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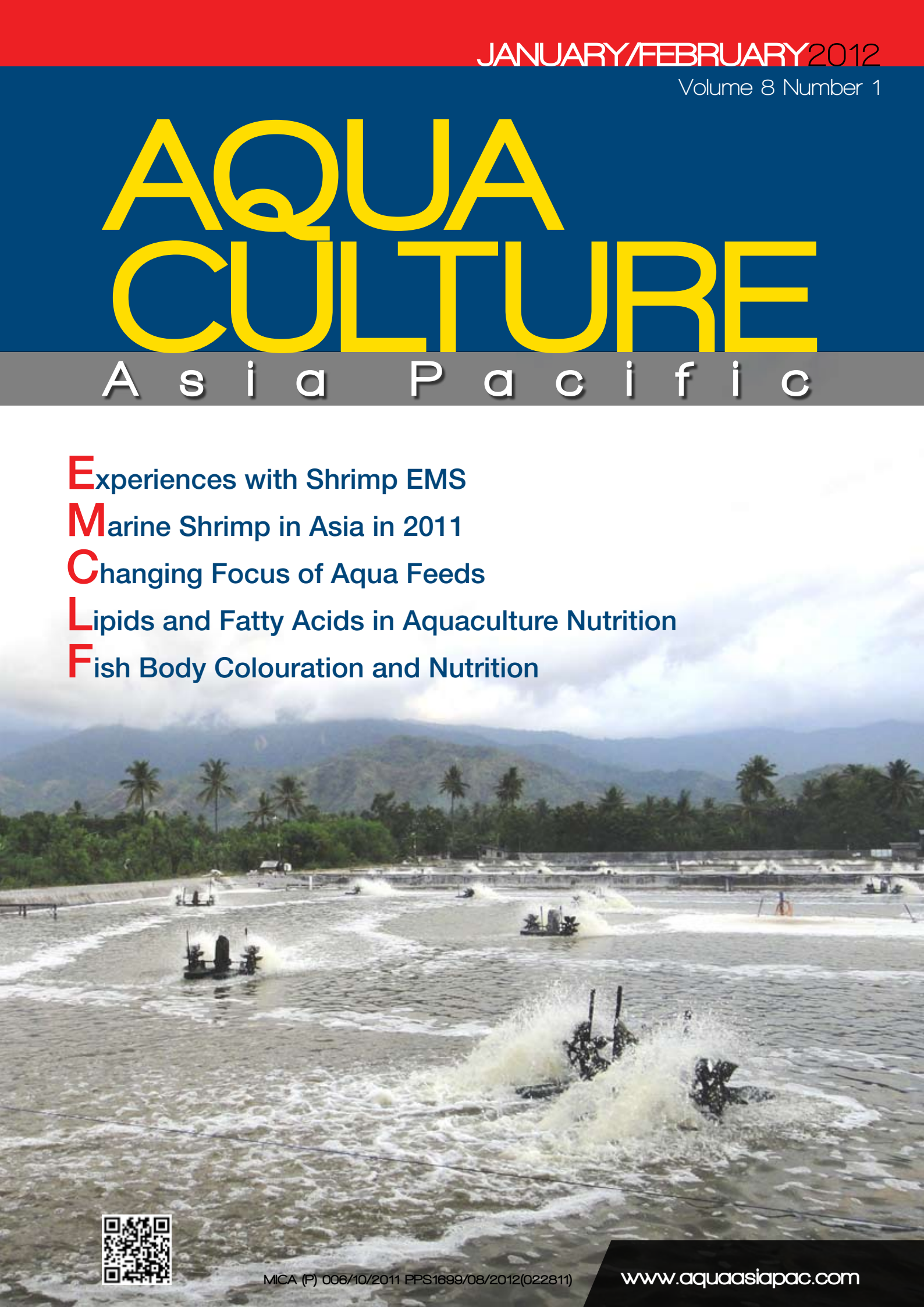
AQUA CULTURE
Asia Pacific

Experiences with Shrimp EMS
Marine Shrimp in Asia in 2011
Changing Focus of Aqua Feeds
Lipids and Fatty Acids in Aquaculture Nutrition
Fish Body Colouration and Nutrition



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From the editor

2012: What's in store?

Industry leaders have said that the good prices for marine shrimp will remain high and stabilise in 2012, at least in the first half of the year. Thailand expects to increase exports while Vietnam, Malaysia, Indonesia and China try to recover from the serious outbreaks of disease, from white spot and white faeces syndrome to the newer early mortality and slow death syndrome. How well the farms in Vietnam will recover will only be known in March, when the season starts.

For some time, Thailand, Malaysia and Indonesia have been vannamei shrimp centric such that the production of monodon shrimp is only for a small niche market. Now that India has expanded its vannamei production, the share of monodon shrimp production is expected to decline further. During the difficult times with diseases in vannamei shrimp in 2011, there was talk of converting to the monodon shrimp but this has yet to take off. In India, there will be some respite when commercial SPF post larvae, arising from the country's domestication and selective breeding program becomes available in early 2012. A hatchery in Malaysia plans to start producing SPF monodon post larvae in January 2012.

Global shrimp supply is expected to be limited while demand in China, the Asian countries and new markets such as Russia will increase. Japan's large importing houses are not willing to subject their consumers to higher prices which will shift consumer preference to smaller sizes and thus, the market will remain stagnant. However, a higher demand is expected from the US, as buyers learn to accept these high prices and pass them on to the consumer.

The rise in the production of tilapia is expected to continue, especially as Vietnam has targeted it as the second freshwater fish. China has been the largest producer and exporter of frozen tilapia. However, its domestic market is helping international prices by decreasing global supply. According to a major producer, its value added and ready to eat meals, developed for the export markets, now remain in China. Meanwhile, Vietnam's exporters of the pangasius expect 2012 to be a good year for expanding exports to the European market as several producers are working with the Aquaculture Stewardship Council (ASC) to certify pangasius under the WWF-Pangasius Aquaculture Dialogues. This will not only give a better image but also demonstrate that the fish is produced in a sustainable way.

The industrialisation of cage aquaculture is taking hold in Asia and we are already seeing the 'dualistic development', with industrial farms focusing on the pompano, barramundi or cobia which will serve the global white fish market as described by Dr Mike Rimmer. The small-scale production of various groupers and snappers will continue to serve the local markets and China for live fish. However, with changes in lifestyle, there will be an increasing demand for frozen and easy to cook fish that the larger scale single species farms can capitalise on.

In shrimp feeds, we can expect more interest in extruded feeds with the use of auto feeders. The better margins will also encourage farmers to try out slightly higher priced extruded feeds. The expansion in marine fish culture will encourage farmers to use more extruded feeds for selected species. This sector shows the highest potential and has already attracted European feed companies to Asia.

In 2011, independent processing plants in Malaysia, Indonesia and Vietnam faced high raw material prices for shrimp and found it difficult to survive. On the other hand, in India, because of a small local market, farmers faced low offer prices from a limited number of processing plants during the high season for their perishable product. In both cases, the trend is to see integration and consolidation in the industry space.

There is an important caveat that should we see a recession in 2012, this will bring in different schools of thought on the impact on the Asian aquaculture industry.

We wish all readers a HAPPY AND PROSPEROUS 2012.

Zuridah Merican

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AAP is pleased to announce the second of The Aquaculture Roundtable Series (TARS 2012). TARS 2012 will focus on the Shrimp Aquaculture – Shaping the Value Chain. It will be held in Phuket, Thailand from 15-16 August 2012. Check out www.tarsaquaculture.com for more details and updates.

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Demand for shrimp

In the first half of 2011, the global shrimp market was positive despite strong international prices. The December 2011 Globefish report indicated that in the first half of 2011, imports into the EU increased to 386,00 tonnes and US imports increased 2.1% compared to the same period in 2010. In Japan, a post tsunami recovery which began in June 2011 carried on to August with increasing demand for semi and processed shrimp whilst that for raw frozen shrimp declined.

Since mid 2009, prices have been rising. Prices for vannamei shrimp head on shell on (HOSO) 50/60 rose 28% to USD 5.50/kg from January 2010 to December 2011 in the EU market. Over the same 24 months period, US prices for headless shell on (HLSO) 36/40/lb rose 32% to USD7/kg and in the Japanese market, HLSO 31/40/lb shrimp rose 14% to USD 8.20/kg.

