VOLUME 3 NUMBER 6 NOVEMBER/DECEMBER 2007 MICA(P) 096/10/2007 ISBN 1793-0561

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## Reviews




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Letters may be edited prior to publication

# From the editor

## Review 2007 – Concerns on food safety and quality continues

Throughout the year, attention was on food safety and quality, be it marine fish, freshwater fish/prawn or marine shrimp. In China, the year started well with the end of the ban on turbot previously found to be contaminated with malachite green. This affected 25,000 tonnes of the fish. Later a more significant concern was the alert on specific freshwater fish from China issued by the US Food and Drug Administration (FDA). This brought doubts on quality of products from China. A positive outcome of this was the realization in the US that 'a more effective approach might be to make sure products meet US standards before they leave their countries of origin'.

This 'farm to fork' concept strategy is the way forward but where lies the responsibility? This 'nipping the problem in the bud' surely will help small producers, especially for the more fragmented fish farming industry in Asia. A recent news report said the US will establish new incentives for importers that follow strong safety practices and demonstrate a good track record. Vietnam faced with a major setback when Russia, a major market for the *Pangasius* catfish, stopped imports. In September, VASEP, Vietnam Association of Seafood Exporters and Producers asked the government to define responsibilities. In Vietfish International, they said that enterprises should pay for all costs for assuring hygiene, food safety and quality of their products and that state budgets are for inspections only. It was suggested that fees be based on testing criteria and not on volumes as at present.

In India, Indonesia and Vietnam, as shrimp consignments were rejected by EU markets and Japan, the pressure increased on all stakeholders. This and the concern on long term sustainability were issues addressed at three meetings of stakeholders – Indaqua in February, Indonesian Aquaculture in July and Asian Pacific Aquaculture 2007 in August. It was evident that shrimp farming and the processing industry are important income generators. A World Bank report on improving Indonesia's competitiveness, also said that the revitalization of this industry is crucial for export growth and poverty reduction purposes. The pressure is on how to meet the global demand on certification and traceability and retain markets. It added that the road will be bumpy but the cost of inaction is surely greater. Indonesia is not alone here.

During the year, regional players were astonished at production increases and the penetration to some 80 markets of Vietnam's *Pangasius* catfish within a short span of time. Industry representatives at Catfish 2007 worry about diseases and environmental damages due to the intensity of culture. The goal of one million tonnes set for 2010 will most likely be exceeded this year, according to Dr Nguyen Huu Dzung, at Catfish 2007. In September, producers, buyers and government officials at the Pangasius aquaculture dialogue initiated by WWF, agreed that the main environmental and social issues related to tra and basa culture include excess food and waste products polluting the water, habitat destruction and the diversion of water, and antibiotics and chemicals having unintended consequences for the environment and human health. These have to be addressed urgently.

Nevertheless, the performance of the *Pangasius* catfish is being watched as others in the region want to emulate Vietnam's success too. Its export revenue increased from USD 19.7 million to USD 736.87 million in ten years. Importers and processors are also seeking alternative supply sources. A report by Fiskeriforskning, said that the *Pangasius* is providing tough competition for the white fish from Norway such as cod, saithe and haddock. It would seem that species does not necessarily have any great influence on the consumers' choice when frozen and processed.

If in 2006, feed producers faced escalating prices for fish meal and some raw materials, in 2007 the list has been extended to wheat flour, soybean etc. Low supply of wheat flour saw prices rising by 80%. The feed vs. fuel issue increases as more corn is planted for ethanol production at the expense of wheat, barley and soybean. In Vietnam, prices for tapioca flour also rose. On the other hand, prices of fish have remained stable. Consequently, farmers have to look towards cheaper feeds. The only good news is that fish meal prices have stabilized. The challenge remains how to use plant meals more effectively in such nutrient rich diets as for the shrimp. One possible solution is in extrusion or heat treatment but these come with extra investment costs.

Overall the shrimp industry had expected a difficult 2007 with a pending review on antidumping duties (see news page 4). However, towards the end of 2007, it was the strengthening of regional currencies against the US dollar that showed the threat of an overdependence on the US market. In Thailand, a much stronger baht (from THB 38 in 2006 to the current 31.5) lowered its competitiveness relative to other countries. Industry in Thailand said that an added burden is the requirement for certification from specified organizations such as ACC rather than using the Thai Quality Shrimp certification. Overall, will producers move more into the EU, Australian and other markets which now offer higher prices? What is clear is that countries that can mitigate these currency exchange changes are those with abundant labour and those which can focus on more value added products.

On the positive note, interest in aquaculture business in Asia continues to attract investments from large global companies. Banks, such as Rabobank are expanding offices into Asia. All these are signs that despite setbacks, aquaculture in Asia is attractive.

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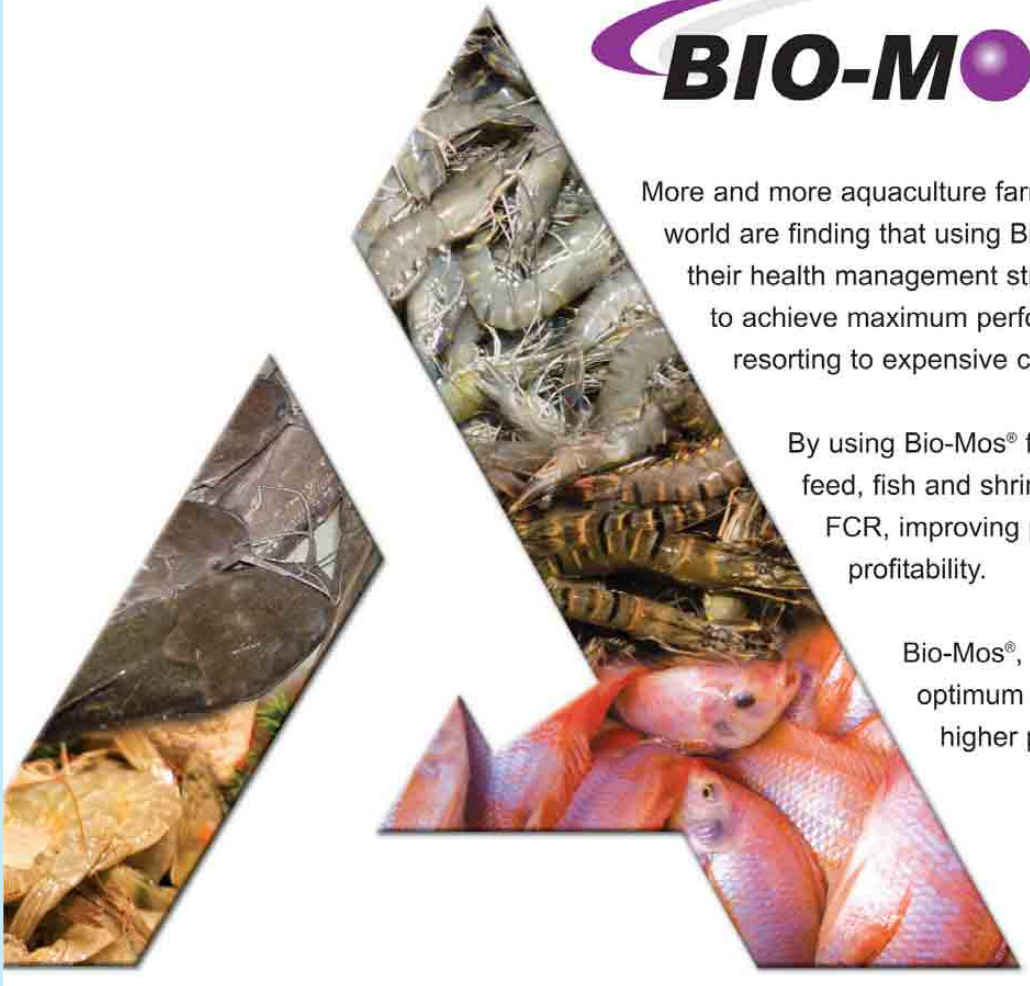

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## US shrimp antidumping

# Annual review benefits India and Brazil

**The US Department of Commerce (DOC) has released its final figures on shrimp anti-dumping duties for the six countries. It has lowered rates for India and Brazil, marginally raising it for Thailand and leaving the duty at the same levels for China and Vietnam.**

In India, it was reported that two companies had duties reduced to 18.83% and 4.38%, one remained unchanged and this helped bring down India's countrywide duty to 7.22% from 10.54% under the initial determination. In a report in WSJ on line, G. Mohan Kumar, chairman of Marine Products Export Development Authority, said the duty falling to less than 5% has put India at an advantageous position.

In the case of Vietnam, two companies will now have zero%, whilst six others will continue with the previous tax rates of 25.76%. In a report in VietNamNet Bridge, the Vietnam Association of Seafood Exporters and Producers VASEP, said that new tax rates would be applied for the companies' imports to the US from August 2003 to January 31, 2006. The rate for the majority of Brazilian exporters fell to 6.96% from as high as 48.13% under the preliminary determination and the countrywide rate for Thailand went up marginally to 4.31% from 4.24%.

## Rabobank

# Seafood from East Asia and Thailand

**The continued growth of East Asia's seafood industry looks set to increase the region's contribution past its current level of 60% of global seafood. This was stated in a report on the East Asia Seafood Industry released by Rabobank International in October.**

Goh Chong Theng, General Manager, Singapore Branch said that East Asia accounts for approximately 55% of global seafood production. The region is also exhibiting the world's highest growth rate of 5% per annum in both wild catch and aquaculture.The region accounts for 42 million tonnes (or 45%) of global wild catch, 43 million tonnes (or 90%) of global aquaculture and 6 million tonnes (or 60%) of the world's freshwater catch.

The report has identified Thailand as having a strong competitive advantage. This is because abundant marine resources, coupled with supportive Government policy, provide a solid foundation for Thailand's seafood industry. In 2006, Thailand's seafood production amounted to nearly 4 million tonnes. Thailand's Department of Foreign Trade has implemented rigorous export procedures that prepare Thai exporters to meet the increasingly stringent food safety and traceability requirements of importing countries, thus avoiding many of the problems faced by other countries in the region. Not only is Thailand one of the largest seafood producers in the world leading the global trade market in shrimp and canned tuna, the average Thai consumes 33 kg of seafood annually. This is relatively high. However, domestic consumption accounts for only half of the country's total production volume. This underscores the importance of trade to Thailand, the world's third largest seafood exporter. Thailand has over 20,000 domestic shrimp farms producing high quality shrimp at competitive prices, making it a global leader in shrimp exports, said Goh.

However, sustainability issues are also compounded by concerns over food safety standards. "Food safety is on the front page and will remain there for some time," said Patrick Vizzone, Regional Head, Asia, Food & Agribusiness, "Seafood is the world's most traded food commodity and one of East Asia's most important exports, so it is naturally the centre of many of the current food safety debates. With this report and our recent conference on seafood sustainability, we feel that Rabobank can provide the leadership to ensure this vital agricultural sector remains healthy for years to come."

The report notes that the most important factor relating to growth in this industry is the increasing awareness of food safety by domestic consumers, especially as their disposable incomes increase. "The booming of up market retail chains and hyper markets in Asia has led to increased scrutiny by consumers to ensure high quality and safe seafood," said Mr Vizzone. "Moreover, metropolitan customers are quickly adopting western standards when it comes to food safety."

## Feed

# DDGS can reduce cost of freshwater fish production

**Scientist at the Agricultural Research Service (ARS) have shown that the ethanol by-product, distiller's dried grains soluble (DDGS) can provide protein for fish feeds at a lower cost than the soybean-corn combinations commonly used.**

This is protein-rich by product that is often used to feed livestock. It is cheaper and more palatable to fish than soybean-corn combinations. However, it lacks some essential amino acids, such as lysine.

In the ARS Aquatic Animal Health Research Unit at Auburn, Alabama, Dr Chhorn Lim and his colleagues are evaluating how diets including DDGS influence growth performance and disease resistance in catfish and tilapia. By feeding fish with diets with 0, 10, 20, 30 or 40% DDGS, they showed that tilapia thrive on feed with up to 20% DDGS. However, by adding supplemental lysine to the feed , the amount of DDGS can be increased to 40%. All feeds had similar levels of energy, protein and fat.

Catfish thrived on feed comprising up to 40% DDGS plus lysine. In addition, they observed that catfish fed diets that included DDGS showed greater resistance to at least one major disease: enteric septicemia of catfish. The catfish fed diets containing DDGS- were more likely to resist infection. Surviving catfish raised on a diet without DDGS had fewer antibodies than those raised on the DDGS feed, particularly fish on the 20%DDGS diet, whose antibodies were significantly higher than those of the control fish.

This work has potential economic benefits for both ethanol and aquaculture. Finding markets for DDGS is essential to economical ethanol production. Substituting soybean-corn combinations with a cheaper protein source could help reduce the cost of fish feed, thereby reducing overall production costs. (Source: USDA Agricultural Research Service).

## Asian seabass *Lates calcarifer*

# Cage culture in ponds in India

**In September, the Rajiv Gandhi Centre for Aquaculture (RGCA), a R&D centre of the Marine Products Export Development Authority (MPEDA), India announced a breakthrough in its culture.**

The fish were reared in cages in pond at their Aquaculture Demonstration Farm, Keezaoduthurai, Karukalacherry, Karaikal, U.T. of Puducherry, South India. The harvest of 12 tonnes/ha was a first for India. It was witnessed by some 200 aqua farmers and entrepreneurs from all regions of India besides fisheries experts and academicians. Also present was Shri. G. Mohan Kumar, Chairman, MPEDA and President of RGCA.

This project is part of the technology development program for marine finfish. RGCA wants to develop commercial farming technology for the seabass. Some 24,000 fingerlings of 10g size were stocked initially in 15 cages of 2 x 2 x 1.3m size in a one ha water area. The fish were segregated periodically based on the biomass in cages, which were maintained at around 20kg/m$^3$. Additional cages were added into the pond to accommodate the growing biomass. At the time of harvest, there were 107 cages. Fish attained an average size of 600g in 6 months with 88% survival. Fish were fed feed imported from Skretting, Australia. FCR was 1:1.25. An important aspect was that production was achieved without the use of any antibiotics/chemicals throughout the culture period.

To date, aquaculture activities in India is confined to the Indian major carps and Chinese carps, marine shrimp and freshwater prawn. It is estimated that the global marine finfish market in the world is valued at more than USD 5 billion but India has not been able to make any headway mainly due to the lack of technology. This successful culture of the seabass in cages in pond demonstrated many advantages such as optimal utilization of unit area and control on feeding and easy maintenance of stock and harvest, according to RGCA. Farmers with freshwater or brackishwater pond can easily adopt this system. The sea bass used in the trial were produced at the RGCA hatchery located Sirkali Taluk, Tamil Nadu. RGCA also said that it can provide practical training on cage culture in ponds at their demonstration farm to disseminate the technology to the prospective farmers.(Related article: Asian seabass culture in India, AquaCulture Asia Pacific, Volume 3 (3), May/June 2007, p32-33)

*Demonstration culture of Asian seabass in cages in pond*

*Harvested seabass*

# Fast growing seabass in Singapore

**Following a three year selective breeding program, Singapore's Marine Aquaculture Centre (MAC) of the Agri-Food and Veterinary Authority (AVA) has produced sea bass fingerlings which are hardy and with faster growth as compared to wild stock. Channel News Asia reported that survival rate can be up to 80%, compared to 50% in the wild. Growth is 15% faster reaching market size of about 500g in less than six months.**

These fingerlings were then tested commercially in cages in a farm off the Riau Islands in Indonesia. Mr Eric Tan, Managing Director of seafood company Marine Harvest, which operates the farm, said that poor fry survival rates often drive the costs of farming up, which in turn have a snowball effect on prices paid by suppliers and customers. He added that the idea is basically to focus on the production cost as opposed to selling it at a very high price. It is also to have a reasonable production cost. The farm is expected to produce up to 100 tonnes of fresh fish monthly, for the next two years. This is about 7% of the demand of 1,500 tonnes/month. Fish from this harvest were sold for SGD 7/kg (USD 4.82/kg)

AVA has also supplied 400,000 fry to fish farms in Singapore and marketable fish were sold to the local market over the past six months. A large-scale marine farm in southern Singapore is also expected by the end of 2007 with a projected production capacity of up to 3,000 tonnes of fish annually by 2008. Next, AVA will replicate this success with the sea bass to other popular fish species such as the red snapper, golden pomfret and cobia. All these are planned to reduce Singapore's reliance on imported fish.

# Brief news

## White shrimp hatcheries in the Visayas

Three accredited white shrimp *Penaeus vannamei* hatcheries have been established in the Visayas, Philippines according to the Daily Star. These are located in Iloilo, Cebu and Bohol and owned by Malou Jamandre, Dodo Allegre and Mar Uy, respectively. According to the Bureau of Fisheries and Aquatic Resources (BFAR), these hatcheries are allowed to import pathogen-free bloodstocks of vannamei only from Honolulu and Florida in the United States. This move is to revive the country's once robust shrimp industry.

## Indonesian seafood meets US standards

After a 10-day inspection of fish ponds and processing units in East Java, North Sumatra and West Nusa Tenggara and examining several fishery laboratories in Jakarta, the US FDA team declared that seafood from the country is safe, reported the Jakarta Post in September. Authorities in Jakarta also said that the FDA advised on how to improve systems for keeping, processing and checking on seafood products to enhance quality. Indonesia was also asked to apply traceability to its products. The US is the largest importer of Indonesian seafood with USD691 million in 2006, followed by Japan and the European Union with USD630 million and USD235 million respectively. Exports to the US increased over the last three years from USD527 million in 2004 and USD591 million in 2005.

## Interest in Brunei's blue shrimp

At the 4th China-Asean Expo in Nanning, China, importers from several countries including China, Italy and France showed keen interest in Brunei's blue shrimp, *Penaeus stylirostris*. In the Brunei Times, Nida A Santiago, Operations Manager, Dua-O-Dua Sdn Bhd said that after establishing export transactions with Taiwan for the past few years, the company hopes to penetrate the Chinese market. The company has 15 ponds totally 30 ha, to produce 2-3 tonnes in each cycle of three months.

The company wants to introduce the blue shrimp species to the Chinese market, offering them a bigger shrimp compared to the common white shrimp species. This is a niche market. Brunei with warmer temperatures has the opportunity to supply shrimp to the Chinese market during the colder season. However, it was clear that there is a need to increase the number of ponds in the sultanate. This is being initiated by the Ministry of Industry and Primary Resources which wants to capture a percentage of the global shrimp market.

## Field guide on animal diseases

NACA and the Australian Department of Agriculture, Fisheries and Forestry (DAFF) have released a field guide, the result of a collaborative activity among a number of fish health experts from various organizations in the Asia-Pacific region. The aim is to improve the ability to diagnose diseases of significance to aquaculture and fisheries in the region. This will be a good reference for fisheries and aquaculture managers, border protection staff, environmentalists, students of aquatic animal health and fisheries management. The regional field guide covers all diseases listed in the Quarterly Aquatic Animal Disease (QAAD) reporting system which includes all OIE listed diseases plus diseases of regional concern. More information at http://library.enaca.org/Health/FieldGuide/index.htm

## WSSV in Taiwan

According to researchers at the National Taiwan University (NTU),their work on genetic analysis have given new insights on the White Spot Syndrome Baculovirus Complex (WSSV). Since 1992, the virus has devastated shrimp culture in Taiwan. The team led by Lo Chu-fang is looking into ways to inoculate shrimp against the virus. In the meantime, they found that during periods of stress, the level of WSSV increases in the shrimp's body at an astonishing rate.

"For instance, we have observed virus levels increasing 100,000-fold during spawning, which is a stressful event. Our research also found that previously the virus was an obscure and largely harmless one affecting certain species of crab", said Lo. She attributed this to the stress on shrimp stocks because local shrimp farmers tend to adopt a very intensive culture approach. This stress could have been the cause of the virus spreading as it did not appear until 1992. Lo's research, which includes the discovery of a way of testing for WSSV, has helped some shrimp producers abroad drastically reduce losses to WSSV from up to 80% to less than 5%.

