailand, Pongpat Boonchuwong and colleagues showed that in the culture of the hybrid catfish *Clarias gariepinus* x *C. macrocephalus*, the adoption of commercial feeds has benefitted intensive and semi intensive farms in terms of high yields. They added that feed cost, fingerlings, labour and survival rate were statistically significant to yields.

In aquaculture, the ongoing debate is on merits of using commercial pellets versus farm made feeds and that with food safety and health issues, the former is highly recommended. In general, the report has fulfilled its aim in demonstrating the economics and cost benefits of various feeding strategies and showed the profitability aspects. This is despite the lack of consideration of other factors. Such information is prerequisite in developing feed managements strategies and will be useful for new investors in deciding on the type of culture, aquaculture producers to relook at their feed management strategies, feed producers in feed marketing and lastly, governments at the socio economic issues facing traditional farms and how they can help industry. –Zuridah Merican

International symposium on catfish farming in Asia

Present Status and Challenges for Sustainable Development

5-7 December 2008, Cantho City, Vietnam

In Viet Nam, *Pangasius bocourti (basa)* and *P. hypophthalmus (tra)* have been farmed for 50 years, and their production reached 1.2 millions tonnes in 2007, making these farming practices one of the fastest growing and most important globally. Similarly, catfish farming is becoming increasingly popular in other Asian countries.

Aquaculture continues to contribute increasingly to the global food fish supplies in the global market place. Processed products of Basa and Tra are currently marketed in more than 100 countries. Recognizing the current importance of catfish aquaculture, Can Tho University (CTU) in conjunction with the Network of Aquaculture Centers in Asia-Pacific and the ASEM Aquaculture Platform have announced this international symposium Catfish Aquaculture in Asia.

The symposium will be held in Can Tho City, Viet Nam, 5-7 December 2008. This two day symposium and the follow-up field trip will provide an excellent opportunity for international and local scientists, practitioners and marketing groups to:

- exchange information on the management of catfish culture;
- to share the latest research findings and achievements in catfish culture;
- exchange trading information on catfish; and
- identify future demands and enhance research collaborations for sustainable development on catfish aquaculture.

The session will include a plenary session and presentations covering developments in selected countries, production systems, nutrition and physiology, disease management, genetics and biodiversity, environmental impacts, processing technology, economics and marketing. There will be a special round table and discussion amongst producers, processors, marketers and researchers and a showcase of products of service providers. Early bird registration ends on Oct. 1, 2008.

More information: Prof. Nguyen Thanh Phuong, Can Tho University, Viet Nam, fax: +84 710 830323, email: Web:

What to expect in Aquaculture Asia Pacific Magazine in 2009

Vol 5 2009	Issue 1 January/ February	Issue 2 March/ April	Issue 3 May/ June	Issue 4 July/ August	Issue 5 September/ October	Issue 6 November/ December
Issue focus *current trends & challenges*	**Aqua Feed Production**	**Food Safety**	**Responsible and Sustainable Aquaculture**	**Health Management**	**Cage culture**	**Hatchery Management**
Industry review *with profiles & outlook*	Marine shrimp	Marine fish	Catfish	Freshwater prawn	Tilapia	Offshore cage culture
Shrimp/fish culture and developments	Features best practices and experiences from industry. Coverage on role models, benchmarking and breakthroughs in industry throughout the region					
Feed technology	Feed ingredients Additives	Extrusion technology Moist feeds	Feed regulations/ Organic feeds	Fish meal & oil replacements Novel meals	Feed processing/ Immunostimulants	Nutrition & formulation Larval feeds
Technical contributions	Certification & standards Disease management	Recirculation technology Fish/shrimp breeding programs	Hatchery management Pre and probiotics	Biosecurity Aeration technology	Fish diseases Biotechnology	Risk assessment Pond culture technology
Markets	Reports on opportunities, market trends, regulations and certifications, branding and product development					
Show preview/ issue	Aqua VIV Asia 2009, Bangkok 11-13 March	World Aquaculture 2009, Mexico 19-23 May	Vietfish 2009 Ho Chi Minh City 12-14 June	Asian Pacific Aquaculture TBA	Cage culture Asia TBA	Aquaculture China 2009 TBA

September 28-October 3
15th Annual Practical Short Course on Aquaculture Feed Extrusion, Nutrition and Feed Management
Texas A& M, USA
Email: mnriaz@tamu.edu
Web: www.tamu.edu/extrusion

September 20-24
The 7th Symposium of World's Chinese Scientists on Nutrition and Feeding of Finfish & Shellfish
Beijing, China
Web: www.aquanutrition.net
Email : liuhaiyan@caas.net.cn; wuxiufeng @sina.com

October 12-14
8th International Symposium on Tilapia in Aquaculture
Cairo,Egypt
Web: http://ag.arizona.edu/azaqua/ista/ISTA8/ISTA8.htm

October 23-25
Future Fish Eurasia 2008
Istanbul, Turkey
Web: www.future-fish.com
Email: mario.stael@eurasiafairs.com

November 4-6
13 Annual China Fisheries & Seafood Expo
Qingdao, China
Email: seafoodchina@seafare.com
Web: www.seafare.com

November 6-9
Global Technical and Trade Conference on Shrimp
Guangzhou, China
Email: infish@po.jaring.my
Web: www.infofish.org (See p29)

November 12-14
VII International Fair of Aquaculture and Fisheries
Sinaloa, Mexico
Email: zoila_lopez@aquamarinternacional.com
Web: www. aquamarinternacional.com (See p26)

November 20-23
Aquafair Malaysia 2008
Kuala Lumpur, Malaysia
Web: www.aquafairmalaysia.com (See p40)

November 24-26
IX International Symposium on Aquatic Nutrition
Ensenada, B.C. Mexico
Email: sinaix@cicese.mx

December 5-7
International Symposium on Catfish Farming in Asia
Cantho City, Vietnam
Email: Prof. Nguyen Thanh Phuong : ntphuong@ctu.edu.vn
Fax: 84710 830323
Web: www.ctu.edu.vn/colleges/aquaculture/catfish/ (See p47)

January 21-23
Indaqua 2009
Bhubaneswar, India
E-mail: premchandran@mpeda.nic.in, or bbsmpeda@dataone.in
Web: www.mpeda.com

February 15-18, 2009
Aquaculture America 2009
Seattle, Washington
Email: worldaqua@aol.com
Web: www.was.org

March 11-13, 2009
Aqua VIV Asia 2009
Bangkok, Thailand
Email:anneke.van.rooijen@vnuexhibitions.com;
Web: www.viv.net

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