The demand from Asian and non traditional markets is also rising. China's imports of all types of shrimp increased to 178,704 tonnes against 149,760 tonnes in the January-June period of 2011 as compared to the same period in 2010. China has also emerged as an important export market for Vietnam's shrimp accounting for 9.6% of exports and rose by 70.5% to USD183 milllion. China has become a net importer with record prices, said Chang Swe Ming, Charoen Pokphand, Malaysia during a seminar in December in Kuala Lumpur. He added that shrimp imports into Korea rose 7% and Taiwan 15% in 2010 as compared to 2009. Vietnam's shrimp exports to South Korea increased by 31.9% to USD 122 million. The domestic market is rising in producer countries such as Thailand, Malaysia and India. Industry in the respective countries estimate these at 100,000 tonnes/year in Thailand, 25,000 tonnes/year in India and 35,000 tonnes/year in Malaysia which includes exports to neighbouring Singapore.

The Russian market increased 20% to 70,000 to 100,000 tonnes in 2010, whilst demand in Canada grew 7% and in Australia, 8%, said Chang. In January to September 2011, Vietnam recorded a 336% increase in exports to Russia at USD18 million, according to Vietnam Association of Seafood Exporters and Producers (VASEP). Shrimp is a popular seafood item in Australia but imports face specific quarantine restrictions since 2007. The total imports of 34,460 tonnes in 2009-2010 were mainly frozen prawns from Thailand, Vietnam and China.

In the US market, Indonesia's exports rose by 15.4% to 53,805 tonnes whilst that from India increased 81% to 33,242 tonnes during the January to September 2011 period. In www.kabarbisnis.com, Johan Suryadharma, vice president of the Indonesian Fishery Products Processing and Marketing Association said that it is without doubt that US shrimp consumption will reach 405,530 tonnes in the January to September 2011 period but the demand is for smaller shrimp which Indonesia can supply.

Globefish also reported that demand during the January- June period in 2011, from major EU countries remained strong with the exception of France where a decrease of 7.5% was seen. Imports by Spain, UK, Italy and Germany grew by 33.5%, 31.6%, 7.8% and 4.6% respectively. It said that the market is still price sensitive, which will favour sales of vannamei and other shrimp species that are in the lower priced categories.

In the Japanese markets all exporters showed declines in volumes for the January to September 2011 period. Thailand's share dropped 4.7% to 26,784 tonnes, Indonesia by 5.17% to 22.416 tonnes and the largest was Vietnam by 23.14%. Vietnam has been a major exporter of shrimp to Japan reaching 40,459 tonnes in 2010 (Jetro, 2011) and since 2009, the country has tariff-free access to the Japanese shrimp market under the Vietnam-Japan Economic Partnership Agreement. However, it recently faced issues with antibiotics residues which in turn instigated 100% checks on consignments. VASEP has advised all seafood exporters to apply rigorous testing measures on exported seafood to prevent financial losses and damage to its reputation.

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Related article: Marine shrimp production in Asia in 2011 in this issue, p 32-35.

Malaysia shift to Asian and US markets

Malaysia's seafood export business has shifted its focus to Asia and the US due to the lack of European Union-approved farms and fishing vessels in the country.

Malaysia Shrimp Industry Association president, Syed Omar Jaafar said in The Star Business, that aquaculture farms would need to invest to upgrade to be EU approved for export. Malaysia instilled a self- imposed ban on seafood exports to the EU in 2009 following an inspection by the Food and Veterinary Office (FVO) of the European Commission in 2008. The ban was removed in May 2009 and following this, farms are slowly modifying to be EU compliant. To date only 16 marine shrimp farms are certified to export to the EU, out of 1,000 farms. Prior to the ban, the value of exports to the EU was MYR 600 (USD 190 million). According to the Ministry of Health Malaysia, since May 2009 to October 2010, exports to the EU totalled 4,600 tonnes valued at MYR 62.7 million (USD 19.9 million).

"An average marine shrimp farm with 20 ponds would require at least MYR 1 to 2 million (USD 317,000 to USD 634,000) to upgrade and be compliant with EU standards and this depends on the condition of the farm. Banks are reluctant to lend money to aquaculture farms and fishing vessels with no strong collateral and regard the business as high risk", said Syed Omar.

"Since there is a limited supply of raw materials from EU approved farms, seafood processing companies are now adjusting their business to focus on exporting to Asian countries, particularly Japan, China, South Korea and Taiwan."

Malaysia's shrimp exports to the EU totalled 13,642 tonnes in 2008 and this declined to only 1,782 tonnes in 2009. Volumes have been increasing and the estimate is 3,368 tonnes in 2011. In contrast, exports to the US were 26,270 tonnes in 2007, 20,704 tonnes in 2009, 23,233 tonnes in 2010 and an estimated 22,415 tonnes in 2011. Producers diverted exports to Korea and other parts of Asia and exports increased to 7,589 tonnes and 25,294 tonnes, respectively in 2010 in comparison to 1,130 tonnes and 16,880 tonnes, respectively in 2008. Exports to Japan rose by almost 70% to an estimated 5,896 tonnes in 2011. The largest increase was exports to Australia at 337%.

Major industry players such as Texchem Resources said that Europe was a key market for them. Subsequently, the company shifted to Japan, China and the US. Chairman Fumihiko Konishi said that Japan is expected to contribute 50% of the business. Whilst China generates 20% of business, its seafood demand is increasing fast. Europe contributed to 30% of the revenue of Golden Fresh prior to the ban and now the company is trying to regain its market in Europe. It is expected to contribute 20% to revenue in 2011.

Combating disease in shrimp and carp

Scientists from Nofima in Norway and Indian scientists in the Central Institute of Brackishwater Aquaculture (CIBA) and Central Institute of Freshwater Aquaculture (CIFA) have characterised gene sequences in the rohu carp and shrimp. The result is extensive databases of the genetic material in these aquaculture species which will be used to find genes associated with disease resistance.

Rohu carp is an important aquaculture species in India. Over 1 million tonnes of rohu carp are produced annually in India and farming of carp in Asia is of far greater significance to global food supply than Norwegian salmon farming.

"The database of gene sequences from rohu carp contains more than 137,000 gene sequences and is an important resource for future genetic studies," said senior scientist Nicholas Robinson from Nofima, who headed the Norwegian component of this Norwegian-Indian collaborative project which began in 2008. The goal of the project is to develop technologies that can give carp and black tiger shrimp, improved resistance against disease.

The diseases furunculosis and white spot syndrome virus (WSSV) have had a dramatic negative impact on aquaculture production of carp and shrimp respectively, both in India and on a global basis. By developing tests and methods to improve resistance against these serious diseases, the project will make a significant contribution to more sustainable and productive aquaculture in this region. The research team aims to identify genes that are associated with resistance to furunculosis in rohu carp and WSSV in shrimp, and to improve disease resistance by selecting animals that have the best variants of these genes for breeding.

Some of the 50,000 genetic markers (single nucleotide polymorphism or SNP) which have been identified in rohu carp show large differences in allele frequencies between lines which were initially selected for high and low resistance to furunculosis. Particular genes are more highly expressed (i.e. have a higher rate of transcription into proteins) in resistant fish than susceptible fish. This knowledge about genetic variation and gene expression may be utilised in future work to increase resistance against disease and shows the benefit of the work so far.

"We have also identified more than 136,000 gene sequences for the black tiger shrimp. More than 50% of the established DNA segments represented previously unknown genes," said Robinson. Consequently, the comprehensive sequencing and mapping approaches used in the study provides a large potential to find genes of importance for disease resistance and other important characteristics in farmed shrimp.

The large amounts of data developed through the project will form the basis for applications for additional funding and, as such, a continuation of the valuable work. "In the first instance this will be beneficial for the Indian fish farmers, but it may also contribute to increased food production in India and elsewhere where these species are grown." (www.nofima.no)

News in Brief

Shrimp Aquaculture Dialogue releases final draft

The Shrimp Aquaculture Dialogue has released on December 21 the final draft of global standards for certifying farmed shrimp. When completed, the final standards will help minimize the key environmental and social impacts related to shrimp farming. This version of the standards is being used to create an Audit Manual and will be subject to voluntary field testing on selected farms. The draft standards for responsible shrimp aquaculture are available for download at http://www.worldwildlife.org/what/globalmarkets/aquaculture/WWFBinaryitem25639.pdf

The Dialogue's Global Steering Committee (GSC) used the feedback received during the last public comment period to revise the standards document and produce this final draft of the standards. The GSC is developing its formal responses to public comments which will be available on the WWF website in early 2012. The GSC reached agreement in this version and looks forward to using the results from this short field-testing phase to make any final, minor revisions to the standards so that they can be put into use on shrimp farms around the world.

The final standards will be handed over to an independent organisation, the Aquaculture Stewardship Council (ASC), during the first half of 2012. ASC will ensure farms are certified against the standards through independent third party certification bodies that are accredited by ASI and follow ISO and ISEAL guidelines.