## Proteins in WSSV

In Singapore, scientists have developed the most detailed list of proteins involved in the White Spot Syndrome virus (WSSV) disease. This work showed how the virus is assembled and how shrimp is infected. They found that the virus is assembled by at least 58 proteins, including 13 that have been reported for the first time. However, how the proteins work together is not known. Their localization in the virus has shed light on some of their functions. This is expected to help determine which ones could be targeted by antiviral drugs. This study led by Dr Choy Leong Hew was reported in the Journal Molecular and Cellular Proteins. (Sciencedaily.com).

## WWF comments on proposed standards for shrimp aquaculture

In its comments on the draft shrimp standards, submitted to GlobalG.A.P. in November, World Wildlife Fund (WWF) said that standards would not be credible because they would not be measurable and would be managed by GlobalG.A.P. instead of an independent and credible third party.

GlobalG.A.P is a private sector body composed of European retailers that sets standards for the certification of agriculture products. WWF also noted that the standards would not be finalized based on consensus from multiple stakeholders. It added that Global Standards proposed by GlobalG.A.P. for certifying shrimp aquaculture products would not reduce or eliminate the key negative environmental and social impacts of shrimp farming.

For similar reasons, WWF also is concerned about standards being developed by Global Aquaculture Alliance (GAA), an industry trade association funded by the shrimp industry. GAA is developing practices for shrimp farmers which they propose as standards. The GAA standards are not being created through a transparent, consensus building process and they are going to be managed by the Aquaculture Certification Council, which is affiliated with GAA and not a neutral third party entity. "To be accepted by consumers and the public as a whole, the standards need to be independently verifiable," said Jose Villalon, director of the Aquaculture Program at WWF. "The standards cannot be created by industry for industry. Also, any standards developed for aquaculture need to address the market demand for farmed fish that is raised without harming the environment or the people working at aquaculture facilities."

Developing standards to address these impacts is a top priority agreed on by key players in aquaculture, including the United Nations Food and Agriculture Organization (FAO), World Bank and WWF.

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Opinion article

# The reality in producing disease free black tiger shrimp seed in India

By S. Chandrasekar

**The issue is the reliance on wild broodstock. Until disease free brood stock is available, there are steps that the grow-out industry can follow to improve production.**

India remains the second largest producer of cultured black tiger shrimp *Penaeus monodon* in the world with an average annual production of about 115,000 tonnes per year. To support grow out production, India produces about 7-8 billion post larvae per year. The country has about 283 shrimp hatcheries with 70% located in the state of Andhra Pradesh. Andhra Pradesh produces about 50,000 tonnes of shrimp annually.

The white spot syndrome virus (WSSV) is the most serious pathogen affecting shrimp production in India. The industry experienced its massive outbreak of WSSV in 1994, although the virus was first detected in December 1992. It continues to cause repeated failures in shrimp farming. Stocking density has been reduced as part of the strategy to combat WSSV. Current stocking density varies between 5 and 7post larve/$m^2$. The reduction in demand for seeds has brought in fierce competition among hatcheries. WSSV is also affecting brood stock. As shrimp hatcheries depend only on the wild broodstock for post larvae production, they are worst affected by the virus. However, the industry is involving major stakeholders to find a solution for the current problems.

## Demand for gravid females

Totally dependent on wild broodstock, the hatcheries are now finding it very difficult to operate economically with the increase in cost of brood stock and the reduction in the price of post larvae (PL). Prices are now 20 paise or INR 200/1000 PL (USD5/1000 PL, September 2007). During extremely low demand, and over production, prices were reported to decrease to as low as 10 paise/PL. The higher cost of broodstock is due to rejections (of shrimps tested positive) based on PCR (polymerase chain reaction) screening for selected viruses, particularly WSSV.

Most hatcheries in India still depend on gravid females. Generally the success rate, in terms of getting a gravid as well as the spawning rate (fecundity and nauplii production) through maturation has been drastically reduced. It is now close to 40%. This has created a huge demand for gravids during the peak seasons. Nauplii production centres play a vital role during the early months of the year when such demand is high. Recently, investigations show higher rates of WSSV infection during December, January and February (Table 1). It follows that screening of brood stock and gravids before and after spawning is crucial.

**Table 1. Prevalence of WSSV infection (%) in wild *Penaeus monodon* broodstock on the east coast of India (Average of data sourced from two disease diagnostic laboratories and two hatcheries based on 25,603 samples in 2006 and 22,339 samples in 2007).**

| | 2007 | 2006 |
|---|---|---|
| January | 35 | 28 |
| February | 36 | 23 |
| March | 19 | 20 |
| April | 8 | 13 |
| May | 7 | 12 |
| June | 25 | 8 |
| July | 17 | 14 |
| August | 16 | 5 |
| September | 5 | 15 |
| October (till 15th) | 10 | 10 |
| November | N/A | 12 |
| December | N/A | 33 |

From the table it is clear that the cooler months of December to March are best avoided if hatcheries want to increase the chances of producing disease-free post larvae at lower prices. This should however be coupled with educating farmers to avoid stocking or lower stocking density during these periods.

## Other diseases

Farmers still depend on the PCR as the only tool for screening of diseases in post larvae in the hatcheries. However, this is not sufficient as intermittent outbreak of WSSV occurs all the time and affects farm production. Farm management and water quality play an important

### Hi health postlarvae by Zuridah Merican

The Hi Health Nauplii Breeding Centre in Neelankarai Beach, run by MPEDA uses only mature brood stock air flown from the Visakhapatnam coast. All undergo tests for WSSV and MBV using PCR and those tested positive are discarded. Fresh feeds such as squid and polychaete worms from natural sources are also screened and tested for diseases, according to Dr Amiya Kumar Panda, Project Manager at the centre.

Spawners are fed for 10 days. The ratio is two females to one male in each spawning tank. In contrast, other hatcheries commonly use one female for each male in each tank. The operational procedures at the centre include daily monitoring of temperature to maintain an optimal 29-30ºC. During the colder months, heaters are used. One of the objectives at the centre is to be able to supply PL from February so that farmers can achieve two cycles of culture per year. In other hatcheries, production shuts down in November to January and begins in February, using only gravid females.

At the centre, eggs are washed and nauplii are sent to two regional hatcheries for nursery to PL15; Tarspac – The Andhra Pradesh Shrimp Seed Production Supply and Research Centre and Ossparc – The Orissa Shrimp Seed Production Supply and Research Centre. On the arrival of the stock, both Tarspac and Ossparc will counter check the disease and physical status of nauplii using in house equipment as well as by sending samples to private laboratories

In general, 20-30% of mature shrimp from the Visakhapatnam coast was found to be infected according to Thampi Sam Raj, Project Director of Rajiv Gandhi Centre for Aquaculture (RGCA), and the infection rate can increase to 50% in December. The centre has identified better quality stock 300km further south which could be attributed to the lower population of ponds.

role in the success of shrimp farming. Loose shell syndrome (LSS) also causes a major problem in India. The problems due to LSS were less severe in 2006 but the shrimp farms were worst affected in early 2007. The etiology of this problem remains unknown, although there are indications that the problem may be due to a pathogen.

Luminescent bacterial infection is a major problem that affects survival in shrimp hatcheries. No approved antibiotic seems to work till date. Indiscriminate use of antibiotics appears to have resulted in the resistance of these pathogens even to the antibiotics that are approved by the government.

## Some solutions

Production of disease free shrimp post larvae requires the involvement of the hatchery operators, the farmers and other stakeholders. Testing of post larvae and screening them for viral pathogen is not sufficient. The average rate of infection detected in post larvae is about 6% whereas the actual rates of infection are higher. The best possible way to minimize the risk is to screen the brood stock and the gravid females (immediately after spawning) for WSSV before the hatcheries stock the nauplii. In such cases, the farmers have to pay a high price for the seedstock.

Efforts need to be made by the shrimp hatchery operators to implement proper bio security measures for improved handling of larvae and to avoid any cross contamination. Stocking in the farms can also be coordinated in a way to stock different farms over a period of time to minimize risk. This will help the farmers (wherever possible) to take advantage of disease free stock that are available during April and May. In addition to this, farmers might also get a good price for their produce if the processors are not swamped with harvested shrimp over a fixed period.

The use of immunostimulants and probiotics is a viable and better alternative to antibiotics and to other chemicals and halogen compounds. In addition to an adequate feeding of artemia to larvae, the enrichment of artemia for improved nutrition makes the larvae stronger especially for stocking in low salinities.

Phage therapy is also looked as a new option especially to control luminescent bacterial infection in hatcheries. This is a process of using a bacterio phage to control the pathogenicity of the target bacteria (bacterio phage is a virus that affect only the particular pathogenic bacteria). Once attached, the bacterio phage injects the DNA into the bacteria and start multiplying inside the host cell. (eg. *Vibrio harveyi* which causes luminescence). After multiplication into the host cell, they burst open the host cell killing the pathogenic bacteria. The bacteriophages are environment friendly, non-toxic and do not affect the useful bacteria associated with shrimp larvae. Phage therapy also helps in overcoming the problems associated with biofilm formation by pathogenic bacteria. The usage of antibiotic can be completely stopped.

Initiatives have been taken by government agencies like the Rajiv Gandhi Centre for Aquaculture (RGCA) to produce viral free seedstock through broodstock screening. Perhaps, the proposed projects on producing Specific Pathogen Free broodstock by the Marine Product Export Development Authority (MPEDA) and the National Fisheries Development Board (NFDB) will succeed so that reliance on wild broodstock can be eliminated.

Accreditation of PCR laboratories by reputed government and international agencies will help to minimize the errors in the PCR screening process. Serious thoughts are also given by various farmer associations to duplicate and follow the procedure to establish disease free brood stock of Indian white shrimp followed in the Middle East.

***The time has come for the Indian shrimp farming industry to adapt new practices to be more cost efficient.***

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# A role model for shrimp farming in the North

**Close to North Vietnam's touristic Halong Bay, this marine shrimp farm is recognised as the first to use probiotics to manage water quality as well as farming in a closed environment.**

*Ms Hien (second from right) with staff of Uni President, Vietnam and Dr Shahridan Faiez, Malaysia (left).*

*In August, P. vannamei shrimp was harvested at 13-15g per piece.*

BIM Seafood, part of the Halong Investment and Development Company (BIM), is known to be the largest shrimp producer in Vietnam. It has a total farming area of 2,000 ha comprising this 270 ha Minh Thanh Industrial Aquaculture farm in Quang Ninh Province and 1,750 ha in the south. It is integrated with post larvae supplied by its hatchery on Phu Quoc Island, Kien Giang province and a seafood processing plant also in the south. The company's shrimp farming is acknowledged as the model for Vietnam's seafood industry by VASEP – the Vietnam Association of Seafood Exporters & Producers.

Two years ago, the farm in Quang Ninh expanded to the current 240 ponds with sizes of 5,000m$^2$ and 2,500 m$^2$. The culture area is separated into two for the culture of *Penaeus monodon* and *P. vannamei* respectively. Incoming water from the estuary, 2km away is chlorinated and kept in reservoirs of 20ha. These are then channeled to the respective ponds.

Ms Mai Thi Thanh Hien, farm manager and director of BIM Halong said, "Vannamei shrimp is the more profitable crop as the culture period is shorter at three months and we can get two crops per year. We started farming this shrimp only in 2003. The cost of production is around VND 23,000 to 25,000/kg and usually the output is 10-12 tonnes/ha/crop. Although our selling prices are lower than in the south, it is still good. The ex farm price was VND 60,000/kg for 12-15g vannamei shrimp (65-68pcs/kg) in August 2007. Stocking density is 150 postlarvae/m$^2$ and survival rates range from 50-60%".

Ms Hien added that in comparison, prices for monodon shrimp are higher in the north. She quoted 2006 prices at VND 93,000/kg in the north versus VND 90,000/kg in the south. This year, she expects prices to increase to VND 97,000/kg for 35-40 pcs/kg shrimp. However, it takes 5 months to harvest 25g monodon shrimp here in the north.

The production season starts in March and the second crop for vannamei shrimp starts in August. Post larvae of both species are obtained from the hatchery in the south. The journey takes 32 hours.

## It all started with a three way relationship

The foray of Dr Doan Quoc Viet in aquaculture in Vietnam was featured in Vietfish Magazine, issue September/October 2004. It said that when Dr Viet, trained as an engineer in Poland, decided to invest into the seafood industry, he knew that the main hurdle in consistent production of the vannamei shrimp was disease free post larvae. Thus he decided to cooperate with HHA –High Health Aquaculture from Hawaii. The role of HHA was to provide breeding technology whereas his BIM Halong Investment and Development company provided the infrastructure and organisation of the production line. The Quang Ninh provincial government gave a plot of land in Cong Tay Island to build the hatchery, 30 km from the coast. The aquaculture project then continued with farming in 110 ponds in 120 ha of land in Minh Thanh commune. By the end of 2003, the farming areas had extended to 160 ha. Dr Viet said that this required a lot of investment. However, he is glad he has managed to do so. Dr Viet expects to produce 5,500 tonnes of shrimp in 2007.

Post larvae are then kept in tanks for five days before stocking into ponds. Culture stops during the winter months when temperatures drop to 12-15°C. During this time, staff at the farm prepares the ponds for the next season's crop or take their annual holidays.

Currently, the production of monodon shrimp averages 8 tones/ha/crop. In 2005, shrimp growth was slow and the harvests of both shrimp species averaged 5 tonnes/ha. The farm management attributed this to the pond environment and decided to use probiotics. They chose a combination of bacteria based products produced locally with a product imported from Japan. Today, the practice is to add probiotics every 5 days. There has been a significant improvement in output.

Biosecurity within and outside the farm is not a major problem. There are only 5 neighboring farms. However, farm security was a problem. Frequent thefts at the farm have been resolved with a total of 35 security personnel and three dogs.

*At the Asian Pacific Aquaculture conference and trade show in Hanoi (August 5-8), Dr Doan Quoc Viet, Chairman and CEO of BIM (third from left) flanked by his son, Huy Quoc Viet (right) and Jie Cheng Chuang, Uni President Vietnam (left).*

## About BIM and seafood

Halong Investment and Development Company (BIM) is one of the leading private investment companies in Vietnam. It was started in 1994 by Dr Doan Quoc Viet who operated hotel restaurants and trading businesses in Poland. He was also the developer behind the successful Halong Plaza Hotel. It then made investments in Ha Long and other cities. It has gained the rights to develop Phu Quoc Island Tourism Zone. The island is recognized as the most beautiful island of Vietnam. Other ventures include real estate, tourism, salt production, shrimp production and seafood processing. Part of the future investments in Halong will be a seafood processing plant, operational in 2008. Since the end of 2006, BIM has also started the farming of the Pacific oyster in the Halong Bay area and will soon expand its product lines to other species.

In August 2007, Indochina Capital, based in London took up 20% of BIM Seafood. It said that BIM Seafood has developed itself as national flagship company in the processing of seafood products, not only in markets in Vietnam but also globally. In 2008, BIM plans to go public.

*12-15g Penaeus monodon*

Hien said, " In fact, how well the farm does depends on the technical capability and dedication of the staff. Our 20 technicians are trained at college and degree levels. We have 200 workers, each responsible for one ha of ponds. Some of them have been with us for more than 3 years. They are divided into groups to cover 5 ha. Each group works as a team. As the bonus for high production is eventually divided amongst them, the group itself will ensure that all work to improve production".

On overall targets, Hien said production from 60% of the ponds is on target. However, the farm is looking forward to producing larger shrimp. The target for vannamei shrimp is 60-70pcs/kg ie. 14-16g shrimp while for monodon shrimp, the target is 40pcs/kg (25g) to increase profit margins.

"Otherwise the cost of production is still too high", said Hien.

# Focus on aquafeeds in India

**Since commercial shrimp production started, the Indian shrimp feed industry has had its share of ups and downs. However, it still continues to attract local and foreign investment, despite an annual production below installed capacity. Mainly in marine shrimp feed production, the diversification into fish feed production is just beginning as carp farmers intensify farm operations. Based on information from industry, below are recent developments in the sector. By Zuridah Merican**

## Shrimp feed: A tough yet moving industry

### History

The developments in India's shrimp feed industry can be divided into several phases. The pioneering feed producers in India were subsidiaries of foreign companies or local companies working in collaboration with Taiwanese or Japanese companies which were experts in black tiger shrimp culture and feed production in the 1980's. In 1992, Higashimaru Feeds (India) started its shrimp feed factory in Cochin collaborating with Higashimaru of Japan. Local animal feed producer Hindustani Lever divested into shrimp and fish feeds in 1991-92.

Later corporate India entered the industry. The Waterbase Ltd started a factory in 1993 working with Luxe International of Taiwan. Avanti started in 1994 with Pingtai Enterprises of Taiwan. Godrej Agrovet entered with a feed mill in Vijayawada in 1995. By 1995, shrimp production peaked to 85,000 tonnes with an expansion of culture area and the estimate of feeds used was 120,000 tonnes (Vasudevan, 2006). CP Aquaculture (India) started a factory in Chennai in mid 1996. During this growth phase, some 50 feed mills were poultry and rice millers diversifying to shrimp feed. After 1996, only 20 survived after consolidation (Vasudevan, 2002).

From 1999, new mills continued to be built and joint ventures and strategic alliances formed. Godrej Agrovet expanded capacity with another feed mill in Chennai in 2000. Grobest Corporation (India) started local production in 2002. Avanti Feeds Ltd formed a joint venture with Thai Union Feedmill Ltd of Thailand in 2003 to produced the latter's flagship feeds in India. In 2004, Cargill started a technology service agreement with Matrix Sciences India to produce 20,000 tonnes of feeds through Cargill Matrix Pvt Ltd. By 2006, CP Aquaculture (India) has an additional factory and a new company Bharat Luxindo of Indonesia entered the market with a mill in Vijayawanda.


*Interests in shrimp and feeds at Indaqua 2007*

In 2006, the JV Godrej Gold Coin Aquafeed Limited (GGCAL), with 51% shareholding by Gold Coin Group, Hong Kong and 49% by Godrej Agrovet Ltd consolidated the aquafeed business of both companies (see box). Earlier in 2005, the acquisition of the shrimp feed marketing business of Higashimaru Feeds through a subsidiary made Godrej Agrovet, number 2 in Indian's shrimp business, according to the company's financial report. The market leader is CP Aquaculture India with more than 50% of market share (pers comm.).

Currently, the total capacity of the top 7 shrimp feed producers is estimated at 300,000 tpy with the largest total installed capacity at 100,000 tpy and the smallest at 20,000 tpy.

### Some market trends

Feed marketing by the top companies up to 2005 was summarized by the late Dr Vasudevan (2006). He highlighted the preference for some brands, which were available either nationwide or in selected states (see table). The choice of feeds was as follows: brand name> price> recommendation of farmers or agencies> payment terms and ease of availability. The first technical criterion was growth, followed by water stability. The main selling points of the top three brands were feed quality, good network of support services well trained in all technical matters, laboratory support and strong marketing strategy such as top management interacting closely with farmers. There is a common pricing among local feed companies. Shrimp feed prices in early 2007 was INR50/kg whilst premium brands may cost around INR63/kg. Prices for scampi (freshwater prawn) feeds ranged from INR 24-34/kg. Differences in prices are usually due to state taxes and transport costs. Feed is sold through distributors and direct to farms. Generally, feed companies quoted feed conversion ratios from 1.4:1 to 1.7:1.

### Recent developments in shrimp production

At the last meeting of the Society of Aquaculture Professionals in September 2007, Udaya Ram Jothy gave the scenario of the farmed shrimp industry in India in 2006. He said that both shrimp and scampi sectors continued to face hurdles at the hatchery and production levels. This was due to the limited availability of good quality broodstock and high incidence of WSSV during production. Farmed shrimp production increased in Tamil Nadu, 'Andhra Pradesh' and Orissa whereas Kerala and West Bengal decreased production by 48% and 28% respectively. More than 200% increase in yield from 923 kg/ha to 2,875 kg/ha was recorded for Karnataka in 2006. The increase was only 15% for yields in Tamil Nadu. Production increased marginally to 115,700 tonnes as compared to 112,000 tonnes in 2005.