Sleepy cod for China's middle class

Sino Agro Food, Inc, is an emerging integrated, diversified agriculture technology and organic food company focused on meeting the demand of China's rising middle class for gourmet and high-quality food items. It announced that a subsidiary, Enping A Power Fishery Development Co. Ltd. (EAPF), has a contract with Guangzhou Jinyang Aquaculture Co. Ltd. (GJAC), a modern and technology driven aquaculture company in Guangdong Province. GJAC specialises in nursery services and breeding of a number of high quality table fish such as puff fish, murray and sleepy cod in 64ha of production area in Pun Yun district, Guangzhou. The contract is for a supply of 500,000 sleepy cod ranging from 150g - 300g in 2012 and 800,000 in 2013.

EAPF will produce a minimum of 500 tonnes and 1,000 tonnes of marketable 500g fish in 2012 and 2013, respectively. This will eliminate the risk involved in growing from fingerling to 300g per fish. Based on current wholesale prices, EAPF is targeting and projecting USD13.5 million and USD 27 million of fish sales for 2012 and 2013.

Successful spawning of pompano in tropical waters

The Agri-Food & Veterinary Authority of Singapore (AVA) has successfully spawned pompano or golden pomfret fry. On a commercially viable scale, this is the first for Singapore. Following this success at the Marine Aquaculture Centre (MAC), located at St John's Island, AVA worked with a local fish farm to transfer the technology and develop a pompano breeding program. The batch of fry spawned at Rong-Yao Fisheries Pte Ltd in October will be ready for the market in April-May period.

Local farms will have a ready supply of pompano fry, which would in turn boost local production of pompano which was around 4.4 tonnes in 2010. By 2012, the supply of pompano is expected to reach 80-100 tonnes. AVA also encourages local fish farms to tap on its Food Fund for upgrading capability and increase productivity. This is part of the strategy to meet Singapore's target of 15% of food fish produced locally. In less than two years, this rose from 4.5% in 2009 to 7%.

Grouper aquaculture technology

National Cheng Kung University (NCKU) announced that it has transferred a novel immune-inhibition technology to promote grouper aquaculture to a third commercial operation. The technology which allows for fast growth in grouper, increasing the meat and fat content without the use of growth hormones, was developed by Chen Tzong-yueh, director of NCKU's Institute of Biotechnology over the last three years. Earlier this year, it was transferred to two other companies. The third party is Grobest Feeds Corp and the technology will add NTD2.2 billion (USD72.85 million) to the company's revenue over the next five years and increase its market share, estimated Chen.

In a 20-week field trial, Chen's research team used the immunosuppressant technology on one pond of groupers and a traditional method on another pond for comparison. The results show that groupers raised in the former pond grew to 490g, while the groupers raised in the latter pond reached only 375g. Chen said that grouper farms normally need 14 months to produce marketable 600g fish. With the new technology, however, his team only needs 10 months to produce the same size of fish.

End to mandatory testing for EU imports

The EU has ended the mandatory testing of frozen fish from Bangladesh from November 2011. It has been testing 20% of consignments from Bangladesh since two years ago. This new ruling will cut delays in exports and reduce costs. The EU relaxed the rule after an audit team of the Food and Veterinary Office (FVO) of the European Commission visited Bangladesh in March- April 2011. The inspection confirmed that improvements have been made particularly in the analytical methods for residue monitoring and traceability. The number of laboratories and testing equipment has increased. The government also implemented laws on feeds and hatcheries. Some 190,000 farms are registered. The seafood sector earned USD 625 milllion in 2010-11 and the Bangladesh Frozen Foods Exporters Association has set a target of USD1.5 billion from shrimp and fish exports in 2015.

More marine fish from Vietnam

Vietnam's Ministry of Agriculture and Rural Development (MARD) has set a target of 160,000 tonnes of marine fish by 2015, through industrial and small scale farming. The priority will be high value species such as groupers, pomfret, snapper, cobia and sea bass combined with the farming of bivalves, sweet snails and seaweed. It has also determined that sea cages should be clusters not exceeding one hectare and will be 500-1000m away from each other. Areas identified are in Quang Ninh, Phu Yen, Khanh Hoa and Kien Giang. A national marine fish hatchery will be built. (Vietfish International, Sept-October, 2011).

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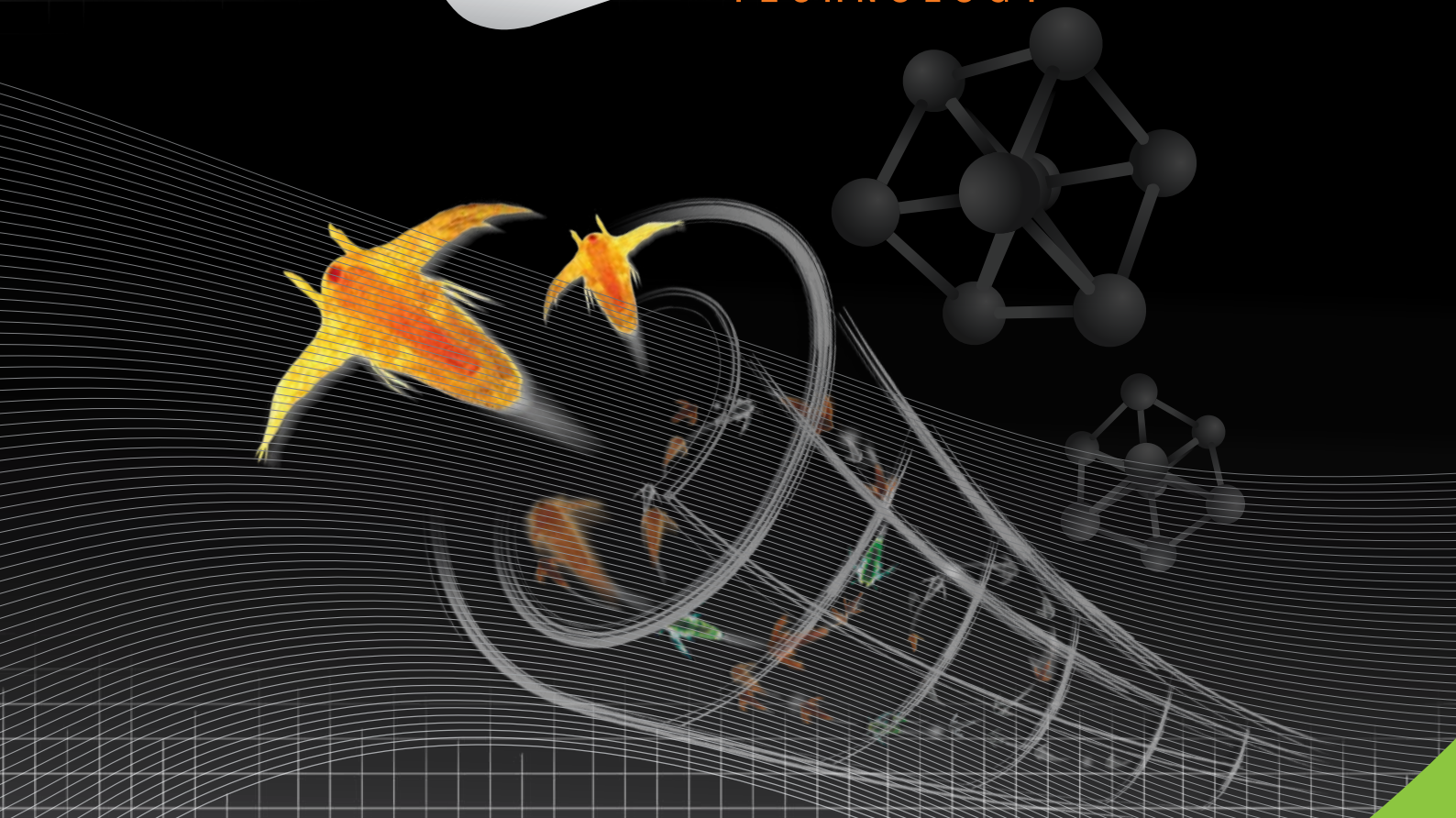

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Opinion article: More on early mortality syndrome in shrimp

Throughout 2011, early mortality syndrome or EMS was recorded as the most damaging syndrome threatening production in almost the entire region. In this article, Soraphat Panakorn shares his experiences in understanding the situation.

Dead shrimp after one month of culture

A soon-to-die shrimp with EMS

I am not sure how the name early mortality syndrome came about. I first heard this from Dr Chalor Limsuwan. We should term this a syndrome, not a disease as there is a collection of signs and symptoms known to frequently appear together but without a known cause.

The general symptoms are that shrimp die too fast after stocking. Investigations on the cause of death indicate no apparent reason for such acute mortality. In all the countries where the syndrome has been reported, the hepatopancreas becomes darker in colour, its size seems to be bigger then becomes pale and begins to shrink. In some shrimp, the hepatopancreas is clear or show clear tissue, similar in colour to gelatin and some, with fluid. At this stage, we see continuous mortality. By then, the hepatopancreas has deteriorated, is shapeless, changes colour and has less lipid droplets.

When samples were plated, there were large populations of *Vibrio* spp such as *V. vulnificus* and *V. parahaemolyticus*. Some dead shrimp from EMS showed black gills. The reason is that weak shrimp stayed close to the pond bottom. Reports indicated that mortality occurs from 15-25 days, ie the sizes would be 1.5 to 2 g. In severe cases, mortality is with almost all of the stock and with others, only 50%.

In EMS, infected shrimp show a pale hepatopancreas

A lesson from China

Many of us familiar with black tiger shrimp farming will remember the 'one month syndrome', except in the case of the current situation, this affects both black tiger and vannamei shrimp and is happening faster at 15 days. Some three years ago, the same symptoms were reported in China. At that time, Chinese farmers used to challenge each other and joked with the greeting, 'how many times did you stock for this crop.' They have experienced shrimp dying within one month. Stocking would be repeated several times, usually from 3-4 times/crop. Nowadays, in China, the answer is more, from 5 to even more than 7!

The early mortality was largely ignored as farm gate prices in China are higher than in other countries, more than USD 6-10/kg for 60 pcs/kg shrimp in comparison to only USD 4.5-5/kg for similar size in Thailand. With demand higher than supply, what the farmer needed was only one harvest a year. In 2011, it has been more serious especially in older areas with a culture history of more than 5 years and those closer to the sea using very saline water of 20-35 ppt range. Shrimp farming in Hainan, Guangdong, Fujian and Guangxi suffered during the first half of 2011 with almost 80% of losses. The second crop was better and the overall estimate was 60% of losses, i.e. 40% of production in 2009. Almost half of the vannamei shrimp production from China is in fresh water and these farms seemed to fare better. Production in Fujian, Zhejiang and Jiangsu from newer ponds of 2-3 years old helped with supply. Throughout 2011, shrimp prices in China were high due to lower supply.

Vietnam and Malaysia

The Mekong Delta used to be the heartland for the black tiger shrimp. The damage from EMS to this species was harsher than that for the

vannamei shrimp. In some farms, the damage was almost 100% although reports only mention up to 70%. In the central and northern part of Vietnam, where only vannamei shrimp is cultured, I would estimate 50% of production loss. Farmers collected dead shrimp and buried them in a pit in the dyke. Once this is full, the farmer will then know that it is time to abandon the whole crop.

The successful farms are those that paid attention to good quality post larvae, good pond preparation, implemented good feed management and biosecurity. They also had good aeration systems, with enough power supply, good water circulation with treatment reservoirs and new or repaired polyethylene liners in ponds.

The situation in Peninsula Malaysia showed another pattern; mortality was high in the eastern coastline, estimated at 70%, western coastline at 40% and overall, the estimate was 50% of the peninsula's yearly production. Another pattern was shrimp farmed in high salinity faced mortality faster than those in low salinity. In a Malaysian farm which did not face any problems with EMS, the Thai farm manager attributed this to high quality post larvae and checks that the post larvae pass all the required tests and on top of that, is free of any bacterial contamination.

Thailand

Contrary to the information that EMS has not affected farms in Thailand, I learnt that early mortality has occurred too, but not at the same level of severity as in these countries. What they have experienced is that during checks on the feed tray at 25-40 days of culture, shrimp reached almost 10g and they were happy at the fast growth. Two weeks later, water turned thicker and a crash was pending. They found some dead shrimp and on harvesting, it was discovered that feed conversion ratio (FCR) was over 2.5 and survival rate was 40%. To date, there has been no remedy.

Why is the situation in Thailand, not as serious as in the other countries? I believe it is because of the Thai system of culture, using high levels of aeration and automatic feeders which can regulate feeding. This also improves pond conditions. It is general knowledge that when shrimp are less stressed with higher dissolved oxygen and low pollution, immunity against infections is higher.

What should farmers do?

As we still do not know for certain what causes EMS, we can only have general suggestions on how to overcome the syndrome. My recommendations are that farmers should only use post larvae that pass all the necessary tests, particular those on virus, bacteria and fungi. They should stock at a minimum age of PL10. I believe that

Dead shrimp with black gills

In Vietnam, farmers fill a pit with dead shrimp

A farm free of EMS in Malaysia

In China, the farmer will dry the dead shrimp on the pond dyke

once post larvae are free of vibriosis, there should be no problems in the ponds. During stocking, it is important to keep the differentials in water parameters between pond water and post larval bag water as close as you can; gaps in pH must less than 0.5, temperature less than 1 degree Celsius and salinity less than 2. Other measures include; avoid stocking under windy, cold, hot or rainy conditions, run aerators at least 10 hours before stocking and do not cause any disturbance to pond bottom during stocking. If salinity is low, it is necessary to provide mineral or salts during the process.

As a standard operating procedure, I would check for *Vibrio* every 2-3 days in pond water. The anaerobic conditions in black soil in the ponds should be monitored for excessive population of *Vibrio* bacteria. The minimum tolerable levels are not clear but in a study conducted 7 years ago, vibrosis at 3 to 4,000 CFU/ml affected black tiger shrimp and vannamei shrimp was affected at higher levels of 10,000 CFU/ml. In 2010, some laboratories reported that a CFU/ml level of 5,000 caused problems for vannamei shrimp.

They should implement good feed management techniques, stock only 80% of the last crop and avoid extreme seasons such as monsoons. Control of pathogenic bacteria can be through the use of effective microorganisms that can digest organic matter and compete or suppress harmful bacteria. Sufficient aeration, preferably consistently at 5mg/l should be the norm. All pond and water conditions should be optimal.

Lastly, one of my respected masters in shrimp farming used to warn me, 'in the future, bacteria might become more serious than viral outbreaks in shrimp culture.' He added that, 'every problem will be out of control unless we can control our greed'.

We should learn from what is happening with the EMS. It is time that all of us learn to respect the shrimp and the environment it needs. This is the only way for us to survive and continue farming shrimp.

Tilapia as biological control in intake water ponds

Soraphat Panakorn is technical sales & support manager for the Aquaculture Business Unit, Novozymes Biologicals, Asia Pacific. This article is his personal opinion and is a result of his visits to farms all over Asia. His message to farm managers is that it will be possible to overcome EMS. All this requires is more attention to the culture systems and environment and take a long term view of the business.

Aquafeeds in Asia

Changing focus in 2011

By Zuridah Merican

A difficult year for the shrimp feed business in Vietnam, Malaysia and Indonesia contrasts with expansion in India and a general optimism with marine fish feeds.

Feed producers in Vietnam, Malaysia, Thailand and Indonesia reported lower sales with shrimp farms facing disease, culture problems and floods. In Malaysia, shrimp production is estimated to drop by 35%, However, the impact on feed is higher resulting in over 40% drop in feed sales. In China, industry reported that shrimp feed production in Guangdong and Hainan Provinces was affected by the drop in shrimp production, but not in Zhejiang and Jiangsu Provinces. Overall volumes remained close to 1.5 million tonnes.

Fish feed production (for both freshwater and marine fish) increased to 13 million tonnes in China. In Thailand, more volumes were reported despite farms being affected by the floods. In the Philippines, large fish kills in several lakes scared off consumers, brought down demand and affected the aqua feed industry. Industry in Vietnam reported a 20% drop in feed volumes for pangasius feeds in June to August 2011. The marine fish feed sector is expanding, particularly in Malaysia and Indonesia, with increasing usage of extruded feeds. In Thailand, because of the massive floods in October and November, several feed millers faced the problem of lack of ingredients to meet production targets and a few in low lying areas stopped production.

Shrimp feeds

In Thailand, industry said that shrimp feed consumption declined by 5-10%. Early in the year, shrimp farms were affected by the flooding and heavy rains in the south. The worst flooding in the country's history in October and November affected farms in the central region, although it was a low season. Farmers will be starting their cycle after January, depending on the temperature and prices.