In Andhra Pradesh, harvests were down to 62,000 tonnes in 2006-2007 (Fishing Chimes, 2007) as some farmers left shrimp farming because of stringent market regulations, antibiotic residues, persistant diseases and low prices. Scampi production also declined to 24,000 tonnes in 2006-2007. In 2006, several shrimp consignments from Andhra Pradesh to the EU were rejected. Currently, the price for 40

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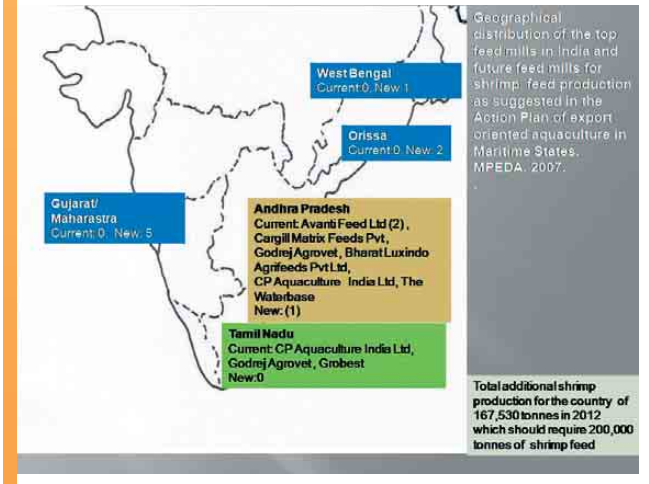
**The choice of brands from the top shrimp and scampi feed producers in India**

| Company | Feedmills | Brands | | | | | Area of coverage |
|---|---|---|---|---|---|---|---|
| | | Shrimp Feeds* | | | | Scampi Feeds | |
| | | % CP >42 | % CP 40-41 | % CP 38-39 | % 37 and less | | |
| CP Aquaculture India Ltd | Chennai, TN Visakhapatanam, AP | | Bintang | Marine Nova CP | Irawan | Speed Perfect | All maritime states, Sri Lanka, Bangladesh |
| Godrej Gold Coin Aquafeed Limited (GGCAL) | Chennai, TN Vijayawada, AP | | Supreme | New tigris, Super tiger, Hositho, Classic | Essence | | WB, OR, TN, KE, KN, GU, MA, Goa & Diu |
| Cargill Matrix Feeds Pvt | Rajahmundry, East Godavari, AP | | Legend | Shrimp Monodon | Ultimax | | TN, AP |
| The Waterbase Ltd | Nellore, AP | Nellore, AP High Gain booster (43%CP) | Tiger Bay Wave, Ultra XL | | | Magnum, Alpha | KE, KN, TN & AP |
| Avanti Feed Ltd | Kovvur and Vemuluru, West Godavari, AP | | Titan (with Pingtai) | Champ, Classic, Vicktor (with Pingtai) | | | AP, TN, OR, GU,KE, WB, MA, WB |
| | | | Prostar (with TUF) | Profeed, (with TUF) | | Scampro | |
| Grobest Feeds corp. (India) Ltd | Chennai, TN | | Grobest, Leader Smart | | Ecobest -36% | Scampi | coastal AP, TN OR,KE, KN, GU & KO, Sri Lanka, Bangladesh, Middle East & Africa. |
| Bharat Luxindo Agrifeeds Pvt Ltd | Palakol, West Godavari, AP | | | Gro Max | Pyramid (26-28% CP) | | AP |

** %CP for Ist grower pellets , AP- Andhra Pradesh, TN-Tamil Nadu, OR-Orissa, KE-Kerala, KN-Karnataka, GU-Gujarat, KO-Konkan, MA-Maharastra, WB-West Bengal. Sources: (Vasudevan, 2005; Industry sources and web sites)*





count shrimp is INR190/kg and INR 230/kg for larger shrimp as compared to INR 316/kg in 2005. Also affecting producers is the strengthening of the Rupee against the US dollar.

## Impact on shrimp feed production

As a consequence of the issues facing industry, Udaya Ram Jothy said that feed sales in 2006 was lower at 135,000 tonnes. In 2007, shrimp feed sales is expected to further decline. An earlier estimate by industry was 165,000 to 190,000 tonnes in 2006 and a rise to 210,000 tonnes in 2007. High fish meal prices forced increases in shrimp feed whilst the implementation of VAT had a moderate impact on prices. The worry is that demand has now shifted to lower quality feeds at lower costs. This will have its consequences on pond and soil conditions and on product quality.

## Future growth

Farmed shrimp is an important export oriented industry and its future growth will be through the expansion of culture areas in the maritime states. Together with an additional production volume of 167,000 tonnes by year 2012, it is envisaged that new shrimp feed mills in the vicinity of culture areas will be required (see map). In the case of scampi, the target additional production is 68,000 tonnes by 2012 and feed volumes of 100,000 tonnes will be required.

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# Synergies within the Godrej Gold Coin Aquafeed Ltd

**In 2006, Godrej Agrovet Ltd, formed a joint venture with the Gold Coin Group to produce and market the Gold Coin brands of feeds in India. Below Viney Vatal, General Manager, explains the benefits of such a JV for both parties.**

*Viney Vatal*

"We are looking at a symbiotic relationship through the JV whereby all the stakeholders stand to gain. The association with Gold Coin will enhance the brand image of our aqua feed through transfer of technology. Gold Coin will benefit with the local manufacturing facility, the distribution network and the support of the field force of Godrej. We expect the maximum benefit to flow to the aqua farmer in India, who will benefit from the technical excellence of Gold Coin and the virtues of customer service and distribution of the Godrej Group".

He added that it will be interesting to see this JV through the eyes of the shrimp farmer in India and his expectations.

"The average Indian farmer expects stable performance from a reasonably priced feed. They expect the best of both the worlds - the performance levels of a technology leader and the economy prices of a feed manufactured in India. Incidentally, the slogan for our JV – "the best of two worlds" – also emphasises this. It is important to offer high levels of service, have a dedicated bunch of trained manpower, and put in place a distribution network with a good reach".

"The duty of a responsible feed company, in time of such crises, is to provide quality feed that helps the farmer reap good harvests at a low cost of production. The FCR of our JV feed has been very economical and is among the best in the market".

"The average Indian farmer also needs constant technical support. As a feed manufacturer, our strategy is to delight him with a mix of consistent feed performance and persistent technical support. Using Gold Coin's global experience and bargaining power in sourcing the best quality raw material at the lowest possible prices, we shall be able to offer the highest value for the farmer's money. On the strategy front, we still need to do some rationalisation on the number of brands so that there is a stronger attachment between the brands and the company. Of course, to help the farmers tide over the inconsistencies in the shrimp prices, we shall keep a close watch on the FCR our farmers get with our feed".

### *On market share....*

"We look at market share as a function of the acceptance of the product in terms of its performance, placing (distribution) and pricing. For the first few years of our existence, we will not stress too much on the market share percentage figures *per se*. We would be looking at building a base of delighted farmers and a set of contented dealers. The significance of word of mouth publicity in agri-related business can never be over-emphasised. We would expect our initial set of farmers to bring their friends and neighbours to our fold through influential opinion and thus multiply the base for the succeeding year".

### *What about the consolidation of brands?*

"The success of any JV depends on the level of integration achieved by the partners among themselves. The initial task, as you asked rightly, is not to compete with the competitors in the market, but to make sure that the new team members who have come from three different companies and three different cultures are able to dream, design and deliver together as a team. To facilitate this, we have drawn up teams not on the basis of their former companies but on the basis of their geographical presence. Thus, sales and technical staff belonging to a particular region will promote the brands of all the three companies in that region".

### *Will fish feeds be next?*

"We have done a test marketing of extruded fish feed aimed at the Indian carps. The results have been quite encouraging. We definitely have plans to enter this segment in a big way. It's too early for me to comment on the date and the entry strategy".


*GGCAL displayed its new feedbags at Indaqua 2007*

# Changing times with fish feeds

**Freshwater fish farming is moving towards more intensive systems which requires the use of commercially produced extruded or pelleted feeds.**

*Extruded fish feeds and feeding (pictures courtesy of SIA/ASA-IM).*

In world aquaculture, India stands next to China in the production of carps and other freshwater fish. In 2005, the production of freshwater fish totaled 2.65 million in 2005 in India (Fishstat Plus, 2007) as compared to 16.9 million tonnes produced in China. Some 40% of production in India, comprise the Indian carp *Catla catla* (1.08 million tonnes), 33% of the rohu *Labeo rohita* (0.9 million tonnes) and 12% silver carp *Hypophthalmichthys molitrix* (0.34 million tonnes) . Also reported in the statistics are the catfish (*Siluriformes*) with a production of 44,000 tonnes which recently rose to 150,000 tonnes of *Pangasius* catfish in 2006. In 2007, production is expected to increase to 250,000 tonnes (pers comm).

Carps and catfish are marketed mainly as fresh fish for domestic consumption. Markets are usually close to production areas. However, fish are transported from Andhra Pradesh, the main production area, to markets in West Bengal. There is also a small export market for the rohu sold as frozen whole fish for the Indian diaspora in the Middle East.

Polyculture of carps is dominant in Andhra Pradesh, Haryana and Punjab states. The average production in extensive systems, which is the major culture system is 2 tonnes/ha/year in polyculture systems with carps. The range for medium intensity systems is usually 4 to 7 tonnes/ha. The output from intensive systems may reach 10-15 tonnes/ha. It was reported that that farmers in Andhra Pradesh with some innovative culture methods revolving around rohu and catla, the most dominant species, have increased yields to 8 tonnes/ha/year (see next article). Multiple stocking and harvests have increased annual yields to 5 tonnes/ha in Punjab. In comparison, intensive culture of carps in China produces 17 tonnes/ha/year to 12 tonnes/ha for medium density culture systems (Nandeesha, 2007).

## Feeds

The low margin carp production in India uses farm made feeds usually comprising a mixture of defatted rice bran and a plant protein such as peanut cake or cottonseed cake, even in intensive systems (Suresh, 2006). Minerals and vitamins are also added. These are placed in perforated bags and hung on poles at specific locations in the ponds. Waste feed combined with organic and inorganic manures add to pond productivity.

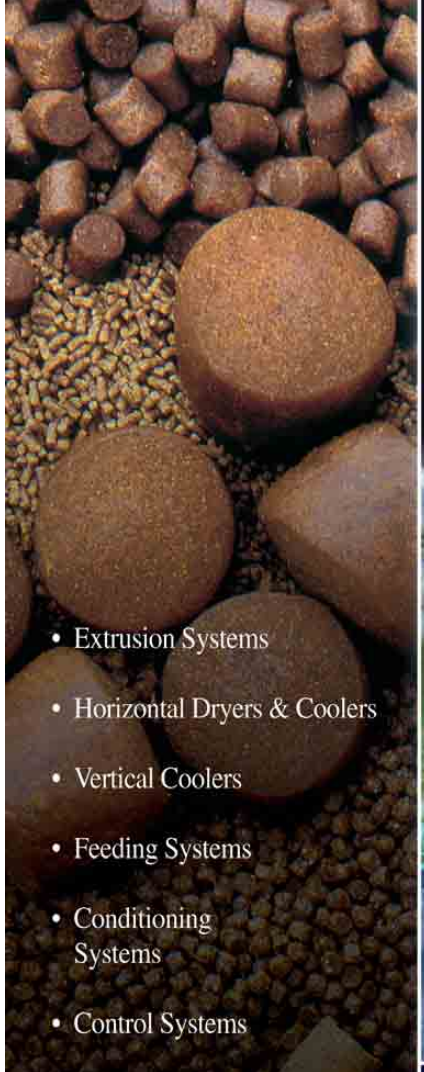
According to Anand (2006), a combination of rice bran (80%), peanut cake (10%) and cotton seed cake (10%) gave a 20% crude protein and 2% fat feed costing USD 0.11 to 0.18/kg, depending on cost of raw material which varies with region and season. This was calculated as less than INR 8.9/kg at the exchange rate in 2006. Generally the feed conversion ratio (FCR) of farm made feeds range from 3:1, 4:1 and 5:1 for the rohu, catfish and snakehead, respectively. FCR is high as the feed in a mash form leaches into the water easily. He added that farmers adjust their production methods and feeding schedules to ensure an acceptable level of income.

It is the generally low ex farm prices and low productivity levels that has limited the use of commercial feeds. The selling prices of these feeds are around INR 26/kg. Prices for the rohu, the most popular carp, range from INR 35 to 40/kg (USD 0.875-1/kg). Recently, ex farm prices for the popular rohu has increased to INR 55/kg (USD 1.37/kg) in local markets. It was pointed out the acceptable price for fish feeds should be in the INR 14-16 range for a FCR of 1.2-1.5:1 for farmers to make a profitable return.

## Pelleted and extruded feeds

In 1997, it was reported that three companies produce fish feeds and production with a total production of 5,000 tonnes per year. Recently, this rose to 10,000 tonnes per year, according to Anand (2006). Since 2006, demand for pelleted and extruded feeds became apparent as farmers see the deterioration of water quality with the use of farm made feeds and with the introduction of more intensive production methods. Usage is still small but the industry has predicted an increase of 20% per month (pers comm.).

Credit for this new development in the sector is given to the Soy-in-Aquaculture Program of the American Soybean Association-International Marketing (SIA/ASA-IM) which proved over the last three years that this feed concept economically works in carp farming (V.Suresh, pers comm.). In 2004 and 2005, the ASA IM through the Soy-in-Aquaculture project carried out several commercial trials feeding carp with soy optimised fish feed. The formula contained soybean meal at 50% and wheat flour at 26.40% and other components such as corn gluten meal, fish oil and



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blood meal. Results were faster growth of fish, higher fish yield of 6.5 tonnes/ha/year and acceptable FCRs with stocking densities at twice that of traditional ponds. It ranged from 1:1.3 for carps. A recent (August 2007) demonstration with *Pangasius* showed the industry that 15 tonnes/ha/175 days could be produced at an FCR of 1:1.1 with fish harvested at 1.6 kg body weight. The feed used here was with 32% protein and 6% fat developed by SIA/ASA-IM (pers comm).

The market has accepted this technology and two large commercial feed producers have started to manufacture extruded feeds. The interest in fish feed production has spread. New and existing feed producers have begun to install extruders, mainly single screw, for the production of floating and sinking feeds. Since mid 2006, five to six extruders have been commissioned. By January 2008, two companies will begin to produce these floating and sinking fish feeds (pers comm.). Some others will use pellet mills for fish feed production as they shift focus away from shrimp feed production.

## Outlook for fish feeds

The Indian market for seafood is opening up fast as purchasing power improves. There has been some progress in the retailing of fish which is expected to increase with the booming middle class. Predictions are that growth of freshwater fish production will be 5% per annum. Consequently, the demand for fish feeds is expected to increase. By 2010, Suresh (pers comm.) said that India will need a minimum of 250,000 tonnes of extruded fish feeds whereas Anand (2006) calculated that if only 10% of the future fish production in 2010 uses commercial feeds, the demand should be 360,000 tonnes at an FCR of 1.5:1.

The requirement is expected to increase further as India is looking at diversification of systems and species. Some of these are the catfish and tilapia with excellent export potential. A recent decision to allow the import of tilapia may pave the way for its culture in India. As tilapia is now cultured along with shrimp worldwide, it will also help improve water quality in ponds improve shrimp size, survival and production. The high yield from tilapia will help meet the country's food security needs. (Business Times, 2007).

Another development which will increase demand for extruded feeds is in the marine fish production sector. Success is in the introduction of sea bass *Lates calcarifer* farming in brackish water ponds and cages (see page 5). Indian scientist are preparing for this as they are also participating in the Integrated Project AquaMax which unites an international team of experts on seafood and nutrition from Europe, India and China. The project will look at a variety of sustainable alternative fish feeds which are vegetable-based and are safer and more sustainable.

On the bearish side, aquafeed producers will continue to work on rising costs of raw materials. Indian farmers can benefit from local supplies of enormous quantities of feed materials derived from crops (see next article). However, prices are competitive. Currently, Indian farmers pay IND 8,000 to 11,000/tonne for deoiled rice bran (USD 205-307/tonne, pers comm). Feed supplements essential for aquaculture feed are also highly taxed at 40%. Recently costs were affected by the increasing value of the rupee against the US dollar. It went up to INR39 (October 2007) as compared to INR45 early in 2007.

**Nevertheless, these new developments form an exciting phase of growth for fish and feed production in the country.**

**The paper is based on information and contributions from Victor Suresh, India and several members from industry.*

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*Members of the Byrraju Foundation, staff from Bharat Luxindo and Yeo (second from right)*

## Hard selling to convince farmers

In 2006, Bharat Luxindo Agrifeeds Pvt Ltd, a company of the Global Aquaculture Indonesia group, started to market its pelleted fish feeds, mainly to the Andhra Pradesh region. According to Yeo Keng Joon, Chairman, the thrust of the activity was to assist rural farmers to enhance their productivity in fish ponds and to participate in the rural transformation spearheaded by the non-profit Byraju Foundation.

"It has involved many hours of hard-selling to convince the small farmers to move away from the traditional method of using deoiled rice bran and groundnut cake and to use pelleted fish feeds. The low prices needed to show the economic benefits meant extremely low margins for us. The benefits to the farmers include faster growth rate, better FCR, healthier looking fish, cleaner pond bottoms and most importantly reducing the environmental pollution caused by the traditional raw materials", said Yeo.

"So far, the company has had positive feedback from the farmers using our feeds. The economics have been helped by the higher price of deoiled rice bran and the higher farm-gate prices for fish cultivated in the last six months".

# Plant derived feedstuff for freshwater aquaculture in India

By P. K. Mukhopadhyay and Gopa Mitra

**In this article, the authors discuss feed management practices in semi-intensive polyculture of carps. The use of by-products of agriculture as inexpensive feed ingredients for farm made feeds is suggested with options on overcoming anti nutritional factors in some of these ingredients.**

Freshwater fish culture in India has emerged as a viable farming enterprise in recent years. Current production has reached 2.9 million tonnes which is 5.5 times the production 15 years ago. It is also viewed as an alternative to declining production from capture fisheries. Today this is based mainly on freshwater cyprinids consisting of 3 major carp species and 3 species of exotic carps.

The sector has an enormous scope for further increase in production through horizontal expansion and higher productivity per unit area with better technology, investments, credit support, entrepreneurship development and strategic planning. The potential of existing water bodies is not yet fully harnessed. If aquaculture production in India is expected to increase quantitatively using better fish culture techniques, the major challenge will be how to ensure a long term sustainable development. From a nutritional perspective, the key factors influencing productivity are quality feed supplying essential nutrients and energy and the right feeding strategy.

India has a broad variety of agro-based by products from about 331 million tonnes of agricultural produce annually. These include cereal grains, pulses, oilseeds, legumes, tuber crops, plantation crops etc. Given the media attention on environmentally friendly production methods, these can provide the required nutritionally rich and inexpensive feed ingredients. There is also a definite need to increase the utilization efficiency of such inputs for economic and ecological reasons.

## Aquaculture practices: ideals versus field experiences

### *The ideal practice*

Semi-intensive culture (with 3 major carps viz catla, rohu and mrigal along with 3 exotic carp species viz, silver carp, common carp and grass carp, table 1) begins with larval rearing in nursery ponds. Fish larvae from the hatchery are stocked at 10 million pcs/ha and attain a body weight of around 130 mg. At this stage, they readily accept formulated feeds immediately after yolk sac absorption.

The feed mixture generally consists of rice polish/rice bran, groundnut oil cake, roasted soybean meal and some fishmeal with occasional use of a mixture of fish/vegetable oil and a premix of vitamins and minerals. This reduces the complete dependence on live food during this early larval stage. Fry are then transferred to rearing ponds where they are stocked at 100,000 fry/ha for about 45 days during which they grow to fingerlings of around 15g each. In the fry rearing stage, an almost similar type of feed as in nursery phase is given, generally by broadcasting in the first month, either in powdered or granular form spread over the pond surface.