Although improvements in culture technology and high shrimp prices encouraged farming, there was little indication that shrimp feed usage increased in Indonesia. In the first half of 2011, the production was 90,000 tonnes for the open market, according to the Aqua Feed Branch of the Indonesian Feed Manufacturers Association. Information on usage by the integrated operations was not available. With the good shrimp prices now, farmers select higher quality feed such Gold Coin's Forte range with 36-38% crude protein which is formulated for the vannamei shrimp.

There are now new formulae tailored to culture systems. In Indonesia, where the trend is to use bio floc technology to improve yields, PT Matahari Sakti introduced a range of feeds for low water exchange systems. The Tata shrimp feed is for culture in densities of

70-150 PL/m^2 and contains 28-30% crude protein. At higher stocking densities of 100-200PL/m^2, there is the 32-35% crude protein feed in the Kaiohji range which also contain nucleotides.

A new vannamei shrimp feed called Uni vana was introduced in India by UPEC India Foods, imported into India from Uni-President Enterprises, in August 2011. This was in addition to three brands of black tiger shrimp feeds and one for the vannamei shrimp. This new feed is to strengthen the position of Uni-President in India. It has a crude protein level of 32-36%. The feed is designed for low stocking density of 60 PL/m^2 as regulated by the government. The company's aim is also to reach a sales volume of 15,000 tonnes/year.

Rising feed prices was an issue in Vietnam, where there have been several price adjustments because of increases in feed ingredients and labour costs. Feed prices are now VND25,000/kg (USD 1.18/kg). In Indonesia, producers have requested for removal of tariffs to reduce feed costs. Prices are IDR 10,000 to 12,000/kg (USD1.09 to 1.31/kg) depending on the region and feed type.

Autofeeders and extruded shrimp feeds

The trend of using autofeeders in feed management was introduced in Thailand in 2006 and has spread to most countries with varying degrees of uptake. While some farmers in Thailand have reverted to manual feeding, new designs continue to show the benefits especially in reducing feed waste, improving feed conversion ratios and reduction of labour. Industry said that using autofeeders actually reduced consumption by 2-3%. At regional trade shows, suppliers in Thailand, Malaysia and Indonesia have been actively introducing versions of the autofeeder. With autofeeders, issues on the physical properties of the pellet and level of fines have been raised. For example in Thailand, a farm is using sizes 3P or 4S feeds only as large pellets tend to break up easily.

Thailand's Betagro is the only producer of extruded shrimp feeds in Thailand and the demand for these feeds is increasing especially with the use of autofeeders. Extruded pellets have less fines. Uni-President Enterprise also produces extruded feeds in Taiwan. In India, the IB group will be launching extruded shrimp feeds in the second quarter of 2012.

Freshwater fish feeds

The industry in Malaysia estimated a lower feed consumption by 20-23% in comparison to that in 2010. This was because of lower prices for tilapia and some infections with *Streptococcus* in the early part the year. It was better after mid-year when fish prices picked up only in August. Tilapia prices rose to MYR 9.50/kg (USD 3/kg) as compared to the low of MYR 5.50/kg (USD 1.8/kg). These prices are expected to stay until the Chinese New Year in January 2012.

Dindings Soya and Multifeeds produces freshwater feeds mainly used by tilapia and Clarias catfish farmers. According to Chong Kam Kin, in charge of sales and marketing, "In the case of feeds for the Clarias, we also expect a drop in volumes as there has been no differentiation in the retail market between fish fed commercial pellets and farm made feeds. In addition, ex-farm prices have been between MYR 3.20-3.30/kg (USD 1.1/kg), below the minimum of MYR 3.80/kg (USD1.27/kg) required for catfish farms using commercial pelleted feeds to meet production costs."

In contrast, in Indonesia, with the program for Clarias farming to increase national fish consumption, PT Matahari Sakti expects higher sales of its Clarias feed with 30% crude protein, costing IDR7,000/kg (USD0.76/kg) and which has shown a FCR of less than 1. It is also optimistic with sales of the 20% crude protein tilapia feeds costing IDR6,000/kg (USD0.65/kg) as shrimp ponds now stock black tilapia.

"In Thailand, before the floods, farmers have been enjoying very good prices, especially for the red tilapia in cages which fetched THB 80/kg (USD 2.5/kg) as compared to pond reared which was THB 60-70/kg (USD 2.2/kg). In general, ex-farm prices for the black tilapia is always less at about THB 50-55/kg (USD 1.74/kg) compared with that for red tilapia and cage-raised is higher than pond reared. Catfish farmers also saw prices increasing to THB 40/kg (USD 1.3/kg)," said Thomas Wilson, Thai Luxe Feeds, Thailand.

"However, the yearly flooding situation has made the farmers extremely risk-averse, and many are considering not farming during the late wet season. In September-October 2011, the flooding in the central region caused losses from 50,000 ponds of fish and shrimp. If these fish had been kept in cages, there would have been little effect. During the flooding, fish were also hard to sell, and prices dropped. Feed demand overall went down as a result, and feed sales have been slow to recover because large areas remain affected. Thus, in the future, farmers may try to have fish in cages in reservoirs, where there is no flooding risk, following the example of Charoen Pokphand and Betagro companies, each with increasing numbers of cages in reservoirs in North East Thailand."

Marine fish feeds

With more corporate farms, the marine fish farming sector is slowly moving away from feeding with trash fish, although for some species, trash fish is still the only option. Notwithstanding, the preferences by the fish, there are also economic considerations by the farmer. In the Malaysian marine fish feed market, there are three local producers; Star Feed Mills, Dindings Soya and Multifeeds and Cargill. Both Uni-President Vietnam and PT Matahari Sakti, are very aggressive in the import market for marine fish feed in Malaysia.

Industry agreed that in 2011, the demand for extruded feeds increased due to higher fish prices. This upside is encouraging local production and Dindings Soya and Multifeeds which produces floating and sinking marine fish feeds will be looking to redevelop its marine fish feeds in the near future, said Chong.

Sean Lai, Star Feed Mills, sees this as signs of better feed sales. "We have reached the stage whereby we can feed the pompano *Trachinotus blochii*, 100% on pellets and now we need to work on the other species. For the seabass, it will depend on the source of juveniles and culture system. In pond culture, we feed 90% pellets. In cages, with juveniles from Thailand, which have not been weaned, we need to combine with trash fish. However, locally produced juveniles will grow very well when fed totally on pellets as is happening in the cages in the southern part of Peninsula Malaysia. The ex-farm prices of sea bass which averages MYR 14/kg (USD 4.5/kg) and can go as high as MYR18/kg (USD 5.7/kg), is also encouraging farming of the fish. The cost of production ranges from MYR 8 to 10/kg (USD 2.5-3.17/kg), depending on the cost of fry," said Lai

In November, prices reached MYR 78/kg for the tiger/giant grouper hybrid, MYR63/kg (USD 20/kg) for the tiger grouper and SGD11/kg (USD 8.4/kg) for the pompano. The giant grouper is fed on trash fish or trash fish and extruded feeds. The feeding of the hybrid grouper vary from a combination with trash fish to 100% extruded feeds depending on the farm.

Changing focus in India

Concurrent with the large production of 240,000 tonnes of shrimp, mainly vannamei, the shrimp feed demand was the highest recorded at 300,000 tonnes, according to industry in India. Five major shrimp feed manufacturers; Charoen Pokphand (India), Avanti Feeds, Waterbase, Grobest and Godrej Agrovet had 80% of the shrimp feed market in 2011. In 2010, Uni-President Enterprises set up their own office in India as UPEC (India) Foods Pvt Ltd. It currently imports 10,000 tonnes

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of shrimp feeds annually. During peak demand, Avanti and Charoen Pokphand also brought in around 12,000 tonnes from Thailand. Selling prices for vannamei shrimp feeds average INR45/kg (USD1.00/kg at exchange rate of INR45 to USD in mid-year). Since 2010, the aqua feed industry in India has been expanding shrimp feed production with new pelleting lines and plants as well as changing focus from fish feed to shrimp feed production.

Avanti set up a third feed mill with 30,000 tonnes per year (tpy) in Valsad, Gujarat on the west coast whilst expanding its feed mill in Andhra Pradesh. In 2011, production was 60,000 tonnes of shrimp feeds. Shrimp feeds are produced in collaboration with Thai Union Feed Mill of Thailand. Charoen Pokphand India expanded capacity in the feed mills in Chennai and Visakhapatnam to double capacity. It produced 170,000 tonnes of shrimp feed in 2011. A new feed mill is planned for Andhra Pradesh, the main shrimp farming area in India. Cargill and Bharat Luxindo, the latter is part of the Global Feeds in Indonesia, are refocusing on the shrimp feed market. Cargill will use its current plant whilst Bharat Luxindo has a new shrimp pelleting line.