During the subsequent period 50% of the required feed is broadcasted and the rest is given in the form of a dough ball placed in a bamboo basket/tray suspended from long bamboo poles. These are sometimes placed within the 3 layers of pond water – upper, middle and bottom for easy access by the different species in the three zones, viz. surface feeders (catla, silver carp), column feeder (rohu and grass carp) and bottom feeders (mrigal and common carp). Fingerlings are then stocked into grow-out production ponds at a density of 5,000 to 10,000 fingerlings/ha. The supplementary feed consists of rice bran, ground nut oil cake, roasted soybean meal, a little fish meal and a vitamin-mineral premix in the form of spaghetti type pellets spread on a bamboo basket. These feeding baskets/trays are placed at 3 to 4 locations in the pond and are monitored closely for feed intake. Feed amounts are adjusted periodically. As a standard practice, feeding is done once in the morning and once in the afternoon.

Table 1. Common polyculture species in a pond.

| | Surface feeders | Column feeders | Bottom feeders |
|---|---|---|---|
| 3 major carps | Catla<br>*Catla catla* | Rohu<br>*Labeo rohita* | Mrigal<br>*Cirrhinus mrigala* |
| 3 exotic carp species | silver carp<br>*Hypophthalmichthys molitrix* | common carp<br>*Cyprinus carpio* | grass carp<br>*Ctenopharyngodon idella* |

*Culture ponds with aeration*

This three tier system for nursery, rearing and grow out production is the recommended practice. Fish production of 3-10 mt/ha/yr may be achieved depending on the levels of inputs such as seed, feed and fertilizers. There is ample evidence that the use of simple techniques such as grinding to reduce feed particle size and compacting (pellets) can improve feed efficiency. Adequate aeration in culture pond contributes to better production and water quality.

### *Real situation*

However, small farmers, who contribute the bulk of production, are not always able to follow the package of practices generally followed in the farm described above. They are constrained by availability of sufficient number of ponds and financial capacity. Many small farmers procure fish seed from local vendors and stock their ponds (often without prior acclimatization to the new environment) with fry (25 mm) or fish larvae (10 mm) instead of fingerlings. This is also due to the lack of nursery and rearing facilities as well as to the lack of sufficient fingerlings. In doing so, they have the tendency to overstock ponds not only in terms of numbers but also in terms of proportions of species. The small farmers also neglect to follow pre-stocking and post-stocking pond management procedures, involving intermittent liming and fertilization.

The most neglected practice is in feeds and feeding. A survey indicated that farmers use nine major ingredients and five feed types. Ingredients are rice bran, groundnut oil cake, cotton seed meal, sunflower meal, soybean meal, mustard oil cake, wheat bran, common salt and mineral mixture. The feed types are rice bran only; rice bran & cotton seed meal; rice bran & groundnut oil cake; rice bran & sunflower meal and rice bran & mustard oil cake.

*Samples of pelleted carp feed*

In general, the tendency is to use a mixture of more rice bran (sometimes with husk only) and less of oil cake, presumably due to costs. The feeding method is broadcasting throughout the year, irrespective of summer or winter months. They are reluctant to use a hand pelletizer although this is not expensive. This results in feed wastage and deterioration of water and sediment quality. It is also common to feed fish when convenient for the farmer. More awareness on the merits of feeding fish to satiation in tune with biological rhythms and an appropriate feed form can help improve production.

However some progressive farmers, in particular those in Andhra Pradesh and West Bengal, are well aware of the development of technologies. They have a strong mindset and entrepreneurship approach and have become capable in transforming freshwater aquaculture into a major economic activity in the region.

These farmers follow a unique practice of raising stunted carp yearlings for stocking in grow-out ponds. Some farmers, who cannot afford to have their own ponds for such purpose, procure fingerlings from nursery farms which raise fry to larger fish varying from 50 to 100 gm for a period of 9-10 months with a restricted feeding regime. After this period of nutritional restriction (or under nutrition), a number of compensatory responses is invoked at the start of re-alimentation in grow out ponds. This results in hyperfagia , rapid weight gain, better feed conversion efficiency compared to that seen in continuously fed fish (normal ones). These farmers thus take advantage of compensatory or catch up growth phenomenon following a period of food deprivation.

Another approach is to stock two carp species, rohu and catla instead of three carp species at a stocking density of 10,000 fish/ha with rohu as the main species. They will then deliberately introduce fingerlings of the snakehead species *Channa striatus* at a stocking density of 500 fish/ha. These serve as scavengers and control aquatic insects and unwanted weed fishes. *Channa striatus* never competes with carp either for food or for basic environmental factors. With regard to feeding the fish in culture ponds, Andhra Pradesh farmers use farm made feeds instead of pelleted feeds. These consist of deoiled rice bran and ground nut oil cake. They also follow the method of traditional demand feeding with perforated nylon bags half immersed and tied to poles.

## Use of plant ingredients

There is a large number of terrestrial agricultural by-products available in India that can be used in aqua feeds. The proximate composition is shown in Table 2. The digestibility values of nutrients/energy have been established for some in carps. Carps have a long intestine (Figure 1) which allows for digestion of a variety of feedstuff and they also have a high amylase activity. The lack of some essential amino acid in certain plant protein sources can be compensated by using a combination of different plant ingredients. Several studies have shown that plant protein sources could be successfully utilized even by the species generally considered as carnivorous.

However, the main concern is the presence of naturally occurring anti-nutritional factors (ANFs) in some oilseeds, legumes, pulses etc.

**Table 2 Proximate composition of selected plant feedstuffs**

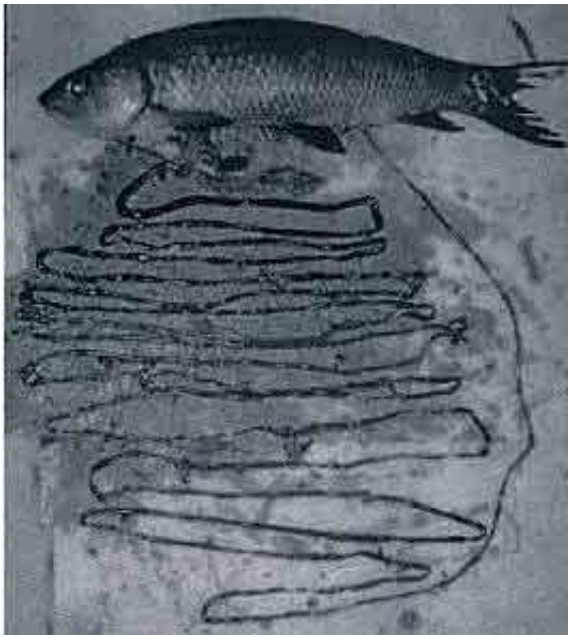
| | Moisture % | Crude protein % | Crude fat % | Crude fibre % | Ash % | NFE % (Nitrogen free extract) |
|---|---|---|---|---|---|---|
| rice bran | 10.0 | 8.0-12.0 | 8.0-10.0 | 12.0-20.0 | 15.0-19.0 | 35.0-40.0 |
| rice polish | 10.0 | 10.0-14.0 | 10.0-16.0 | 8.0-10.0 | 5.0-6.0 | 40.0-45.0 |
| wheat bran | 8.0 | 12.0-14.0 | 2.0-3.0 | 10.0-12.0 | 4.0-6.0 | 50.0-55.0 |
| groundnut cake | 10.0 | 40.0-42.0 | 6.0-8.0 | 10.0-12.0 | 3.0-4.0 | 25.0-28.0 |
| sunflower cake | 9.0 | 30.0-32.0 | 4.0-6.0 | 15.0-20.0 | 5.0-7.0 | 35.0-40.0 |
| mustard cake | 9.0 | 30.0-35.0 | 7.0-9.0 | 10.0-15.0 | 7.0-9.0 | 30.0-35.0 |
| sesame cake | 9.0 | 32.0-36.0 | 7.0-10.0 | 10.0-14.0 | 8.0-10.0 | 20.0-25.0 |
| rapeseed cake | 10.0 | 30.0-35.0 | 2.0-3.0 | 12.0-14.0 | 5.0-7.0 | 30.0-34.0 |
| salseed cake | 9.0 | 8.0-10.0 | 2.0-3.0 | 3.0-5.0 | 8.0-10.0 | 65.0-70.0 |
| cotton seed cake | 8.0 | 35.0-40.0 | 3.0-5.0 | 11.0-13.0 | 6.0-8.0 | 25.0-28.0 |
| rubber seed cake | 9.0 | 30.0-35.0 | 10.0-15.0 | 7.0-8.0 | 8.0-10.0 | 32.0-36.0 |
| copra cake | 12.0 | 20.0-24.0 | 6.0-8.0 | 12.0-14.0 | 5.0-6.0 | 40.0-43.0 |
| soybean cake | 9.0 | 45.0-50.0 | 1.0-2.0 | 8.0-10.0 | 7.0-8.0 | 30.0-35.0 |
| palm kernel cake | 9.0 | 12.0-14.0 | 5.0-7.0 | 25.0-28.0 | 3.0-4.0 | 42.0-46.0 |
| tamarind seed cake | 9.0 | 13.0-15.0 | 6.0-8.0 | 13.0-15.0 | 3.0-4.0 | 60.0-65.0 |
| black gram husk | 9.0 | 24.0-26.0 | 10.0-15.0 | 8.0-10.0 | 4.0-6.0 | 30.0-34.0 |
| green gram husk | 9.0 | 24.0-26.0 | 3.0-5.0 | 5.0-7.0 | 5.0-6.0 | 30.0-35.0 |
| mulberry leaf | 10.0 | 24.0-27.0 | 2.0-4.0 | 10.0-12.0 | 6.0-8.0 | 45.0-48.0 |
| ipomoea leaf | 12.0 | 16.0-20.0 | 2.0-4.0 | 9.0-10.0 | 8.0-10.0 | 45.0-48.0 |
| ipil-ipil (leucaena) | 8.0 | 18.0-21.0 | 4.0-6.0 | 5.0-7.0 | 8.0-9.0 | 48.0-52.0 |

This is the limiting factor in their potential use in aqua feeds. Suitable processing can increase the nutritive value of these ingredients. It can reduce or remove ANFs and thus increase bio-availability of nutrients.

Uncooked seeds of many legumes such as soybean, grass pea, horse gram, black gram, oilseeds like rapeseed, mustard, groundnut, sunflower, sesame, linseed and palm kernel contain ANFs such as trypsin inhibitors, tannin, lectin, saponin, phytate etc. Roasting or heat treatment not only will inactivate these but will also increase nutrient digestibility. However, excessive heat is of course undesirable because of the Millard reaction which can destroy activity of lysine and cystine.

Another processing method is fermentation of legumes which can be used to improve nutritive value and decrease certain ANFs such as phytate and protease inhibitors. Extrusion is another means of processing to improve the nutritive value of legumes primarily. This method is a means of reducing the level of heat-labile ANFs. Thermal processing by extrusion and micronising (infra red heat) is positively correlated to digestibility.

**Figure 1. Digestive tract of the rohu.**



*Rohu*

*Catla*

Approximately two thirds of total phosphorus in oilseed meals or grains is present as phytate, an indigestible form of phosphorus which binds protein, basic amino acids and cations like Zn, Fe, Ca, Mn. Phytase is an enzyme specific to phytate hydrolysis. This enzyme is absent in the digestive tract of fish and even if it is, the amount is normally too small to digest dietary phytate to any significant extent. By applying exogenous phytase to fish feeds (prior to pelletisation) containing oilseed meal or legumes and their by-product meals, discharge of phosphorus into the aquatic environment can be reduced. Commercial phytase is currently available as a feed supplement for fish and other animal feeds. Phosphorus (P) is one of the most expensive minerals that is supplemented in fish feeds. With the use of phytase, the exogenous supply of P and other minerals such as Ca, Mg, Zn, Mn and Fe may be reduced or possibly unnecessary. Moreover, by virtue of the chelating process, supplemental phytase may have protein-sparing effect in feeds by releasing phytate bound protein.

Plant feedstuffs contain non-starch polysaccharides (NSP) such as cellulose, xylans and mannans that reduce the nutritive value of feeds. Intestinal enzymes to digest these carbohydrates are not produced in most fish species. By supplementing NSP degrading enzymes, fibre containing plant materials can be effectively utilized in fish. Dietary use of such enzymes will not only improve nutrient utilisation but also minimize waste excretion in the water.

To improve digestibility of these ingredients, bioconversion by solid state fermentation of the plant ingredients with suitable microbial culture and optimizing the fermentation condition may lead to pre-digestion. This will enhance nutrient utilization from potential feed ingredients. While considering the effectiveness of enzyme applications, one must also take into account the findings that have shown no significant impact of enzyme application.

## Future steps

There is a need for simple regional site-specific databases on the nutritional quality of plant feedstuffs available year-round. This will provide nutritional information (chemical composition, nutrient/energy availability) on a large number of potential ingredients from where the small farmers can choose based on availability, cost etc. Such information will be useful not only for R&D purposes but also feed manufacturers.

The supplementation of fibrolytic or NSP degrading enzymes may allow for an effective use of many feed ingredients. However, a word of caution is that random use of exogenous enzymes without consideration for specific substrate target will not yield the desired result. Hence there is a necessity to evolve substrate specific fibrolytic/ NSP enzymes mixture. The additional advantage of fibrolytic enzymes is their ability to improve water quality by reducing waste emission.

There is a large amount of scientific literature on the merits of eating fish for human health such as the supply of animal protein with high biological value, reduction of cardiovascular aliments due to poly and highly unsaturated fatty acids and supply of vitamins such as cyanobalamine and important mineral elements like Ca, P, Zn, Iodine. It is also known that one can tailor aquaculture product quality through proper application of nutritional principles. Even in a semi-intensive system it is possible to modify the fatty acid composition of fish through feed and thus can ensure supply of adequate long chain n-3 PUFAs for better human health and nutrition.

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# Turbot Farming in China

By Arjen Roem

**The emerging domestic market in China wants imported species such as the salmon but also flatfishes such as turbot, halibut and sole. Seacul Turbot is expanding to meet this demand.**

The turbot (*Psetta maxima*) industry in China is less than a decade old. Turbot culture was initiated around Qingdao in the Shandong Province in Northern China and initially juveniles were imported from France. Within three years, the country became self sufficient in hatchery reared juveniles. In 2002, there were less than 10 hatcheries. Today, there are 10 large size hatcheries producing 10-20 million and over 100 small hatcheries producing 15-30 million in China. Prices decreased from 12 RMB/piece for imported to 1-2 RMB/piece for locally produced juveniles. In the Shandong Province there were more than 1000 indoor farms producing more than 30,000 tonnes in 2006. Market size is typically 0.6-0.7 kg. This made China number one in turbot farming.

Qingdao-based Seacul Turbot is one of the pioneer companies in the culture of turbot. It was established in 2000 by Professor Lei Jilin who succeeded to breed turbot in 1999. Subsequently, he pioneered its culture in indoor tanks in the Shandong Province. Today, turbot culture in indoor tanks is also popular in East Liaoning and in the coastal areas of Hebei and Tianjin. There are even a few farms south in Fujian and Zhejiang Provinces.

While there has been a huge increase in production of turbot according to Kevin Huang of Seacul Turbot, there are still high mortality rates due to diseases. He attributes this to inbreeding as most farms grow locally produced juveniles on to broodstock. Malpigmentation is common, an indication of poor larval nutrition. However, it may be a positive trait as the market seems to prefer light coloured turbot rather the dark (normal) pigmented ones.

Unfortunately, in November 2006, turbot was detected with nitrofuran and chloramphenicol by the Shanghai Food and Drug Administration. Although the reported levels of these antibiotics were not threatening to human health, most of the fish markets, shopping malls, and hotels in China stopped selling turbot following the government warnings. The turbot industry suffered losses after the sales ban was enforced. It was estimated that 50 million fish totalling 25,000 tonnes in Shandong could not be sold. Hundreds of turbot farms went bankrupt. The lowest price for market size live turbot was at one point 5-6 RMB/500 gram, even cheaper than the carp. Consequently, juvenile production and the fish volume in 2007 decreased by 75%. Food safety has become a hot issue in 2007 in China. Wholesalers and retail food markets are now requiring food safety standards and guarantees and the market is moving towards full traceability schemes. Efforts by Seacul Turbot to raise the image of the industry by introducing a 'Quality Label' were well appreciated.

*From left; Kevin is the Import/Export Manager of Qingdao Seacul Turbot, Tie Tecklok is Skretting Sales Manager in East Asia and Ji Wenjuan is a fishfeed expert.*

The market recovered at the end of September 2007. Turbot farmers have stopped the use of the banned antibiotics and the price is normalising to 23 RMB/500 grams. Due to the lack of supply, it is expected that the price will continue to increase towards year end. Furthermore, Kevin said, "We are seeing a current trend towards several other types of flatfish. For some time we have imported juveniles of Summer flounder from the Atlantic coast of the US, for breeding and on-growing. Another species is the Atlantic halibut *Hippoglossus hippoglossus* from Iceland".

Seacul Turbot has expanded its culture facilities to other provinces. Currently, it operates a flatfish hatchery in Ji Mo and a land based farm in Chang Yi in Shandong. More than 500,000 turbot, 300,000 flounder and more than one million black seabass (*Centropristis striata*, a new grouper) fingerlings were produced in 2006. South of Shandong, a farm in Jiangsu Province produces turbot and Chinese sole (*Cynoglossus spp.*) during the summer months. A sea cage farm in Fujian is on-growing black seabass and summer flounder in the winter season.

*Malpigmentation is an issue in domestically-bred stocks in China*

*Land based farm in Changyi*

*Adult turbot in tanks*

*Imported feeds for the turbot*

Turbot Seacul has also teamed up with Skretting, a global fish feed company, to market high quality feeds in North China. Skretting feeds were initially imported from Japan but recently production has shifted to China.

"Producing good turbot feed is not easy as turbot is very sensitive to protein quality and requires an energy dense feed. We are glad that a company as Skretting, market leader in turbot feeds in Europe, has committed itself to produce locally," Kevin said. Other feed companies active in the turbot feed market are Salmofood (Chile), Biomar (Denmark), Grobest (Taiwan) and the local Sheng Suo. Turbot grower feed costs about 12 RMB/kg.

Tie Tecklok, Skretting sales manager for North-East Asia, said, "We are excited to have Seacul Turbot as our distributor. With their expertise in breeding and farming combined with the right nutrition and food safety guarantees, we can support the expanding flatfish industry in China."

At the moment both companies are studying the feasibility for a joint operation in a turbot demonstration centre in Shandong. The centre aims to share best practice with the industry in the fields of farm management, environmental responsibility and fish quality programs.

**Dr. Arjen Roem** has more than 20 years worldwide experience in practical fish nutrition. Currently, he is working as product development manager for the Skretting Asia fish feed activities. Email: arjen.roem@skretting.com

# Workshop "Industry-To-Industry Update"

## Resolving ingredient bottlenecks, a must for sustainable aquaculture

**The demand by farmers for aqua feeds is well known. These must be cost efficient and sustaining high growth and health of the animal throughout the production cycle. The final products need to be safe, attractive and nutritious. Several bottlenecks impede production of cost effective aqua feeds. This is mainly in ingredients to replace or reduce the use of fish meal, a perpetual yet expensive requirement in aqua feeds. The focus for feed formulators is how to move away from this necessity of using fish meal in aqua feeds. The direction was provided during this workshop "'industry to industry updates' organized by INVE Aquaculture, in conjunction with the launch of its feed mill specialty products during Asian Aquaculture 2007, held in Hanoi, Vietnam from 5 to 8 August 2007.**

"Vietnam has in a few years positioned itself among the top producers and exporters of shrimp and catfish. Aquafeed production has expanded very fast despite the recent difficulties encountered in the global feed ingredient markets for fishmeal, plant proteins, vitamins, etc. Vietnamese feed millers do not always have easy access to the information and expertise they need. The program of the workshop is designed to fill in some needs for information on formulation, feed processing and alternative ingredients." said Dr. Peter Coutteau, Manager of INVE Aquafeed Experts – a multidisciplinary team of aquafeed experts supporting the development and customer services of its aquaculture's feedmill sales.

"The idea behind this seminar was to introduce our new product range of feed mill specialties and kick-start the contacts between our customers and our distributor for feed mill products in Vietnam (Asian Chemical Corporation, with offices in HCM and Hanoi) through an event where international experts inform the Vietnamese feed millers about the global ingredient situation." said Rudy Bijnens, commercial manager, Asia.

The program at the workshop included a presentation on the industry in Vietnam, the fish feed and fish oil supply situation and others covering two areas; vegetable and terrestrial based animal by products as alternatives to fish meal and tailoring feeds to growth and health of the animal.


*From left Nisarat, Inve Thailand, Andrew Jackson, Sergio Nates and Lukas Manomaitis*

## Vietnam's aquaculture

In his brief summary on the rapidly expanding industry in Vietnam, **Vo Hoang Nguyen**, Thu Nhan Consulting Co Ltd said that the target for marine shrimp production is 360,000 tonnes by 2010 whereas Pangasius catfish production will exceed 1,000,000 tonnes in 2007. Areas for the farming of the catfish have increased 7 times and exports jumped 36 times from 7,000 tonnes to 286,000 tonnes in 2006. Feeding with farm made feeds continues despite there being 30 feed mills for catfish. Disease such as enteric septicemia and gill fluke infection are being resolved with antibiotics and other parasitic treatments. The industry knows that it has to adopt good aquaculture practices and work towards a sustainable industry. Stakeholders are now self regulating through 'sustainable farming groups'. Vo concluded that there is a quantitative improvement in production, but not qualitatively, which is crucial to maintain export markets.

## The fish meal and fish oil situation

**Dr Andrew Jackson**, Technical Director of the International Fish meal and Fish Oil Organisation (IFFO), said that in 2006, fish oil production remained at one million tonnes but fish meal production dipped to 5 million tonnes from 6 million tonnes in 2004. Based on FAO projections for aquaculture production and using current inclusion rates, the use of fish meal in aqua feeds will reach 4.5 million tonnes and for fish oil, it will be 1 million tonnes by 2012. However, based on the assumption that inclusion rates will decline to 16% in 2010 from the current 19% (2006) for shrimp feeds, 34% from 38% in marine fish feeds, 37% from 40% for eel feeds and 3% from 4% in tilapia feeds, the use of fish meal in these aqua feeds can be reduced to 3.5 million tonnes. He added that with increased substitution, fish oil usage can decline to 800,000 tonnes by 2010. An estimate of global aqua feed production, according to Tacon et al, (2006) will be 32 million tonnes by 2012.

Andrew said that aquaculture has remained a major consumer of fish meal. Globally, it was 45% in 2002 and 57% in 2006, as there were reductions in the use for livestock production. In 2006, the largest user was China importing 979,144 tonnes in 2006. This was lower than the volume of 1.5 million tonnes in 2005 but up to April 2007, it had already imported 434,442 tonnes. The price of FAQ fish meal reached USD 1,500/tonne in 2006 and has declined to USD 800/tonne in 2007.

Predictions of supply have been difficult with natural occurrences such as *El-Nino*. The factors affecting future demand will be price, growth of aquaculture, global pet food production among others. Demand is also influenced by the consumer's perception of the sustainability of both fish meal and fish oil and the growing appreciation of EPA and DHA in diets. The future will see fish meal and fish oil as a strategic ingredient, used for specialty feeds such as for starter, bloodstock, finisher feeds.

Andrew concluded that so far it has been a win-win situation as the industry gets a higher price for this fixed volume for this product with unique value. The farmer has feeds designed to deliver high growth performance and the consumers are assure that the production process is using an ingredient from a well managed and sustainable source. Replacing fish meal

"Fish has the ideal amino acid profile, no anti nutritional factors (ANF), residual health benefits and UGF (unknown growth factors).

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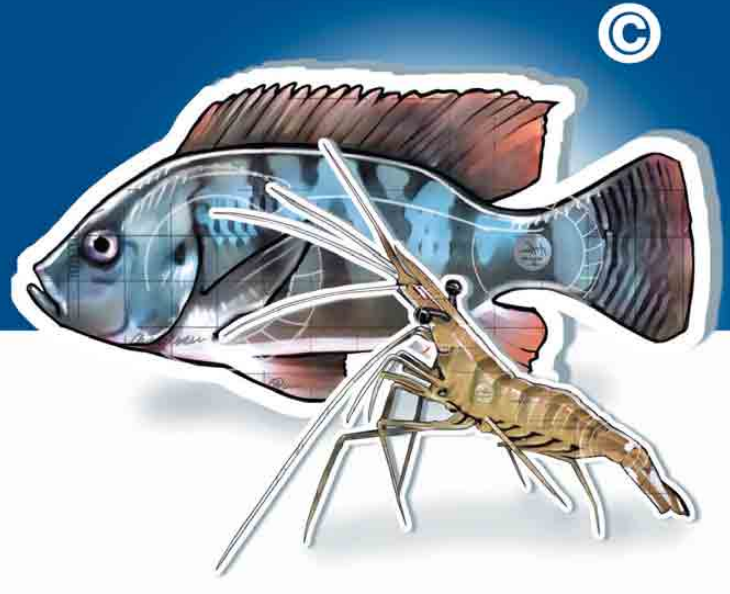

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Scientists in Norway are continuing to decipher the latter. Conversely, the negative aspects of some alternatives such as plant meals are high fibre, ANF, poor growth performance from low palatability and digestibility. There are also issues of genetically modified organism (GM) and perceived risks from products such meat and bone meal. Seeking substitutions has not been easy", said Andrew.


*Dr Peter Coutteau*

**Dr Peter Coutteau** maintained that reduction of marine ingredients in aquafeed formulations have been constrained by the need to keep up feed performance whilst maintaining cost efficiency. Fish meal has so far been one of the most cost-efficient sources of highly digestible protein and energy, besides a range of essential nutrients, for most aquaculture species, but recent market trends and future forecasts on availability show that formulations for carnivorous species will be forced to include less marine ingredients. Yet, nutritional research studies have not looked at cost efficiency, availability, regulations on its use, acceptability to the end user and on product quality and processing costs of substitutes to fish meal. He added that in Europe even if the legislation permits the use of an ingredient, the supermarkets may not accept its use because of perceived health hazards.

Even if ingredients are found to be suitable through nutritional research studies (usually under stable and optimal environmental conditions), they then have to be assessed in terms of economics in commercial farm conditions and throughout the whole production cycle. There are also the interactions between feed quality and other production parameters such as fluctuating environmental conditions.

Some of the nutritional implications of replacing fish meal in shrimp diets are reduced levels of the essential lipids such as cholesterol, n-3 HUFAs and phospholipids. Another implication will be reduced attractiveness and palatability. Peter proposed products such as Aquasterol and Aquaflavour which can improve utilisation of essential lipids and stimulate appetite respectively. For fish, the nutritional complications of reduced levels of fishmeal are very dependent on the species but anti-nutritional factors, reduced palatability and changed kinetics of protein digestibility are important issues. Specific feed supplements are being developed to correct for these problems on as species-specific basis.


*Mr Alexander van Halteren*

Replacing fish meal with plant and terrestrial protein meals is not just at the formulation level. It requires trouble shooting and innovations at the feed mill, said **Mr Alexander van Halteren**, Project Coordinator for INVE Aquafeed Experts. These are at several points during raw material and feed processing. Mill operators, familiar with processing parameters of plant versus marine/animal meals, need to be aware that with plant proteins, they will need to adapt processing parameters. During grinding, ingredients with higher fat content can clog up the hammermill. Pre mixing of macro raw materials can give a better distribution as well as reduce the energy consumption and risk of clogging. Where there is no pre mixer, partial weighing of ingredients is recommended but extra dosing steps will be required. This will reduce capacity. Problems also occur when grinding material with more fibre/hulls such soya, corn, rice bran etc and pre grinding with a sifter is recommended. Grinding coarse materials with more ash is also more enegy consuming. The level of contamination with stones etc is also higher in plant meals. Precautions to protect screens etc are required.

Fish meal contributes to good water stability in comparison to plant protein meals. Plant proteins meals absorb more water than animal proteins. However, with the substitution of fish meal with plant protein meals, water stability could be improved by knowing the differences between the different sources of meals as well as optimizing the grinding, pre and post condition stages. Through such steps, water stability of 80±5% and 95% to specification was obtained in a feed mill in South America. In the extruder, the functional properties of the plant protein will affect expansion ratio. The operator must be aware on how to adjust processing parameters to have the desired floating and sinking effect. The control of sinking behavior can be adjusted with addition of starch or oil. There are several density systems in the market which can be used which according to Alexander have been developed by equipment manufacturers as usually 'plant operators and formulators do not talk to each other'.

Aside from physical appearances, improvements in palatability and attractability can also be done at the feed mill operator level. Alexander said although not commonly done in Asia at the moment, several techniques from the petfeed industry could find interesting applications in aquafeed processing such as the use of external coating with attractants (eg application of powdered attractants in oil coating).

## Ingredients

### *Rendered meals*

Replacing fish meal with either plant or animal protein sources is not just a question of demand, supply and cost but also one related to the use of 2-3.5kg of fish to produce 1 kg of farmed fish and the question of sustainability of aquaculture, according to **Dr Sergio Nates**, President./Director, Fats and Proteins Research Foundation. In developing alternatives, it is important to look at and address issues of concern such safety, nutritional value functional properties, price and most importantly, environmental effects.

The rendering industry is committed to food safety and biosecurity and the nutritional value of animal protein has improved over the last 15 years, contrary to perception. Rendered meals are good sources of protein, amino acids and in particular, taurine. Additionally they are sources of fat, calcium, phosphorus, microminerals and vitamins. Meat and bone meal (MBM) and poultry by products meal (PBM) used in aqua feeds usually contain 55% and 65% crude protein and 10% and 12.4% fat respectively. In comparison with fish meal protein which has 2.31% methionine and cystine, blood meal has 2.32% and soybean meal, only 1.43%. In comparison with menhaden fish meal which has 237 mg/100g of cholesterol, blood meal contain 241 to 407 mg/100g, depending on processing methodology.

Digestibility should be the criteria in determining the suitability of the raw material, similar to that carried ut in the livestock feed formulations. This is what aqua feed formulators should strive for, said Sergio. Crude protein hydrolysed by products such as PBM and MBM, feather meal (FM) and blood meal (BM) are highly digestible and this

vary according to the production process. Spray dried BM has 95% protein digestibility as compared with 64% in drum dried BM. A study showed no significant differences on the attractability and feeding activity of MBM and BM as compared to squid meal and fish meal compositions to *Litopenaeus vannamei*.

## Plant meals

The primary future protein source for aquafeeds will be plant proteins in almost all types of feeds, according to **Mr. Lukas Manomaitis**, Aquaculture and Seafood Consultant of Seafood Consulting Associates (SCA) and the Regional Project Manager for the American Soybean Association International Marketing Program's Soy In Aquaculture Project (ASA-IM SIA). He agreed with Dr Andrew Jackson that the future will see fish meal reserved for specialty applications and high value fish species. Plant meals with global availability, good protein digestibility and complementary nutrient composition such as soybean, corn and other plant meals will increasingly replace fish meal. To some degree, most plant proteins contain some anti nutritional factors that vary with the processing, type and quality of the plant protein. Formulators should keep these concerns in mind so as to source the correct quality and type plant protein for the target species. Some specific concerns are:

- Dehulled soy meal urease activity should be between 0-0.23.
- Cotton seed meal free gossypol should be >0.08% and the maximum inclusion rate 15 to 20%. (It is not recommended for broodstock or shrimp feeds.)
- Only meals from the canola varieties of rapeseed were recommended and these meals should not be used for juvenile fish feeds.
- Peanut meal has a good amino acid profile and high protein, but has high fiber and the potential risk of aflatoxin contamination.

*Soybean meal. Picture courtesy of Bridget Owen, ASA-IM Program*

The main issue of replacing fish meal with plant protein sources is how to ensure the correct amino acid balance as different plant proteins may lack in available methionine, lysine or other amino acids. This can be addressed by formulators combining various plant protein sources, such as using soy meal with corn gluten meal to address the low methionine in soy. ASA-IM trials and demonstration projects over the past 17 years have shown that in freshwater fish diets fish meal could be entirely replaced with plant proteins and in marine diets fishmeal can be dramatically reduced by using plant meals and concentrates. As fish meal price and availability increasingly become factors, least cost formulation will draw in plant protein replacements.

## Ingredients for health maintenance

The mission of the Aquaculture's health division is to develop cost effective health solutions, according to **Dr Patrick Lavens**, Business Development Manager, INVE Aquaculture Health. Some aspects of these do not concern the feed miller but when approached pro-actively, it can result in better security with respect to fish and shrimp production. At the feed mill, it is ingredients such as plant extracts that can produce stronger and healthy animals. Some of the products outlined in his presentation included Sanoguard Aquastim, complete formulas comprising immunostimulants and nutraceuticals for the grow-out of fish and shrimp, and Sanolife Pro, a series of probiotics specifically developed for application via the water or the feed in shrimp farming. Application of probiotics via the feedmill is possible through suspending a highly concentrated probiotic mix (PRO FMC) in oil which is added to the pellet after the cooler by standard coating technology. Increasing documentation from probiont trials with various shrimp species in different regions, indicated better performance, feed intake, FCR, uniformity at harvest and improved pond bottom quality.

## Bottom line

The supply of fish meal will be sufficient to meet the requirement of aqua feeds but it was the escalation in prices over the last two years which demonstrated that the cost implications of using fish meal are too high. However, replacing fish meal with plant or animal meals requires the right selection of nutrient sources and supplements to enhance digestibility and palatability. The selection of which plant meal to use will effect processing parameters. All these indicate that the economics of replacing fish meal with plant and animal meals requires a holistic approach.

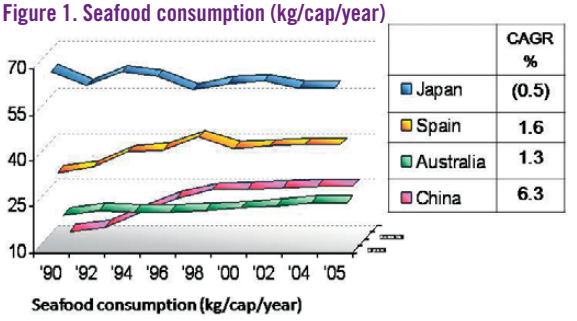
# *Quo Vadis* – Production and markets for farmed white fish in Asia Pacific

By Jacques Gabaudan and Zuridah Merican

**As demand is increasing in the global white fish market, supply will be from white fish alternatives farmed in Asia Pacific, mainly *Pangasius* from Vietnam and tilapia from China. Will the barramundi emerge as the next white fish?**

It has been estimated that the global demand for food fish will increase to 245 million tonnes by 2030 following increases in purchasing power and fish consumption. At a constant consumption pattern, demand will still increase but only to 123 million tonnes. Globally, seafood consumption is increasing with the exception of Japan where the per capita consumption reduced from 69kg/person to 64kg/person. Countries with increasingly higher consumption patterns are Spain, Australia and China. In the US, consumption of seafood increased from 6.7 kg/capita in 2001 to 7.49 kg in 2006. Of this, white fish consumption, i.e of pollock, tilapia, catfish, cod totaled nearly 2 kg/capita (Figure 1)

Figure 1. Seafood consumption (kg/cap/year)



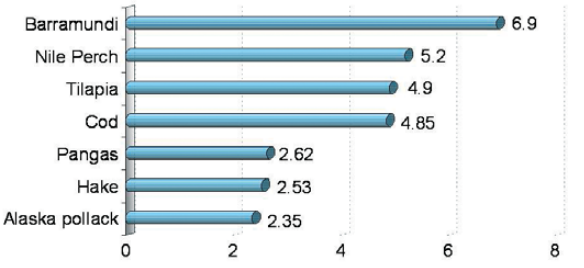

## Global white fish markets

Originally, the global white fish market comprised the hake, hoki, Alaskan pollock, cod, haddock and saithe fished from cold waters. At its peak, supply reached 12.6 million tonnes in 1987 and this declined to 6.5 million tonnes 2004 (Josupeit, 2006). During the same period, Alaskan pollock and cod accounted for 57% and 48% of white fish supply, respectively. Current trends indicated that demand is growing but supply from capture fisheries is declining. The moderately exploited stocks are now only 23% of total stocks as compared to 40% in 1974. Some 52% of stocks are fully exploited in 2005 as compared to 50% in 1974. Fishing is now restricted by governments to revitalize natural resources. The white fish market remains attractive as prices are sometimes three times that of chicken. Substitution with farmed species is increasing to meet demand.

## Farmed alternatives

In 2006, 3.98 million tonnes of fish for the white fish market was farmed cod, barramundi *Lates calcarifer* or Asian seabass, Nile perch, seabass or seabream ,tilapia and pangasius catfish. This rose from 2.80 million tonnes in 2004. Of these, the largest volume was the tilapia at 2.6 million tonnes in 2006 and the smallest was cod at 10,000 tonnes. The largest increase in production was with the *Pangasius* catfish which increased from 40,000 tonnes in 1997 to 825,000 tonnes in 2006. Prices for captured or farmed white fish depend on species.

Figure 2. Fish price Euro/kg in 2005.



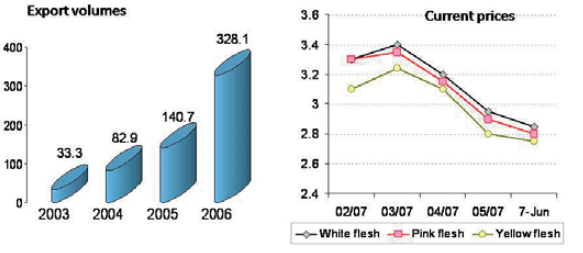

Fish price Euro/kg – 2005 (Globefish Seafood Highlights 2007)

The barramundi has the highest price at Euro 6.9/kg. The lowest price is for the Alaskan pollock at Euro 2.35/kg (Figure 2).

## *Pangasius* catfish

This is Europe's alternative to captured white fish. Vietnam's success in aquaculture is reflected in the exponential increase in production of the *Pangasius* catfish. Current markets number 80 worldwide. Exports have been increasing exponentially since 2003 from 33,300 tonnes to 82,900 tonnes in 2004 to 140,700 tonnes in 2005. In 2006, export volumes rose to 328,100 tonnes with 48% of the export volume going to markets in Europe, followed by Russia (14%). In the Dutch market, the *Pangasius* fish is taking market share away from the more expensive Cape hake from South Africa and Namibia. The hake is priced at Euro 4 whereas Pangasius prices range from Euro 2.20 to Euro 4.00, according to IntraFish. (Figure3)

Figure 3. Export volumes and current prices of *Pangasius*.




Export volumes and current prices of *Pangasius*

Farmed area increased 7 fold but production grew 36 times. Consequently, exports of fillet increased 40 times to 286,000 tonnes. The average productivity has also increased to 90 tonnes/ha from 31.2 tonnes/ha in 1997. The estimation of production is 1.2 million tonnes in 2007. To take into account the non sustainability of farming in cages mainly in the Mekong Delta and more controlled ponds conditions with pond systems, the trend is now towards intensive pond farming and

stocking 60-80 fish/m$^2$. In pond systems, industry has moved towards commercially produced pelleted feeds with FCR of 1.5 to 1.8. This contrasted with farmed made feed frequently used in cage culture with a FCR of 3-4:1 on a wet weight basis. Farm made feeds comprise rice bran, trash fish, fish meal, soybean meal and water hyacinth. Market size of 1 to 1.2kg is achievable in 5-6 months.

However, the view of the Vietnam Association of Seafood Exporters and Producers (VASEP) centres on the side effects of the uncontrollable growth of the industry. The question is not "Can you grow" but "is the growth sustainable?" Thus, the authorities want to improve quality of the catfish in order to get higher export value, rather than try to expand farming scale at any cost. It is also looking at diversification of culture species.

"It wants to implement responsible farming through VietnamGAP , community based governance of the sector, international cooperation for fair trade networking", said Dr Nguyen Huu Dzung, Secretary of VASEP, at a presentation at AquaVison in 2006.