Building a new feedmill is Nexus Feeds belonging to the Reddy & Reddy Group in Bhimavaram. Production is expected to start at the end of February 2012. In the last quarter of 2011, Sharat Seafoods completed the expansion of its pelleting line and started marketing feed to the open market. The company is an integrated vannamei shrimp producer with a shrimp hatchery, a 180 ha farm, feed mill and processing facilities in Thotapalli Gudur Mandalam, Nellore District. The shrimp is certified by Friend of the Sea (FOS).

"Since 2009, there was a rapid expansion in the production of extruded feeds for the pangasius catfish. In 2011, the eight players in extruded fish feed production had a combined production capacity of 160 tonnes/hour. Consequently, there was uncontrollable increase in stocking density, leading to an over production of the fish. This sudden increase would have been manageable if we had the cold storage and processing capacity. Prices dropped to below cost of production and many farmers stopped farming the fish," said Ramesh G, manager, Wenger, India.

"Fish feed producers were in a dilemma on what to do with the excess capacity, especially when floating feeds are slow to find acceptance among rohu carp farmers and the demand for extruded marine fish feeds does not exist. Current production uses only 50% of this capacity. The revival of fish farming would happen only with species diversification and the development of fish processing industry"

To sustain their business, these dedicated fish feed producers will now be looking at either using the extrusion equipment for the production of shrimp feeds or add on shrimp feed pelleting lines. Uno Feeds will be setting a pelleting line for shrimp feeds to start production by mid 2012 whereas the IB group will be launching extruded shrimp feeds in the second quarter of 2012, which will be closely followed by the Growel group launching their shrimp feed by end of 2012. Recently, the Coastal Aquaculture Authority has allowed vannamei shrimp to be farmed in freshwater ponds and this seems to be a good business decision for these fish feed producers.

Expansion and acquisitions

These have been mainly in Vietnam's shrimp feed industry. Uni-President Vietnam, the leader in shrimp feed production in Vietnam added a feed mill in Quang Nam in the north producing only shrimp feeds. This is in addition to the feed mills in Binh Duong, near Ho Chi Minh City and Tien Giang in the south, both producing shrimp, marine

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and freshwater fish feeds. Cargill, a leading producer of feeds for the pangasius catfish added shrimp feed to its portofolio through the acquisition of Higashimaru Vietnam Co, a shrimp feed mill.

In 2011, Skretting Group, the world largest aqua feed production group, entered the markets in Vietnam and China. In Vietnam, it acquired Tomboy Aquafeed JSC, one of the leaders in the shrimp feed market. Tomboy also produces feeds for the tilapia, barramundi, snapper and grouper from two plants near Ho Chi Min City and in Long An Province. It has a country-wide distribution network, both for fish and shrimp feed. Tomboy had the fourth largest share in the shrimp feed market in Vietnam, after Uni President, Charoen Pokphand and Grobest Feeds. In China, Skretting acquired Shihai Co Ltd, a shrimp feed producer in Zhuhai, Guangdong province. Shihai produced 150,000 tpy of feeds with six production lines for shrimp feeds and three for fish feeds. In China, Shihai targets the high end segment. Some 50% of production is shrimp feeds whilst the rest are feeds for the snakehead, grouper and tilapia. Since April 2011, Tomboy began to produce 10,000 tpy of premium pangasius catfish feed, officially registered in Vietnam as fully 'ASC compliant'. Such feeds will be required by farms seeking certification under the WWF-Pangasius Aquaculture Dialogues.

Ewos, Norway, through its group Cermaq created a joint venture in Vietnam to focus on feeds for the pangasius catfish. The venture partner Anova Corporation has a plant in Long Anh Province with a capacity of 85,000 tonnes of fish feeds. Cermaq may also look to investing in pangasius farming in the future. Thailand's Betagro will be concentrating on fish feed production and will expand. It may go further into integration activities.

New to the aqua feed business in Vietnam is De Heus LLC Vietnam, currently selling complete feed, concentrates and premixes for swine and poultry. It has acquired a fourth feed mill in Vietnam in Hoa Phu Industrial Zone, Long Ho Commune, Vinh Long Province. The former Phi Dung aqua feed mill produces feeds for the pangasius catfish and has a capacity of 4,000 tonnes per month. De Heus will upgrade this to 6,000 tonnes per month and targets to be a top 10 feed producer in Vietnam by 2013.

In China, the Haid group is rapidly expanding its aqua feed production capacity. It will have new fish feed factories in Zhuhai City, Guangdong Province with 18 production lines and Hainan Province as well as a fish and shrimp factory in Guangxi Province. Others will be aqua feed and poultry factories in Tianjian City, Yiyang City, Hunan Province, Nantong City, Jiangsu and Jiangxi Provinces.

Table 1. Some estimates on aqua feed consumption (tonnes) in 2011 in selected countries.

Countries	Marine shrimp	Freshwater Fish	Marine fish
China[a]	1,500,000	13,000,000 (include marine fish feeds)	
Thailand[a]	840 000	700,000	NA
Vietnam	350,000[a]	1,200,000[b]	NA
Indonesia[c]	250,000	730,000	25,000
India[a]	300,000	420,000	Nil
Malaysia[d]	80,000	80,000	50,000

[a] estimates by industry stakeholders and feed producers,
[b] mainly feeds for the pangasius catfish; 600,000 tonnes in integrator market
[c] Indonesia – calculated based on industry estimate of feed in open market of 180,000 tonnes and integrator market of 70,000 tonnes in 2011; fish feed-estimate made in 2010
[d] Malaysia - includes 27,000 tonnes of shrimp feed imports; Freshwater fish-mainly feeds for tilapia; Marine fish-includes about 16,000 tonnes of imported marine fish feeds

17th Aquaculture Conference Asia Pacific

This year, the DSM Aquaculture Conference prepares for the future for healthy seafood with emphasis on lipids and omega-3 fatty acids, algal DHA and nucleotides. This is supplemented with information on the current situation with diseases in marine shrimp and trends in the global markets for fish meal and fish and vegetable oils.

From left: Jean-François Mittaine, Thomas Wilson, Thai Luxe Feeds, Thailand and Jacques Gabaudan

Moises John C Reyes, DSM Philippines (middle) with from left. Dr M Poornima, Dr Saengchan Senapin, Heny Budi Utari and Pakkakul Sangsuriya, Centex Shrimp, Mahidol University.

Dr Jacques Gabaudan, Aquaculture Centre Asia Pacific said, "The world has reached a milestone with the 7th billion baby born in the Philippines. As the world celebrates this, we should have solutions on how to feed the world. Aquaculture is quoted by Foresight UK in 'the future of food and farming' as the way to meet fish supply. "The resource challenges ahead will require the industry to produce more but with increased sustainability".

"FAO already estimates that 50% of our fish supply will be from aquaculture in the near future. The annual growth rate of aquaculture was 8.3% for the period from 1970 to 2008. China, the largest aquaculture producer consumed 80.2% of food fish from aquaculture, from 24% in 1970. The rest of the world consumes only 26.7% of food fish from aquaculture, up from 5% in 1970.

"In our previous conferences, we have looked at issues of sustainable production with respect to fish meal replacement. Today, we will update you on lipid nutrition and nutritional tools for disease management."

Healthy fish and shrimp

This was discussed in two presentations which covered lipids and fatty acids and their role in the production of healthy seafood. **Prof Douglas R Tocher**, University of Stirling, Scotland said that besides being rich in proteins, essential amino acids and essential vitamins and minerals such as iodine, Se, vitamins A, D & E, seafood is the unique source of essential omega-3 (or n-3) long-chain polyunsaturated fatty acids (LC-PUFA), specifically 20:5n-3 (EPA) and 22:6n-3 (DHA), in the human diet.

The n-3 LC-PUFA have important roles in the alleviation of coronary heart disease (CHD) where evidence shows a 25% reduction in CHD/MI (myocardial infarction) and 45% reduction in sudden cardiac death with n-3 supplements. Besides this, LC-PUFAs have specific roles in the control of inflammatory and neurological diseases. The LC-PUFAs, particularly DHA, are crucial in neural tissue development especially in neonatal & foetal development of the brain and retina. The proliferation of some cancer cells increased with n-6 PUFA but is attenuated with n-3 LC-PUFA which promotes apoptosis of leukaemia and lymphoma cells. Animal studies showed reduced cancer growth and increased efficacy of chemotherapy with n-3 supplementation.