## Tilapia

This fish is well positioned as the alternative to the cod. It has white flesh, mild taste, no bones, low fat, minimal off flavour, reasonable price and year round availability. The large upscale UK supermarket chain Waitrose is looking at tilapia from Zimbabwe as their choice to replace line caught cod, according to John Evans from intrafish

The compound annual growth rate (CAGR) of tilapia was 11.2% since 1995. It is estimated that global production will total 3 million tonnes in 2007 with Asia contributing 78.57% to this production. Of this, China will contribute 48% and Philippines and Indonesia, 8-9%. The export market in the EU is still in its infancy. The US imported 158,300 tonnes of fresh fillets, frozen and whole frozen fish from China, Taiwan and Ecuador in 2006. Demand is increasing in the U.S. Imports surged 28.7% in 2007. For the first half of 2007, imports totaled 88,300 tonnes. China's top export markets were the US, Mexico and Russian Federation.

As *Pangasius* catfish is to Vietnam, tilapia is to China. Production is from family owned ponds and cost of production is low at USD 0.70 to 0.80 USD/kg. Some 80%of production is for the domestic market and exports are mainly frozen whole and fillet. There is a lack of vertical integration and the use of carbon monoxide is an issue. The emphasis on quality assurance programs is now in place. Similar to Pangasius prices in the US which declined from USD 3.4 in March 2007 to USD 2.8/kg in June 2007, tilapia prices dropped to USD1.5/lb in 2007. Tilapia enjoys a strong demand in the US, possibly overtaking imports of ground fish.

## Barramundi

This is the next 'big' fish as production is increasing in Thailand, Taiwan, Malaysia, Indonesia and Australia. The volume reported in 2005 was 30,651 tonnes. Interestingly, the value of barramundi produced in Australia is almost 3 times superior to that produced in other Asian countries.

Today, the markets are mostly domestics but production is going global with farms expanding in US, Holland and UK. New entrants are India and Sri Lanka. The future will be in value added products rather than substituting for traditional white fish (Figure 4 and 5).

**Figure 4. Barramundi- is this the next big fish.**

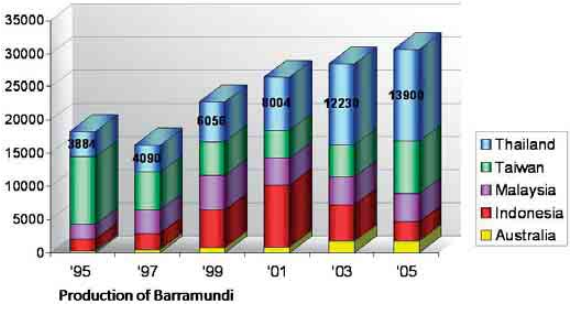
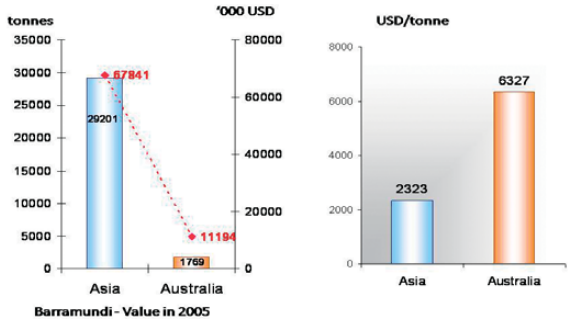



**Figure 5. Barramundi value 2005.**




## Bottom line

A reliable supply base of white fish is essential for the fish processing industry to supply consumers with the products they want. As seafood producers turn to alternatives to dwindling white fish from capture fisheries, farmed fish from the Asia Pacific region are the choice. However, consumers demand safe and healthy products, traceability is important to bring greater confidence along the supply chain. The other issue is sustainable production methods. This is no longer a choice but a prerequisite to market access.

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# Understanding the role of special microbes in shrimp culture

By David J Drahos

**In intensive farming of shrimp, the growth of naturally occurring microorganisms may be too slow to be effective in maintaining healthy pond conditions. A number of powerful microbial tools are now available to the shrimp farmer that can provide a proven, natural, organic means to solve specific problems and insure optimal growth of shrimp. How these work is explained in this article.**

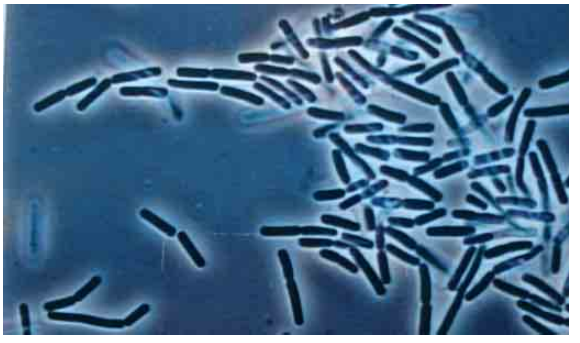
Microorganisms have always played an integral role in all environmental cycles such as in the carbon, nitrogen, sulfur and phosphorus cycles. They are also naturally present in the pond environment and are vital in maintaining a healthy pond ecology. However, in the current scenario of intensive farming increased organic loads in the pond, the naturally occurring microorganisms are often slow to reach an effective population density or may be out-competed by pathogens. Now, their activity can be augmented by the use of carefully selected, highly concentrated microbes with specialized activity.

Recent advances have identified such novel strains with strong confirmation of field activity. Practical and beneficial applications are being realized from diverse types of microbes, including the more common heterotrophs (Bacillus), the less common types such as chemolithotrophs (nitrifiers) and anaerobic $H_2S$ oxidizers (*Paracoccus*). Some bacterial strains have been demonstrated to be effective in establishing shrimp gut microflora, especially when provided in the early larval stages.

This appears to result in the competitive exclusion of detrimental pathogens such as *Vibrio* and *Aeoromonas*. More importantly, a more complete understanding of the mechanism for strain activity has allowed for much greater accuracy and predictability.

## Preventing algal blooms

Heterotrophic Bacillus grow rapidly and are highly competitive for nutrients in the pond environment. They have been used in the past to remove excess ammonia and nitrate, particularly when additional sugar or short-chain carbohydrates are provided along with the Bacillus. However, the added sugar can result in a very rapid growth of the Bacillus strains but causing significant oxygen depletion and detrimental effects on the shrimp.



*Selected beneficial bacteria in PondPlus® growing in pond water*

With high levels of heterotrophs, water can become too cloudy and brown-colored. As a result, light penetration may be very limited, impacting light-dependent phytoplankton and causing a reduction in their phototrophic oxygen evolution. This brings about a dramatic decrease in dissolved oxygen (DO) in the pond. In addition, the larger population of phytoplankton can begin to die, resulting in a build up of bottom sludge.

Newer Bacillus products, however, have been developed which without added sugar are able to grow at a much more controlled rate. These strains use an array of rare enzymes to slowly but effectively break down the more complex carbohydrates and proteins and by using some of the excess nitrate in the water.

A group of seven diverse and highly effective Bacillus strains such as in PondPlus® (Novozymes,USA) has been shown to grow efficiently under a wide range of salinity and temperature conditions and which produce a spectrum of complex enzymes. The result is a much better balance between the heterotrophs and the phytoplankton. It prevents a nitrate-driven bloom and crash cycle as well as bottom sludge build-up. A more steady elevated oxygen level is achieved. Over the course of the grow-out, the pond bottom remains cleaner, a healthy balanced green color is maintained. The shrimp in such a pond are much more feed-efficient and often the growing period can be extended to greatly improve shrimp size, yield and value.

*Unbalanced pond with high amount of native heterotrophs*

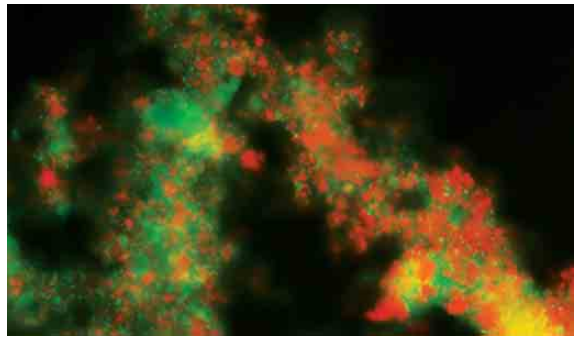
*Balanced pond with PondPlus® strains*

## Ammonia-nitrogen reduction

Ammonia and nitrite increases are often observed even in the best managed pond. As healthy shrimp grow, they naturally release ammonia from their gills. Ammonia nitrogen ($NH_3$-N) can easily build up to levels which are very toxic to shrimp even in brackish water or full sea water and at pH levels as low as 7.4. Certain microbes called "nitrifiers" are able to use ammonia ($NH_3$) for energy and oxidize it to nitrite ($NO_2$), which is also quite toxic to shrimp. A second group of nitrifiers are able to oxidize the nitrite ($NO_2$) to the much less toxic nitrate ($NO_3$) form.

However, growth of these nitrifying bacteria is much slower than the heterotrophs. They take a longer time to respond to increasing ammonia or nitrite levels by turning on their critical genes and finally reducing the $NH_3$ and the $NO_2$. Native nitrifiers, even though they are present in small numbers in most shrimp ponds, take considerable time to "wake up" and cleanse the water. The result can be highly damaging "spikes" or increases which often permanently limit the overall growth and yield potential of the shrimp.

Furthermore, nitrite spikes often occur early in the grow-out period, debilitating the young shrimp and leaving them far more vulnerable to



*Nitrifier bacterial consortium in PondProtect. The red tagged cells are $NH_3$-oxidizers, green tagged cells are $NO_2$-oxidizers.*

disease. This becomes most evident later in the shrimp growth period (85-95 days of culture) when their best potential to rapidly increase their size, weight, and overall value is stunted or lost entirely. Some new nitrification strain products have recently shown excellent field results in providing consistent, stable and effective ammonia and nitrite control.

In the past, liquid or dry forms of such nitrifiers were very unstable, had very low activity, or often only contained the type of strains able to help with ammonia but did nothing to reduce the deadly nitrite spikes when they occurred. A new nitrifier product, PondProtect®, has been introduced in a dry and highly active form which is stable for a least a year under standard farm storage conditions. New molecular tracking tools, such as real-time PCR (polymerase chain reaction) show that these nitrifiers are rapidly dispersed from the dry carrier. They become highly active throughout the commercial ponds within 2 days. Presence of these nitrification strains are directly correlated with significant ammonia and nitrite reduction and yield increase.

## Combating build-up of $H_2S$

A third problem affecting even the most experienced shrimp farmers is the build-up of hydrogen sulfide ($H_2S$) near the pond bottom. As bottom sludge builds up during later stages of grow-out, anaerobic (low oxygen) zones develop where sulfate reducing bacteria (SRB) use nitrate in the water to convert the natural sulfate in seawater to $H_2S$. Hydrogen sulfide is highly toxic to shrimp and it is also volatile. As it begins to slowly bubble into the lower water zone, the sensitive shrimp are greatly irritated and can even start swimming to the pond surface or edges. Their feeding is reduced and they become more susceptible to diseases.

A novel bacterial strain of *Paracoccus* has been found which can be delivered on a special dry carrier (PondDtox®) to the pond bottom, where it becomes incorporated into the anaerobic sludge zone. There it very effectively uses nitrate ($NO_3$) as an electron acceptor and oxidizes $H_2S$ to harmless forms, while at the same time suppressing the SRB strains present. The result seen in replicated, controlled field studies is higher yield, greater shrimp value (size) and a lower feed conversion ratio (FCR). The *Paracoccus* strain in PondDtox would work well with nitrate pond additives, such as described by Boyd, et al. (Aqua Culture AsiaPacific 2007, 3:27-28)

*Paracoccus pantotrophus in PondDtox for hydrogen sulphide removal*

## Building up resistance from bacterial diseases

Finally, disease is a seemingly never-ending plague of shrimp farmers. Certain bacterial diseases, such as Vibrio and *Aeromonas* are notorious in limiting the yield of even a very effective shrimp farmer. Even for SPF (Specific pathogen free) post larvae, bacterial disease microbes can be an on-going challenge, especially when shrimp are stressed.

It has been determined that the addition of certain Bacillus strains in hatchery water early during larval development, may work to limit the impact of a later challenge by *Vibrio* bacteria. It is has been proposed that such Bacillus strains form active beneficial biofilms on the gut of the shrimp larvae which, once established, compete against the later invasion by the pathogenic strains. Such post larvae have a much higher chance of resisting the later challenge by *Vibrio* and other bacterial pathogens even during grow out in the pond.

In conclusion, these are the powerful microbial tools now available to the shrimp farmer to provide a proven, natural, organic means to solve specific problems and insure optimal growth and value potentials. As chemical and antibiotic treatments become less acceptable, the successful shrimp farmer can today reap the strong benefits of biotechnology and generate healthy shrimp ponds along with consistent yield and value.

*Vibrio Test plate*

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This article with the title "Specialised microbes for effective shrimp ponds" was presented at Indonesian Aquaculture 2007, 30 July-2 August 2007, Bali Indonesia.

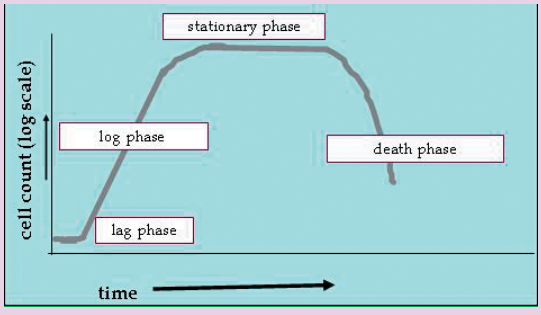
# Biological treatment vs chemical treatment

### The importance of understanding the 'waiting period' in biological treatment

Biological products such as microbes are living organisms which are used industrially to perform a certain activity. A frequently used parameter to compare the efficiency of a biological product with a chemical product is the speed of activity.

It is important to understand that when a biological product is introduced in the environment, there is a lag phase or a "waiting period" of several days before the microorganisms begin full activity. During this phase, the microbes sense the substrate, produce enzymes, begin metabolism and start to grow. It is only when they enter the exponential phase or the "growth period" do the cells start dividing rapidly and the population mass of the microbial product increases and takes effect. After this phase of exponential growth, the biological product has a sustained activity over a period of time which is called the stationary or maturity phase. Finally the biological product stops cell division, cells die and product activity declines.

Compared with biological products, most chemical products show their effect almost instantaneously. There is there is no waiting period. They reach the peak of their activity in a short period and then are completely consumed in the chemical reaction. The action of chemical treatment is rapid but short lived. There is no sustained effect. Besides the short term effect, another limitation of most




chemical treatments is the formation of by-products or traces in the aquatic animal or pond environment. Judicious and appropriate use of chemical treatments is therefore necessary.

The right combination of biological treatments to deliver long term benefits and chemical treatments to address urgent crisis can help the farmer protect his yield, survival and maintain his pond in a sustainable manner.

# More investment and trade opportunities at this forum on Asia's top aquaculture commodity

**"The tilapia will become the most important aquaculture crop in this century with 3 million tonnes by 2010 with the widest demand, no religious/cultural and few environmental concerns and with more genetic potential" –** ***Eric Roderick, in the presentation Tilapia – a global commodity, the 'aquatic chicken' comes of age at Tilapia 2007***

The tilapia continues to show tremendous growth in output. Global production totaled 2,348,656 tonnes in 2006. Half of this is traded internationally. China remains the largest producer with 1.11 million tonnes in 2006, followed by Egypt with 217,019 tonnes in 2005. Dubbed the 'aquatic chicken', the culture of tilapia began in rural communities as an affordable fish protein source. In 2000, the tilapia became an aquaculture trade commodity. International trade in tilapia is now a USD 2.5 billion business which will expand to USD 5 billion by year 2010.

Trade flows are between producers in Asia and Latin American to markets in the US and EU, Taiwan markets sashimi grade tilapia to Japan and the US and Africa to EU markets. Investments in tilapia production are flourishing with new ventures in Europe, Central America, Africa and of course Asia. As markets expand, the industry is being scrutinized on production methods, food safety, quality of products, animal welfare and biodiversity. The increasing commercialization of the industry will require more concerted efforts on responsible management practices.

These are some of the developments raised during the Tilapia 2007, held from August 23-25, in Kuala Lumpur. It was organized by INFOFISH, NACA, Malaysian Ministry of Agriculture and Agro based Industries and World Fish Centre. This second International Technical and Trade Conference was attended by 340 industry leaders, policy makers, importers and exporters from 34 countries.

Conference Coordinator Tarlochan Singh of INFOFISH said, "At this meeting, participants took the opportunity to network and discuss industry situation, production, markets and technological developments. Similar to the first Tilapia 2001 conference, this was a very successful comprehensive business oriented meeting for all involved in the production and trade of the tilapia. The fruitful discussions reflected how such meetings can help producers make decisions in planning production and in marketing tilapia".

## The tilapia comes of age

The world supply of tilapia continues on its upward trend. According to **Helga Josupeit,** Industry Fishery Officer, FAO, the forecast is now 3 million tonnes by 2010. Real growth in aquaculture production from 2000 to 2005 has been in China (from 755,000 to 1.09 million tonnes), South America (from 70,000 to 120,000 tonnes), Central America (from 22,000 to 56,000 tonnes) and South East Asian countries (from 340,000 tonnes to 500,000 tonnes). Egypt reported an impressive growth in the nineties from 25,000 tonnes to 300,000 tonnes. Although production has stabilized to 200,000 tonnes in 2005, it is still the number two producer.

### *..but more scrutiny on production and food safety*

The dramatic increase in production has lead to tilapia being increasingly popular in major markets. In US seafood consumption tables, it moved from number 10 in 2001 to number 5 in 2006, overtaking the catfish, said **Dan Fegan**, Regional Technical Director, Cargill Animal Nutrition in his discussion on current issues in the global tilapia market. This increase in visibility has led to a greater degree of scrutiny on its production methods and on the quality of tilapia traded internationally. Although the tilapia is not directly implicated in some several high profile cases such as the detection of antibiotics residues in farmed fish from China, it is likely there will continue to be a high rate of scrutiny on tilapia imports. The demands are on traceability and accountability in the food chain i.e. food safety, production and processing practices, animal welfare and biodiversity. With the current two tier production methods of small scale producers and large scale integrated operations, these pose particular challenges to the former but favours larger, vertically integrated operations (including contract farming).


*A selection of processed tilapia fillet. Picture courtesy of Eric Roderick*


*At the opening session, the Minister of Agriculture and Agro based Industries Malaysia and Eric Roderick (right).*


*Ms Ng Siow Leng, Group Manager Aquaculture, Cargill Feed Malaysia (front, centre) and the aquafeed production and sales team at the trade show.*

Dan added that when discussing food safety, tilapia is considered to be hardy with no need for antibiotic or chemical treatments. However, it does have certain problems with disease such as *Streptococcus*, a serious seasonal pathogen which is often treated with antibiotics. This is also more likely with small-scale farmers who fail to appreciate the issues surrounding chemical use.

In his presentation on diseases in tilapia, **Cedric Komar**, Regional Technical Manager, Intervet Norbio Singapore said that the long standing myth about tilapia being resistant to disease does not hold any more in the intensive farming systems being used. Intervet Norbio Singapore has been doing regular surveys in intensive farming systems over the last years. They have identified that tilapia suffer from 6 to 8 major infectious diseases. Major bacterial disease have been identified as *Streptococcus agalactiae, S.iniae, Flavobacterium columnare* and *Francisella* spp, RLO (previously called RLO, a rickettsia like organism), Edwardsiella tarda and *Aeromonas hydrophila*. There is also a iridovirus disease and two major protozoan parasites,Trichodina and Amyloodinium.. The prevalence of each of these diseases is affected by location, culture systems and conditions, salinity, physico- chemical conditions of culture areas and biological factors such as age, nutrition and stress conditions.

A proactive treatment protocol such as vaccination and immune-modulation combined with good husbandry practices should ensure a sustainable future of the industry, said Cedric. However, it is possible to use antibiotics if it is done the responsible way by conducting laboratory identification and choosing the adequate antibiotic based on results of antibiogram. It is also important that the use of antibiotics is supervised by aquatic animal health professional and that treatment dose and duration are respected. Finally, antibiotics should be bought from a trustworthy source. His take home message was that health monitoring system and data management are key factors and that disease diagnosis should always precede treatment. Prevention is always better than cure.