Tocher reviewed the physiological functions and requirements of lipids and LC-PUFA in aquaculture species. Which PUFA can satisfy essential fatty acid (EFA) requirements depends on the species. Some characteristics of fatty acids are clear such as digestibility which increases with increasing unsaturation and decreases with increasing chain length, particularly with saturated fatty acids. Digestibility also decreases with decreasing temperature and is largely based on physical properties (solubility) of the fatty acid. The relative oxidation rates of fatty acids from *in vitro* studies show saturated/monounsaturated fatty acids > PUFA > LC-PUFA. In the case of saturated fatty acids, oxidation of shorter chain fatty acids is higher than of long-chain and PUFA, and the relative oxidation rate is higher for n-6 as compared to the n-3 fatty acids. *In vivo* studies show that fatty acid relative deposition and retention is reduced at higher concentrations of the fatty acid in the diet. The exceptions are DHA which is more resistant to β-oxidation because of the 4 double bond and 22:1n-11 which is highly oxidised, irrespective of dietary level.

Requirements of lipids and essential fatty acids (EFA)

"We cannot be specific on the optimal lipid requirement or even accurately define this as it depends both on the other components of the diet and the composition of the lipid component. There is a minimum lipid level based on the amount required to supply essential lipids (EFA, phospholipids and cholesterol), and a maximum level based on the ability to efficiently digest and metabolise the lipid. Phospholipids are required in early (larval/juvenile) life stages by both fish and crustaceans at between 1% to more than 10% of diet, but apparently not in adults. Phosphatidylcholine appears to be more associated with stimulation of growth whereas phosphatidylinositol is more associated

An update on the global market for fish meal and oil

Jean-François Mittaine, consultant, "Fish, Oil & Meal World", returned to the conference to give his overview of recent trends in fish meal and oil markets. His last update was in 2009. Fish, Oil & Meal World is a joint-venture with ISTA Mielke GmbH, publisher of OIL WORLD, founded in 1958, a leading private authority for global research and market analyses for oilseeds, oils & fats and oil meals.

"The commodity market is generally bearish in light of the world economic situation, financial volatility and the overall economic uncertainties. The soybean market shows signs of weakness on account of lower demand," said Mittaine.

Fish meal

"Since January 2011, fish meal prices have declined steadily to a current USD1120/tonne, FOB Peru for the standard quality. These are USD200 below those of 2010. But fish meal is not just fish meal. 'Super prime' and 'prime' fish meal have shown a premium of about USD200/tonne for the past ten months. China is a key market, accounting for 28% of world consumption. Other markets are EU27, Japan, Thailand, Norway, USA, Taiwan and Vietnam.

"One quarter of world fish meal production is produced from trimmings such as from salmon which can be used for shrimp feed. This share will be increasing. In general, the price situation is a result of supply and demand. Consumption fell to 4.6 million tonnes which is 9% below that for the 2007-2010 period. In 2011, world production of fish meal was up by 20% at 5.1 million tonnes. This was the steepest annual increase since 1999."

Fish and vegetable oils

Fish oil prices have been relatively stable at USD 1300 to 1350/ tonne since June 2011. As rapeseed oil prices have been weakening a bit lately, the fish oil/ rapeseed oil price ratio has been rising from 1 to 1.2. Such ratio favours substitution with rapeseed oil.

Fish oil production increased 14% to 1.02 million tonnes but consumption has declined 3% as compared to 2010, to less than 1.0 million tonnes. However, 80% is still used for aqua feed. The leading market is Norway which, combined with EU-27, account for 41% of the volume. Other markets are Chile, Japan, China, Canada, Taiwan, Turkey and USA.

World demand for vegetable oils has increased by 59 million tonnes in the last 10 years, largely on account of rising of the requirement for biofuel production and domestic uses. Rapeseed oil production has increased to 23 million tonnes in 2011 from 8.7 million tonnes in 1990/1991.

Mittaine emphasised two new developments. "The long term vision is for the direct human consumption of fish meal, i.e. feed the people. As such the industry should be encouraged to carry out research on such proteins, and develop marketing strategies to introduce such fish proteins to the end-users.

"The new market for fish oil is that for 'omega 3' oil for which demand is rising. In 2009, about 90,000 tonnes of crude fish oil was used for this purpose. In 2011, this usage is expected to reach 150,000 tonnes. The global fish oil market is moving towards this segment and the main challenge is supply control. There are other sources of omega 3 but supply is still limited and as such, the trend is bullish for this market. A new market is also that of fatty acid as additives but this is not a commodity market," said Mittaine.

with increased survival. Cholesterol is required in the early stages of crustaceans at around 0.2% but are we clear on this for the adult stage? Cholesterol is not required for fish.

Between species, the EFA requirements of fish and crustaceans will vary qualitatively and quantitatively. Requirements also vary with stages of development. In general, the EFA requirements of freshwater fish can be met with C18 PUFA whereas there is requirement for LC-PUFA (EPA, DHA and ARA, 20:4n-6) for marine fish. In crustaceans, the situation is not entirely clear but there are species that require C18 PUFA such as *Penaeus monodon* and LC-PUFA such as *P. vannamei*.

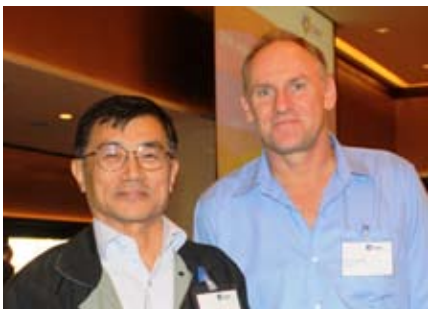
"There are no major physiological roles for the 18:2n-3 and 18:3n-3 in fish and crustaceans, except that they can be precursors for LC-PUFA if the appropriate genes/enzymes are present. For example, with salmon, the EFA requirement can be satisfied by 1% 18:3n-3 but LC-PUFA can satisfy EFA requirement at a lower level. Nowadays, with much higher expectations on growth, should we revisit EFA requirements for some species? Which PUFA satisfy EFA requirements depends on endogenous metabolism," said Tocher.

"In the past there has been no issue with LC-PUFA because we have been using fish meal and fish oil. Increasing demand and static or declining supply of these marine resources has demanded that we seek alternative protein and lipid sources. Currently, the most sustainable solution has been replacement with plant meals and vegetable oils. However, plants lack LC-PUFA and so there is the considerable challenge to maintain adequate n-3 LC-PUFA in the product to satisfy human health, product quality and certification requirements (such as Label Rouge). In salmon production, during grow-out, feeds are currently formulated with a relatively high level of plant proteins and a blend of fish oil and vegetable oil, primarily rapeseed oil, that maintain a good level of n-3 LC-PUFA. However, these levels can be boosted by using a fish oil finishing diet prior to harvest. For the longer term, we need to find alternative sources of n-3 LC-PUFA. Some research is looking at other marine resources such as microalgae or zooplankton (krill and copepod oils), but currently the most promising long-term solution is the *de novo* production of n-3 LC-PUFA in transgenic organisms including oilseed crops engineered to contain EPA and DHA."

DHA

DHA is important throughout all stages of life, said **Christian Martin**, DSM Nutritional Products. Some 97% and 93% of n-3 fatty acids in the brain and retina respectively is DHA. It supports myelination which influences the speed that information is acquired and processed and in older adults, increasing the intake of DHA reduces the risk of dementia by 47%. DHA

From left, Tawat Kittibunchakul, Vet Agritech Co Ltd, Dr Orapin Sukpiriyagul, Betagro Agro-Group Public Co., Dr Mali Boonyaratpalin, Dr. Supis Thongrod, Thai Union Feedmill Co and Kittipol Ratankul, Vet Agritech Co Ltd (back)



Dr Chen Ming Dang, Charoen Pokphand, Thailand and Matthew Briggs

Christian Martin

Douglas R. Tocher

algal oil from Martek, slows the development of β amyloid plaques and Tau levels, hallmarks of Alzheimer's disease. Awareness of the health benefits of DHA is on the rise; it was 50% in 2009 from 10% in 2003.

A source of DHA is algae with biochemical pathways distinct from higher plants, animals, fungi and bacteria. This is a unique genetic resource that can be screened and utilised for a variety of valuable applications and gives us proteins, carbohydrates, nucleic and fatty acids. The drum dried, whole cell *Schizochytrium* sp is the algal product, DHAgold™ produced by Martek which DSM acquired in 2011. It has about 18% DHA. When encapsulated it is protected from oxidation. How can all this be applied to the aqua nutrition market?

"This is a sustainable source of DHA and omega-3 fatty acids. It can be extruded and mixed into the feed. The DHA recovery is good. DHA in finishing diets bolsters fatty acid profile and provides value to consumers desiring higher DHA levels. At a feeding rate of 1% in grow out and finisher feeds, it is a good replacement for fishmeal," said Martin.