## Regional tilapia production

In the **Middle East**, 370,628 tonnes of tilapia was produced in 2005 of which 232,324 tonnes came from aquaculture. Culture is well established in Eqypt with 217,019 tonnes followed by smaller volumes from Israel and Syria, according to **Izzat H Feidi**, Consultant in his review on industrial tilapia culture in the Middle East. Systems ranged from extensive systems in Sudan, raceways in Lebanon and intensive systems in Eqypt and Morocco. Recently, production was recorded from Saudi Arabia with 2,900 tonnes. Entering the markets are Algeria with plastic lined ponds using semi intensive culture practices, Morocco with concrete ponds and Tunisia.

## In Asia: Is tilapia an alien but be considered naturalised?

**Professor Sena S de Silva**, Director General of NACA, the Network of Aquaculture Centres in Asia Pacific, Thailand raised this in his keynote address. Common public perceptions have been that aquaculture production in (terms of volumes) is expanding at the expense of mangrove destruction, use of fish meal and extensive culture of alien species. The impact of the latter is a negative one on biodiversity.

In the case of tilapia, an introduced species in Asia, there is no evidence that it has affected biodiversity. Consequently, it does not threaten sustainability and environmental integrity. This debate is important as an 'alien species' may be deemed noxious and affect consumer acceptance and trade in tilapia. The success of a species should not be determined by its success in production but that it maintains environmental integrity and have minimal influences on the indigenous flora and fauna and on habitats.

"On the positive side, tilapia is physiologically very 'robust' and is capable of tolerating many environmental conditions not easily tolerated by indigenous species. It has a simple reproductive cycle with insignificant larval mortality and is easily weaned to artificial diets. It requires less protein compared with other intensively cultured species. Most of all it does require less technical and management skills in the production process. On its marketing, it has a relatively high dress weight ratio and an acceptable taste to most consumers. It may have been blamed because it happens to occupy habitats degraded from human activities. Sena brought out comparisons with introduced species such as trout to some countries, where there is scientific evidence suggesting that these have impacted biodiversity, but are still not considered as invasive, and continue to be stocked in natural waters. He suggested that there is a disparity with regard to labelling alien species in this regard, with perhaps cultural links being considered favorably in preference to stark scientific evidence.

The conclusion was that it is crucial that the global production of tilapia is viewed through its contribution to aquaculture; as a food source for the rural communities, in industrial aquaculture ventures and for its general acceptance globally. With more than 6 decades of production in Asia, it has not been invasive.

Sena pointed out that "it becomes invasive when water bodies are degraded due to other human activities and become un conducive for indigenous species".

"There is overwhelming evidence to consider tilapia naturalized as 'as a part and parcel of our ecosystems".

## Progress due to selective breeding...

A bottleneck for tilapia culture in Asia was the inadequate seed supply and deteriorating performance of the fish in many aquaculture systems in Asia.

In 1988, The WorldFish Centre and partners in the Philippines and Norway developed the GIFT strain using four stocks of African origin, as well as four other tilapia strains already present in Asia at the time. Through this 'Genetic Improvement of Farmed Tilapia' program, a faster growing strain was developed. In his presentation on how this came about, **Raul W. Ponzoni**, geneticist from The WorldFish Center, said, that the GIFT tilapia developed, by the fifth generation of selection, had a 85% greater growth rate than the original stock. It was then tested in Bangladesh, China, Philippines, Thailand and Vietnam. This initial work indicated improvements in yields of 18% in China to 58% in Bangladesh. Today, GIFT tilapia is used in tilapia culture in 11 countries in the Asian Pacific region and it has more recently been sent to Brazil. It has captured 69%, 36% and 24% of the market in the market in Philippines, Thailand and Vietnam, respectively. Since 2001, with stocks from the Philippines, further research and development is continuing in Malaysia at the Jitra Research Centre, Department of Fisheries, Malaysia. In 2002, the Bureau of Fisheries and Aquatic Resources in the Philippines developed the GET strain from the GIFT strain.

Raul added that growth rate has continued to improve by about 10% per generation. GIFT tilapia has also shown better growth rate than the red tilapia hybrid. In terms of fillet yield and sensory assessment, there was no difference between the two strains. The red tilapia does not have any market advantage over GIFT tilapia when the final product is skinless fillet. The future work will continue for the creation of a high performing tilapia strain and to include more traits in the breeding objective.

Another interesting topic dealt with at the conference was that related to the production of all male populations for the grow out system. The original tilapia, though hardy and tolerant of poor water quality had one large fault for industrial farming. It breeds easily with the female fish using all its energy for reproduction at the expense of growth. An all male population was desired. The initial step was the use of methyltesterone for sex reversal work. As an alternative to hormone sex-reversal, the YY technology was developed by Fish Gen, UK. **Eric Roderick** said that this is a unique genetic breeding program to produce novel "supermales" which sire only male progeny known as Genetically Male Tilapia (GMT®). This is accompanied by other attributes such as reduced variation in size, high growth rate and overall yields. The technology is now available worldwide through established partners.

*From left, Mazuki Hashim, DOF, Malaysia and Firmansjah Sastradiwirja Vice President, PT Central Proteinaprima,Indonesia*

*Participants from Bangladesh*

"Countries in the Middle East are potential producers to meet domestic and regional demand for tilapia at affordable prices. However, increase in production is dependent on changes such as on the scarcity of funding commercial projects and shortage of water resources for aquaculture. More and more countries in the wider Middle East region are introducing tilapia farming. Possibly, potential entrants to the industry are Bahrain, Qatar, Yemen and Iraq. In Iran, this depends on the lifting of restrictions on the farming of 'exotic species", said Izzat.

Production is expected to increase with capital investments and improved efficiency. All these are to meet the developments and changes in fish consumption patterns and rapid increase in population growth.

In **Africa**, growth in tilapia production is somewhat erratic, according to **Erik Hempel**, Project Manager, INFOSA. Production, excluding Egypt was just 25,000 tonnes, while Egypt alone produces over 220,000 tonnes. Culture technology differs with covered recirculation water systems to retain heat during cold seasons and prevent evaporation during warmer months such as in South Africa, large floating cages in reservoirs to earthern ponds in small scale culture. It was estimated that 9 of 10 farms in South Africa use recirculation water systems. The largest cage culture operation is Lake Harvest on Lake Kariba. Lake Harvest has employed basically salmon cage technology with 7m deep nets which have over the years have been adapted to local conditions. There is also potential in the use of underground water for aquaculture. Erik quoted particular sites in Namibia and Botswana where the annual ground water availability even in desert areas can be considerable, and could provide freshwater for culture operations.

Currently, the future development in African states is constrained by feed supplies, production of juveniles as well as legislation, investments and high transport costs. However, he added that currently, most investment in tilapia production will target the EU markets where they compete with low cost producers in Asia.

"However, there is a good and growing market for tilapia in Africa itself. The current consumption was estimated at 10,000 tonnes and

this should grow to 40,000 tonnes in 5-10 years, according to Lake Harvest. Sold mainly round or gutted 300-500g fish in domestic markets, prices at USD3.50-4.20/kg compare favourably with those in the markets in Europe. Whereas the farm gate price for processing to fillet is only USD 1.20 per kg".

In **China**, **Chen Shuping**, INFOYU China, said it was the potential in exports that has driven the industry in China. Exports rose from USD 50 million in 2002 and USD 400 million in 2006. Nevertheless, local demand for the tilapia is also high at 629,000 tonnes out of the total production of 1.11 million tonnes in 2006. Some 37% of the tilapia production is exported annually.

*Chen Shuping*

In China, although the consumer price index (CPI), rose by 4.4% and pork prices increased 20%, tilapia prices only increased by 6%. Ex farm prices near production areas was RMB 8-9/kg. In the cities such as Beijing, wholesale price rose to 15-16 RMB/kg whilst in Shanghai, it was RMB 17-18/kg. " Tilapia culture will continue to be a profitable business. The cost of production of tilapia is currently RMB 8/kg. Feed is the highest input at 60% of total cost.

"The rise in production will continue at an annual rate of 10%. This is because relative to the carp, sold usually as live fish, the tilapia has good export and domestic markets and can be transformed into many product forms. Tilapia culture is also attracting white shrimp (*P. vannamei*) farmers faced with environmental problems in inland farms", said Chen.

"Production is nearly nationwide with Guangdong in the south producing 49%. The drawback for the industry is that supply and quality is erratic. This is because the industry is highly fragmented with mainly small scale producers. There has been no attempt at branding. Usually, production begins in March/April and within 5 months, 500g fish can be harvested. However, many farms risk higher fish mortality to produce 1kg fish for the international fillet market. In the five year plan, the government plans to improve quality and food safety standards. Industry needs more organization to manage trade issues but if however, it faces, non tariff barriers, the domestic market will be there to pick up the stock".

In other parts of **Asia**, the major producers in terms of volumes were Philippines, Indonesia, Thailand, Taiwan, Malaysia and Bangladesh (Table 1) tilapia in 2005. **Rafeal D Guerrero III**, Philippines Council for Aquatic Research and Development outlined the various culture practices in the region. Extensive culture in ponds yields 4 tonnes/ha whereas intensive cage culture in Indonesia yields 20 kg/m$^2$. In shrimp ponds, tilapia in used against vibrosis. An example of intensive culture is in cement tanks in Malaysia. With the development of salt tolerant hybrids of the tilapia, culture is brackishwater ponds and marine cages is practiced in the Philippines, Indonesia and Singapore.

*From left, Frank Fu Sung Chiang, and Dr Sena de Silva. Frank discussed Taiwan's experience in branding tilapia (see next issue) and tilapia investment opportunities in Belize, Myanmar, Thailand and Vietnam.*

The production in Bangladesh has reached 19,268 tonnes in 2005. **M.G. Hussain**, Bangladesh Fisheries Research Institute expects this to increase with the expansion of culture in brackishwater and freshwater areas and the dissemination of appropriate technologies. There are 35 hatcheries producing 10-12 billion fry and 200 commercial farms. A new activity is cage culture, producing 120 to 190 kg/m$^3$ after 8-9 months. The potential is in cage culture in reservoirs, rivers and their tributaries lakes, lagoons, irrigation canals.

*In the next issue – The business of sustainable tilapia farming at Tilapia 2007.*

## Biomin

# New CEO for Asia Pacific

**At the recently held Biomin Asia Nutrition Forum held in Siem Reap Cambodia, Mr. Erich Erber, founder of Biomin announced the promotion of David Saunders to the position of CEO-Biomin Asia Pacific.**

*David Saunders*

Previously, David Saunders was the Regional Sales & Marketing Director, Asia Pacific, a position he held since joining Biomin in October 2006. Mr. Erber, previously the CEO of Biomin Asia Pacific will focus on the Erber Group's on long term strategies.

In Singapore, David talked on the role of Biomin in aquaculture in Asia, "The next 40 years will see a massive growth in the aqua industry. We want to have an active role in its development. Thus, Biomin is committing significant technical and research resources to this industry segment today. Based on feedback from the aqua industry here in Asia, the industry still needs to refine many production parameters in specific species segments as compared to the well developed salmon industry in other parts of the world. With Biomin's R&D efforts, we want to play a role in that development here in Asia."

Biomin's strength is its position in the swine and livestock industries and this will be brought to the aquaculture industry. One of the core competences is the R&D and affiliations with more than 80 different research institutions throughout the world. Biomin dedicates 5% of its annual sales to R&D.

"Biomin's R&D focus in the aqua industry is in three areas- mycotoxin management, health & nutrition and the environment. In Thailand, we have set up an Aquaculture Centre for Applied Nutrition (ACAN). Here we will carry out trials to generate data in search for specific solutions for our customers. Coupled with our product line of probiotics and mycotoxins, we will provide key solutions for the aqua industry."

"With regards to mycotoxins, from our annual survey on mycotoxin contamination, we realize that there has not been enough emphasis on mycotoxins in aqua feeds. Traditionally the industry has focused on aflatoxins where the solution is a simple mycotoxin binder. In fact, DON and ZON may be more of a threat. Hence, we will supply deactivation tools which are unique to Biomin."

"For the environment, our challenge is to provide alternatives to sub therapeutic levels of antibiotics by applying our probiotic and immune-modulation technology to the shrimp and fish industry. Similarly, these same products can unlock nutrient utilization deficiencies and reduce waste outputs."

Biomin is well placed in Asia to grow with the expanding aquaculture industry. operating from nine Biomin offices and three manufacturing sites. Over the immediate future Biomin will primarily focus resources on well established aquaculture markets including Indonesia, Vietnam, and Thailand.

"The strategy is to place key personnel in these markets. Although, we have legal entities in many countries, we still value working with partners dedicated to the industry", said David.

Biomin is one of 3 divisions with 40 legal entities within the 'Erber AG' group. The group operates in more than 100 countries. The products that the research teams develop are manufactured within the company's own production units in Austria, Hungary, Vietnam, Singapore, Mexico and Brazil, all of which are HACCP and ISO approved.

# An Aquaculture Centre for Applied Nutrition (ACAN) in Thailand

**The investment and commitment of Biomin to provide solutions for the aquaculture industry has reached a new stage with the opening of the new Biomin research center, dedicated exclusively to aquaculture. This research facility located in Bangkok is the new addition to Biomin's Center of Applied Nutrition (CAN's) network.**

The research will be conducted with several of the most important species for the aquaculture industry in the region including marine and fresh water species such as catfish, tilapia, seabass and shrimp. Biomin will also collaborate closely with local universities to extend the scope of its research.

The activities at the new research center will be coordinated by Dr. Pedro Encarnacao, Biomin's aquaculture specialist in direct collaboration with Biomin's R&D department and the technical staff at the ACAN. The aquaculture center will give Biomin the capability to conduct innovative research to provide effective solutions to the industry in several key areas: nutrition and feed formulation, gut health, immune-modulation, waste management and feed safety.

ACAN has a total of 64 tanks of different volumes (120, 350 and 500 litres) supported by three independent recirculation systems. It also contains a feed formulation laboratory for the preparation of test diets including a laboratory scale extruder. This will allow for the testing of different ingredients and solutions under conditions similar to those found in the aquaculture industry.

*Dr. Pedro Encarnacao (right) in the laboratory*

## Aqua Bounty Technologies

# New Asian Regional Sales Manager

**This biotechnology company focusing on enhancing health and productivity in the fast-growing aquaculture industry, has announced the appointment of Lawrence Giessinger to lead its Asian sales and development effort.**

In a separate press release, Aqua Bounty Technologies, Inc. announced the appointment of David Frank as the Company's new Chief Financial Officer and as an Executive Director, effective from 15 October 2007. Frank has many years of experience in the biotech and IT industries as CFO, and in other senior executive positions. Frank comes to Aqua Bounty from Magellan Biosciences Inc., where he was a Director and President and General Manager of TekCel LLC, a subsidiary company which Magellan acquired in May 2005.

*Larry Giessinger*

Larry, a seasoned executive with deep experience in Asia in corporate finance and business development, has specialized in the shrimp aquaculture industry for the past dozen years. As Asian Regional Sales Manager at Aqua Bounty, Larry will introduce the company's portfolio of therapeutics, feed additives and health management products to the largest producing region in the USD 6 billion global shrimp aquaculture industry.

Larry comes to the Company from Advanced BioNutrition Corp., a developer of shrimp feed additives, where he established a company presence in Thailand and India. He had previously developed Asian markets for Sanders Brine Shrimp Co. and Zeigler Bros. Inc., both significant suppliers of larval shrimp feeds, and for Adsgo Drugs Co. Ltd. of Bangkok, Thailand, and maintains a network of associations with shrimp growers, hatcheries and feed producers throughout the region.

"Larry Giessinger has an extraordinary depth of experience in Asia going back to the early 1970s. He was a banker when the "Asian Tiger" economies made their breakthrough and he has been part of the Asian shrimp farming industry during the period that witnessed its growth to a position of global leadership", said Henry Clifford, Vice-President for Sales and Marketing at Aqua Bounty Technologies. "With our Shrimp IMS product well on the way to industry adoption in Latin America, we're preparing its launch into the major markets of Asia. Larry is, without doubt, the man to take on that job successfully."

"Shrimp farmers in Asia are technically sophisticated and highly innovative," Larry explained. "They are prepared to adopt the best available technologies to meet their production targets but expect those technologies to pay their own way. Aqua Bounty understands the growers' need for practical solutions to the daily challenges of farm management. Their products and pipeline focus on delivering cost effective gains in shrimp farm productivity. That's a message that will be well-received in the region."

# Complete farming solutions through cost effective and quality inputs

**The leading biotechnology company, Biostadt India Ltd has been developing solutions for the agriculture and aquaculture industries. This is part of its mission to 'deliver research based customized tools for sustained productivity' and its belief that 'the growth of India is directly related to the growth of the rural areas'.**

Its aqua product portfolio ranges from pond & feed probiotics, adsorbents, deodorizers & oxygen generators, sanitizers and disinfectants, feed additives and binders to a synthetic gonadotropin releasing hormone analogue for carp breeding. These products are known for their quality and efficacy have been well accepted in the Indian aquaculture industry. They are also widely used in Vietnam, Philippines, Bangladesh and Tanzania. Biostadt has recently opened a new state of the art R&D facility for developing research based products for its aquaculture and agriculture portfolio.

Some 18 product designs have been developed specially for shrimp farming. According to the company, the concept of the probiotics dates back to India's 'vedic' times and the awareness of natural products in improving human health. A solution for poor pond soil conditions is ENVIRON-AC™, a unique bio-product developed by Biostadt and Biotechnology Organization Techniques et Biochimie Appliqués (TBA). The product consists of a consortium of large number of selective, non-pathogenic, beneficial, native microorganisms bio-fixed on a highly porous and natural material called cocolith.

*The new R&D facility will continue to develop research based products for its aquaculture and agriculture portfolio.Dr. Patangrao Kadam, Garden Minister, Maharastra; Mr. Chandrasekhar, MP and Dr. Kale, MLA inaugurate the function*

For shrimp and freshwater prawn, the powerful spore-forming bacteria in the feed probiotic AQUALACT™ prevents the growth of pathogens such as clostridia, Streptococci, *E.coli*, Salmonella and Vibrio species, thereby preventing occurrence of major diseases. A seaweed extract further enhances the binding quality of the product. CLINZEX™-DS has been recognized as the high quality of aquaculture grade zeolite. Molecular sieves zeolites are crystalline sodium or calcium aluminum silicates. It works in an effective way by absorbing 'ammonia' through its CEC (cation exchange capacity), thus producing a healthy environment. The process means that only refined micro crystalline forms high in calcium and having tetrahedral structures are sieved out to attain a very high CEC.

Biostadt has a specialty cost-effective binder gel, Trubind™, enriched with carotenoid, which enhances the shrimp pigmentation. This is a binder with nutritional value in terms of protein, vitamins and cholesterol. According to the company, the latest in vitamin C is WOCKCEE™ with a poly-phosphate base and offering the advantages of quality, high stability, and bioavailability. As loose shell syndrome (LSS) is one of the prevailing problems in shrimp culture in India and which experts attribute to phosphorus deficiency, the company has added phytase and protease to the product. Phytase increases the availability of phosphorus in feed and protease improves the digestion of the proteinaceous material.

In a pioneering effort, the company in collaboration with Biostadt (Europe) Ltd. and a leading feed manufacturer in Thailand has begun to manufacture a TaQaT+™, a high protein pelleted shrimp feed. There are six feed sizes and the initial three starter sizes are crumbles. The initial results are encouraging.

"We are in the business of serving the farming community with care and responsibility in India and beyond. We will reach out to our customers through business associates, supported by quality extension services.Our belief is that speed and teamwork will ultimately lead to growth", said Dr Partha Bandyopadhyay, Technical Executive (Aquaculture).

"In today's competitive environment, companies that constantly innovate are able to face the challenges of the market place. This is a new milestone for our company and will give new focus and thrust to our new product ideas and development".

## OceanSpar/ Nichimo

# A new partnership for Japan market

**OceanSpar has announced that Nichimo Co Ltd will represent its products and services in Japan. It will promote the company's line of SeaStation and AquaSpar fish pens, along with support equipment for sustainable offshore aquaculture. Nichimo works closely with the leading aquaculture producers in Japan and will also help OceanSpar provide local services.**

OceanSpar is the leading provider of submersible offshore fish pens with 50 installations worldwide. Nichimo is a listed company in Tokyo with 97 years of company history. It is a leading supplier of equipment to the commercial fishing and aquaculture industries. It is also a leading supplier of surimi, fresh and frozen fish products and value-added seafood products.

"We have a long and successful working relationship with Nichimo and believe they are well-positioned to lead the expected growth in offshore aquaculture in Japan," said Todd Madsen, President & CEO of OceanSpar, "We're excited to deepen our partnership with them and begin developing this important market."

"This partnership allows Nichimo to offer a full range of aquaculture fish pens and equipment," said Tomomi Ishii, Managing Director of Nichimo, "We are looking forward to working with the OceanSpar team as the Japanese market develops over the next few years."

More information: www.OceanSpar.com; www.nichimo.co.jp

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## Pioneer A.E. Company Limited

# Aeration to cage technology

**Taiwan based Pioneer A.E. Company Limited manufactures a comprehensive range of paddlewheel and air injection aerators to suit various pond/pen and cage culture conditions. The paddlewheel aerators use the ISO9001/ISO14001 compliant 'Teco' motors.**

With a 10 years presence in the global aquaculture, the company also manufactures automatic feeders, roots/ring blowers, power control panels and automatic grits manufacturing machines, mixer machines, fish chopping machines and fish mincing machines as well as supply electrical cables (all ISO9001), water pumps and HDPE pond liners (both ISO9002). It has introduced several models and designs of aerators to suit varying pond sizes and water conditions in pens and cages. The newest is the Aqua Lucks Paddlewheel Aerator, with a new technical design to give a very Economical & High Efficiency.

Sunny Wang, General Manager said, "Initially we will work with the clients to determine the most suitable aerators to get the lowest costs and optimum efficiency. For example in a tilapia cage farm in Central America, diesel engine driven multi-impeller paddlewheel aerators are used in the lake environment. Our aerators are also used in shrimp and tilapia/fish farms in Ecuador, Costa Rica, Belize, Honduras and Colombia, USA etc.

During the last four years, the company has been actively marketing its total concept cage systems. This can include raw material selection, cage design and technical support. Services such as site selection & cage installation are available at extra costs. It is also promoting cage culture as a better culture system using existing water bodies.

In Taiwan, their 20m diameter cages are used for cobia and sea bream culture. In Mexico, Indonesia and Honduras etc, these cages are used for tilapia culture. Larger 30m diameter cages are used for marine fish culture in Vietnam and China. The cages using HDPE100 for the handrail pipes and HDPE80 for the floating pipes and brackets are made to resist conditions such as the strong waves and typhoon conditions in Asia.

(More information: Web: www.pioneer-tw.com; email: pioneer.tw@msa.hinet.net)


*Sunny Wang at the recent Eurasia Exhibition in Istanbul, Turkey. Pioneer is marketing cages in Turkey as cage culture farms have started to move offshore to increase production whilst reducing environmental impacts and concerns. Turkey is currently the second largest producer of sea bass and sea bream in Europe.*

*Cages for cobia culture off Taiwan*

## Alltech

# Supporting AQS

**The company has announced that David Byrne, former European Commissioner for Health and Consumer Protection has joined its board as a non-executive director.**

This appointment of Byrne strengthens this commitment to global traceability and quality in the feed industry. Byrne was instrumental in the establishment of European Food Safety Authority (EFSA) and European Centre for Disease Control (ECDC). Dr. Pearse Lyons, Alltech president said that, "Alltech has been, and always will be committed to feed safety, quality and traceability."

Alltech has embraced efforts to standardise systems of quality assurance by taking advantage of these legislative developments worldwide and developing its own code of practice. Prior to establishing its own Alltech Quality System (AQS), Alltech benchmarked all the global, legislative, quality and safety requirements being implemented. AQS ensures that all products are produced to the highest standards to ensure consistency and can therefore, be used in the feed industry with complete assurance.

More information: www.alltech.com

*David Byrne*

# Extruders and Expanders in pet food, aquatic and livestock feeds

**Mian N. Riaz (Ed)** *420 pages, hardcover*
**ISBN: 978-3-86037-301-9, Publisher: Agri mediaGmbH, July 2007.**


This book is the result of years of experience by experts in extrusion and expansion technology. Edited by Dr Mian Riaz, Head of Extrusion Technology Program, Texas A&M University, USA, Extruders and Expanders in Pet Food, Aquatic and Livestock Feeds, follows closely the practical short course philosophy developed during 25 years of teaching technical processing techniques at the university. As a reference book, it gives the reader the basic considerations for the application of extrusion/expansion technology to feed industry process and focuses on the various types of extruders/expanders available for a growing number of feed applications. It brings together practical experience and in-depth knowledge of extrusion and expansion cooking technology of several industry experts.

There are 17 chapters and these are arranged in a procedural, top-to-bottom basis, as one progress from understanding extrusion in chapter 1 to raw material, formulation, grinding etc in chapter 2 onwards. The first chapter starts by introducing extrusion technology, with related terms used and types of extruders. The chapter ends with how to select an extruder. The next chapter deals with raw material (with their nutritional qualities), and processing characteristics and is followed by formulation and dietary ingredients in Chapter 3. This is especially relevant as Galen Rokey, the author indicated that "the formulation components interact and a study of one would not be complete without determining the influence on others". In chapter 4 on particle size reduction, Bill Bliss gives some guidelines and principles in selecting hammer mills. Chapter 5 on expander technology deals with the function of the expander, designs and the roles of expander as pressure conditioner before pelleting or as standalone for special applications such as starch modification. Chapters 6 & 7 are on universal pellet/cooker and on dry extrusion. This is followed by chapter 8 on preconditioning of pet foods, aquatic and livestock feeds. It covers the advantages as well as hardware and software for preconditioners.

In chapter 9 and 10, Galen Rokey and Brian Plattner cover single screw extrusion and twin screw extrusion, respectively. Both chapters cover in detail hardware components such as feeding devices, extruder drives etc to processing conditions. Going further to more detailed aspects are chapters 11 and 12 which cover extrusion die and knife principles and density management and control. The latter is critical in pet and aqua feeds. To complete the production process, the subsequent chapters in the book discuss drying and cooling of extruded feeds, optimizing feed quality and with liquid coating systems. Since more than 80% extrusion systems sold today comes with automation, a chapter is dedicated to operational automation and its benefits. The book ends with a chapter on troubleshooting and extrusion operations.

Currently, limited information is available on extruder and expansion. The 17 chapters in the book fulfill the needs of aquafeed producers, although some sections will be more relevant for livestock and pet food producers. The book could be improved to include particle reduction with pulverisers. Nevertheless, it will especially help newcomers to the industry as sufficient attention is given to each aspect during the production process. The book should be used as a reference not only by the equipment operator but also by managers and nutritionists as it does covers considerations in purchasing extruders and expanders and material specifications and formulations.

The book is available for online at http://en.agrimedia.com/libfeed/shop/list.php#id246. Item #: 301-9, (Weight: 1,600 g) at Euro 99.00/USD 136. For more information: email: ulrike.kauber@agrimedia.com; Tel: +49 5844 9711 60; Fax: +49 5844 9711 61

## What to expect in AQUACulture Asia Pacific Magazine in 2008

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

# Antibacterial coating in hatcheries

**At fish farms, parasitic water mould is a problem because it inhibits the hatching of fish particularly in the salmon family. Using an antibacterial coating called Kenifine, developed by Kobe Steel, Japan, it is now possible to reduce the amount of expensive veterinary medical products used to maintain the sanitation of hatchery equipment.**

Kenifine is an electrolytic plating containing nickel and trace amounts of other elements with outstanding antibacterial properties. It is effective at controlling microorganisms in comparison to conventional surface-treated products, such as antibacterial paint and antibacterial stainless steel. Highly resistant to corrosion in fresh water, the alloy coating also has outstanding antifungal and anti algal characteristics. It has also passed various safety tests, including acute toxicity tests, set by the Society of Industrial-Technology for Antimicrobial Articles (SIAA).

This is a relatively inexpensive alternative to products such as malachite green, commonly used to control parasitic water mould on fish eggs. Malachite green is now banned following a revision in Japan's Pharmaceutical Affairs Law in August 2005. Since then, a veterinary medical product called Pyceze has been used to disinfect fish eggs. However, growing consumer interest in food safety is creating demand for a low-cost method, while avoiding chemical agents when possible.

After two and a half years of trials at fish farms in Shizuoka Prefecture, the Fuji Trout Hatchery at the Shizuoka Prefectural Research Institute of Fishery and Kobe Steel, Ltd. have commercially applied an antibacterial coating that improves the sanitation of fish hatchery equipment to control parasitic water mould. The company is producing stainless steel wire plated with Kenifine for use in hatching nets. Until now, nets have been plated after being woven. However, film formation at the points where the steel wires cross is difficult and becomes a breeding ground for bacteria. Plating the wire first before making the nets solves this problem. It also aims to conduct studies in applying the coating to salt-water conditions. In addition, an antibacterial powder was also developed to produce antibacterial plastic and antibacterial paint. (More information: Dr. Takenori Nakayama Email: ta-nakayama@kobelco.jp)

# Tablets for direct addition to catfish and shrimp ponds

**Aqua-In-Tech Inc.USA has a product AquaPro B designed to ensure targeted delivery of high bacterial loads directly to the pond bottom. This is a consortium of Bacillus (subject of US Patent # 5746155) to reduce sludge in catfish ponds and in shrimp ponds.These bacteria have been incorporated into a tablet format. The tablets are added to the ponds at a rate that ranges from a minimum of 150 for semi-intensive environments to more than 5000 per ha per cycle for high density rearing environments. The dosage depends on water quality and environmental parameters.**

The accumulation of sludge in pond bottoms is a limiting factor in the production of shrimp and fish in traditional ponds with soil bottoms. It also is a serious problem in lined ponds as well. The traditional approach is the addition of bacteria to ponds where the bacteria germinate (hatch) and grow. The drawback is that the numbers of bacteria required to effect significant change has been determined by some researchers to be very high and this is usually not economically viable. The second is that these products are added to the water column when the pond bottom is where they need to be active.

"Unlike traditional products each client can tailor the use of our product to optimize it for their particular culture conditions. The tablets drop to the bottom of the pond where they dissolve delivering the bacteria in the product directly to the sludge. Each tablet contains approximately 50 billion colony forming units (CFU) and weighs 13 grams. In the immediate area where the tablets are added a very large number of sludge digesting bacteria are available to actively digest the sludge in-situ", said Dr Stephen Newman, President.

Trials in aquaria have confirmed that the bacteria in the tablets (which are identical to the bacteria in the granular product (AquaPro-B) rapidly degrade organic material resulting in improvement in water quality with concomitant drops in the level of algae in the aquaria. The results of a large field trial in Belize confirm the benefits. During the first production cycle of *Penaeus vannamei* in semi-intensive (25/m2) and intensive (60/$m^2$) ponds in 2007, Royal Mayan Sea Farms Ltd., Belize has reported some substantial positive benefits in the use of the product.

Growth improved from the average of around 0.8 grams/week during the warmer cycle of the year to an average growth rate 0.94 grams in treated ponds. This allows for shorter production cycles. Furthermore, when bacterial disease outbreaks are apparent, adding the tablets stops the problem in its tracks. The farm managers have reported that there is less accumulated organic material in the ponds at harvest. In general, they are seeing higher levels of green algae in an environment where there have always been problems with blue green algae. Feed conversions have improved substantially from prior cycles. While many factors can account for this, the changes in the pond environment can readily play a role in this.

"Overall this farm is reporting a substantial positive benefit on their bottom line from the use of these tablets. The cost benefit when everything is taken into account is greater than a USD10 savings for every USD1 that they spent on the product', said Stephen.

(More information: Web: www.aqua-in-tech.com Email: sgnewm@aqua-in-tech.com )

# VICTAM ASIA 2008 & Feed Ingredients & Additives Asia Pacific 2008

## 5-7 March 2008, Bangkok, Thailand

With two months to go, this Victam show and series of conferences in Bangkok, is virtually full and the organisers might have to apply for additional exhibition area to accommodate all the exhibitors. Henk van de Bunt, Victam's General Manager said at a recent interview, "The responses to the 2008 show is better than expected. Not only are there many new exhibitors but also many of the companies that had reserved exhibition areas in 2006 have increased their stand space. Exhibitors have been pleased with the event in 2006 that they felt that with the industry in South East Asia expanding so significantly they had to respond by showing more equipment on their stands so as to meet the increased demands for new technology, etc."

"Response to the new introduced co-located trade show and conferences Feed Ingredientes & Additives Asia Pacific (FIAAP), from exhibitors, conference delegates and visitors show that the feed industry requires a specialist event for these important subjects." said Henk.

"The events are highly targeted in both the products shown within the exhibition and also to whom the shows would appeal to as a visitor. This ensures the exhibitions are highly effective for both our exhibitors and visitors, and this is especially important as so many of our visitors come from outside of Thailand and we have to ensure their visit is cost effective and fruitful. I am pleased to say we seem to be achieving this as our number of exhibitors and visitors increases substantially from show to show."

***Victam Asia 2008 and Feed Ingredients & Additives Asia Pacific 2008 will open at the Queen Sirikit National Convention Center, Bangkok, Thailand from 5-7 March 2008. The exhibitions are FREE for trade visitors. For further information on the exhibitions, the conference program, free visitor registration, etc visit www.victam.com***

## Conferences

There will be the following specialist conferences; aquafeed, animal feed ingredients, petfood and the Thai Feed Conference.

### *FIAAP Conference – March 5, 2008*

This new event will provide insights into feed ingredient availability and price projections and explore new solutions for formulating animal feeds. It will be a key occasion for feed formulators, ingredient buyers, processors, suppliers, distributors and everyone whose business involves animal, pet or aquatic feed production in the vibrant Asia Pacific market.

Organised by Aquafeed.com conferences in association with Linx Publishing LLC, publishers of Feed Technology Update and FeedLink.com, FIAAP is supported by the Thai Department of Livestock Development; Thai Department of Fisheries, Thai Feed Mill Association, Thai Tapioca Trade Association, Thai Chamber of Commerce and Thai Ministry of Agriculture & Co-operatives.

### Program

- Raw material supply and demand – are they in balance? - Dr. Robert Swick, ASA-IM, Singapore
- Amino acid content in fishmeal shows high variation - Dr. Torben Madsen, Degussa, Singapore
- A comparison of digestible protein and amino acids content and value of terrestrial animal protein meals for aquafeeds - Dr. Yu Yu, National Renderers Association, Hong Kong
- Mycotoxins in animal nutrition – problems and solutions - Dr. Mathieu Cortyl, Impextraco, Singapore
- Bacterial contamination of feed and Feed ingredients: - Dr. Adam Smith, Anitox, U.K.
- A healthy gut for optimal performance through target release concepts in animal diets - Dr. Koen Schwarzer, Nutri-Ad International, Belgium
- Efficacy of phytogenics in commercial layers - Dr. Robert Nichol, Biomin, Singapore
- Turning bad news into good news-feeding opportunities for the Asia Pacific animal industry to maximize profitability - Dr. Andeas Kocher, Alltech Biotechnology, Australia
- Natural Ingredients – product opportunities and process issues - Colin Mair, Cormal Technology, U.K.

### *Aquafeed Horizons Asia 2008 – March 6, 2008*

This conference will deliver an expert level of technical information to meet the needs of the commercial aquafeed industry, particularly within the Asia Pacific region. The meeting will provide invaluable insights for service, ingredient and equipment suppliers, researchers, veterinarians and others whose business depends on understanding the needs of aquaculture and the possibilities offered by advances in aquafeed technology and formulation. It will also be an opportunity for networking and discussion within industry.

Delegates to FIAAP can now combine their registration with Aquafeed Horizons Asia '08. Save by registering for both Aquafeed Horizons Asia and Feed Ingredients & Additives Asia (FIAAP) with one combined registration. For full details: www.feedconferences.com; Email: conference@aquafeed.com

### Provisional Program

Chair: Dr. Dean Akiyama, Senior VP Charoen Pokphand Indonesia, Aquafeed Technology, Indonesia and Dr. Warren Dominy, Director, Aquatic Feed & Nutrition Department, Oceanic Institute, Hawaii

- Aquafeed and aquaculture production and policies in Thailand - Dr Juadee Pongmaneerat, Dept. of Fisheries, Thailand
- Pheromone-based feeding attractants for sustainable aquaculture - Dr. Andrew Moore, Centre for Environment, Fisheries and Aquaculture Science, U.K.
- Promoting animal health through feed - Dr. Peter Coutteau, Inve, Belgium
- Krill as a feed source for aquaculture - Dimitri Sclabos, Sclabos Consulting, Chile
- Beyond pre-conditioning – reducing carbon footprint and increasing quality - Colin Mair, Cormal Technology Ltd., U.K
- Ingredient trends and effects on extrusion process - Galen Rokey, Wenger Manufacturing, Inc., USA
- Technical advances in extruded shrimp feeds - Joe Kearns, Wenger Manufacturing, Inc., USA
- Starter diet production technology - Will Henry, Extru-Tech, Inc., USA
- Improving palatability in shrimp feeds - Dr. Vincent Fournier, Aquativ, France

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

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

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

## February 8-10
**India International Seafood Show 2008**
Kochi
*Email:premchandran@mpeda.nic.in*
*Web: www.mpeda.com*

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

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

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

## 28-29 March
**Giant Malaysian Prawn 2008**
Kuala Lumpur, Malaysia
*Email: myfisoc@gmail.com*
*Web: www.vet.upm.edu.my/~mfs*

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

## June 1-5
**XIII International Symposium on Fish Nutrition and Feeding (ISFNF)**
Florianópolis , Brazil
*Web: www.isfnf2008.com.br*

## June 12-14
**Vietfish Fisheries International Exhibition**
Ho Chi Minh City, Vietnam
*Email:quocthanh@vasep.com.vn*
*Web: www.vietfish.com.vn*

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

## July 25-27
**The Seventh International Conference on Recirculating Aquaculture**
Roanoke, VA, USA
*Email: aqua@vt.edu*
*Web: www.cpe.vt.edu/aquaculture/r-aqua/*

## 3-6 August
**Australasian Aquaculture 2008**
Brisbane, Australia
*Email: sarahjane.day@aquaculture.org.au*
*Web: www.australian-aquacultureportal.com*

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

# Giant Malaysian Prawn 2008

### 28-29 March, 2008, Kuala Lumpur, Malaysia

**This 2-day International seminar will be held in Malaysia, where the successful closing of the larval cycle of the Giant Malaysian Prawn, *Macrobrachium rosenbergii* was done some 50 years ago. Commercial farming then followed. Today, the prawn is one of the most popular crustaceans farmed in freshwater environments.**

With the increasing importance of Giant Malaysian Prawn today, the Malaysian Fisheries Society, is hosting this seminar with the view of providing a forum for the exchange of information and ideas on the various aspects of farming the Giant Malaysian Prawn. It will bring together scientists and professionals to deliberate on the issues focusing on the commercial farming of the Giant Malaysian Prawn. The program will include papers on genetics, breeding, culture, nutrition, economics and marketing.

More information: email: myfisoc@gmail.com; Web: http://www.vet.upm.edu.my/~mfs

# 16th India International Seafood Show (IISS) 2008

### 8-10 February 2008, Kochi, India

**This biennial show is organized by the Marine Products Export Development Authority-MPEDA (Ministry of Commerce and Industry, Govt. of India) in association with Seafood Exporters Association of India (SEAI). It will be held at Le Meridien, Kochi**

This is one of the largest seafood fairs in Asia. It is a biennial show and a common forum for meeting under one roof of seafood processors, exporters, importers, aquaculturists, processing machinery manufacturers and allied industries. The first show was held in 1973 at Mumbai and the previous 15 shows were held in cities like Kochi, Chennai, Bangalore, Delhi, Visakhapatanam, Goa and Kolkata which had attracted a large number of seafood trading people and enabled them to find out suitable means for strengthening the seafood trade for mutual benefits. Some 87 exhibitors (both national and international) participated in the last IISS -06 held at Kolkata.

More information: Email:premchandran@mpeda.nic.in; Web: www.mpeda.com


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