In several studies with salmon and other fish, it was shown that the algae can be used to replace fish oil without detriment to growth. A diet where 50% of the fish meal was replaced with a plant based protein and 100% of the fish oil was replaced with DHAgold plus linseed oil showed identical growth to the FM/FO controls (Laurin et al., 2006). As FIFO ratios are critical for industry to be sustainable and ratio of wild fisheries inputs to farmed fish is high at 5.0 for Atlantic salmon, the outlook for single-cell organisms to replace fish oil is promising. In shrimp, a fish meal-free, vegetarian diet including *Schizochytrium* sp. can be a fully equivalent or superior shrimp production grow-out feed compared to conventional fish meal-based diets (Browdy et al., 2006). Cobia fed a diet including 1.5g/100g of DHAgold achieved a 218% weight gain and 2.75% specific growth rate. Fish on this diet also had a higher feed efficiency ratio (56%), compared to other experimental diets. (Salze et al., 2010).

"Sustainability is a main driver of production especially with companies such as Wal-Mart which will only buy products certified as sustainable. At

the same time, with the increasing awareness of the role of DHA in health, US consumers are being encouraged to eat more seafood."

Shrimp diseases and nutritional tools

There are new diseases as well as recurrence of others such as the white spot syndrome (WSSV). These have caused stagnation in production in 2010 and will likely bring down production in 2011, said **Dr Matthew Briggs**, Vannamei 101, Thailand, in his presentation on the status of shrimp diseases in the region. There are more and more viruses to worry about. Currently, the major problems have been new diseases working their way around China, Vietnam, Indonesia and Malaysia. These are in addition to the omnipresent WSSV which continues to manifest in its established areas and is also appearing elsewhere.

Briggs said that WSSV is the single biggest threat with periodic severe outbreaks especially during the colder months in Asia. New outbreaks were also reported in Saudi Arabia, Mexico, Brazil, Hawaii and Mozambique. Unfortunately, there are no treatments except that WSSV resistant strains of vannamei shrimp have been recently developed in Latin America. IMNV- infectious myonecrosis virus has been in Indonesia since 2005 and the debate is on whether it has spread outside off Indonesia. Despite persistent rumours of IMNV occurring in others parts of Asia, confirmed positives from shrimp samples have been limited to those from Indonesia. Selection against IMNV is being attempted but this will take a long time before it reaches the market.

Some of the management strategies against IMNV have been maintaining temperature of post larvae at 30°C, reducing stocking density to 70-80 post larvae/m^2 from 130 post larvae/m^2 and increasing biosecurity in all areas. Some farms have turned to culture practices such as all batch in and out, using crustacide, replacing the species with monodon shrimp, changing to closed biofloc systems and polyculture with tilapia and milkfish at 0.5 fish/m^2," said Briggs.

The new threat

The most recent threat to farms in China, Indonesia, Malaysia, and Vietnam is early mortality syndrome (EMS) with high mortality at 15-30 days. As there is acute progressive degeneration of the hepatopancreas, shrimp disease expert Donald Lightner, Arizona University has named this as AHDS-Acute Hepatopancreatic Degeneration Syndrome. It was first reported in the spring of 2010 with vannamei shrimp in China and monodon shrimp in Vietnam and deteriorated in the following year. It is also present throughout West Malaysia. There is also a slow death syndrome, occurring at the first month and again after 2 months.

"It is unclear whether EMS and this slow death syndrome are related. The symptoms are pale hepatopancreas and the stages show destruction of the B, R and F cells and karyomegaly and sloughing of E-cells in the hepatopancreas. The presence of *Vibrio harveyi* is attributed to secondary bacterial infections. For the first time, the FAO/

OIE/WHO Crisis Management Centre for Animal Health (CMC-AH) was called to investigate the outbreak in Vietnam. Samples are undergoing analysis and epidemiology studies suggested that the spread is consistent with a direct transmission of an infective agent which is still unidentifiable.

"The signs are slow growth, shrunken and pale brown/blue and a progressively degenerating hepatopancreas. In most of these cases, shrimp die at more than 10 per day at ponds sides and within 4-5 days, from direct transmission, the whole farm will be affected. The less affected farms have lower salinity water, use plastic liners and have biofloc systems in place. The epidemiology suggested that stress triggers mortality. In part, this may be caused by extremes in temperature, salinity and cyano bacteria. Affected farms have high salinity water at stocking."

Nucleotides and health

In a disease state or periods of limited nutrient intake or rapid growth such as during weaning, dietary nucleotides can become semi essential. It is already present in animal diets, said **Dr Rainer Mosenthi**n, Institute of Animal Nutrition, University of Hohenheim, Stuttgart, Germany. Although nucleotides can be synthesized *de novo* in animals, several tissues with a rapid turnover such as the intestines may benefit with exogenous supply to decrease energy usage. In feed ingredients, low concentrations of nucleotides are present in cereals such as barley and soy protein concentrate at less than 0.2mg/100mg and soybean meal at 1.6mg/100mg. In soy protein concentrate, solvents used in the processing have washed away the nucleotides. The supplementation of nucleotides would be in the form of yeast products which contain RNA, a nucleotide/nucleoside mix and individual nucleotides.

Similarly in fish, according to **Dr Shi-Yen Shiau**, Department of Food science, National Taiwan Ocean University, synthesis of nucleotides exist for all cells except the intestinal and immune cells but the process requires energy. Thus an exogenous source is more beneficial especially during conditions of stress. Borda et al. (2003) hypothesised that an exogenous supply of nucleotide may promote growth of fish and crustacean in early stages to meet their high rate of cell replication.

The use of nucleotides in aquafeeds has a 30-year history but the nutritional value of nucleotides continues to be debated. Shiau said that recently, successive investigations by Gatlin and Li (2007) suggested that nucleotides requirements increase during injury and/or wound repair, and deficiency may impair liver, health, intestine, and immune functions in fish. Various studies have analysed growth and immune responses and disease resistance in several fish species with the supplementation of nucleotides in feeds. Shiau discussed some these in terms of quantity of commercial (which contains RNA and other compounds such as trace minerals and polysaccharides) or purified nucleotides and type of purified nucleotides.

In the Atlantic salmon, 2g/kg diet of nucleotides had a 15-22% weight advantage after 8 weeks (Burrells et al., 2001) but in the European seabass, nucleotides from Torula yeast RNA extract added


Shi-Yen Shiau


Rainer Mosenthin


Matthew Briggs

at 62g/kg of diet did not improve growth and at 124g/kg diet growth was depressed (Peres and Oliva-Teles, 2003). Hybrid striped bass fed commercial nucleotides (Ascogen P) at 5 g/kg diet showed no significant differences in weight gain or feed efficiency of fish fed diets (Li et al., 2004).

In assessments on immune response, it was shown that in hybrid tilapia, nucleotides in Ascogen at 5 g/kg diet showed increases in macrophage migration and antibody titre after vaccination (Ramadan et al., 1994). In the common carp, Sakai et al.(2001) showed that the oral administration of ribonucleic-digested yeast RNA at three levels (0.15, 1.5, 15mg/fish) increased phagocytosis, respiratory burst and lysozyme. Survival after challenge with certain pathogens is usually assessed as a measure of disease resistance.

Hybrid tilapia, *Oreochromis niloticus* x *O.aureus*, fish supplemented at 0.15 and 0.30 g/kg of nucleotides from Rovimax NX (80% total nucleotides, 40% free and 40% bound) showed higher weight gain, immune responses and disease resistance than other dietary treatments. After a challenge with *S. iniae* for 1 week, over 80% survival was observed in fish fed diets supplemented with nucleotides as compared to 56.7% in fish fed non supplemented diets.

In a study with a mixture of pure nucleotides of adenosine monophosphate(AMP), cytidine monophosphate (CMP), uridine monophosphate (UMP), guanine monophosphate(GMP) and inosine monophosphate(IMP) at a ratio of 1:1:1:1:1, Li et al (2007) reported growth at 0.4g/kg for the vannamei shrimp. In channel catfish, use of exogenous sources of nucleotides as prophylactic before culture related stress may be beneficial as it decreased the immune suppression effects of stress but does not prevent *Edwardsiella ictalurii* in the fish (Welker et al., 2011). In the grouper, purified nucleotides showed better weight gain and immune responses in diets with 1.5g/kg of diet (Lin et al., 2009). With respect to individual nucleotides, diets with 1.5g/kg of AMP were more beneficial with immune response.

The big 'CHALLENGE' in white shrimp

By Orapint Jintasataporn and Alessio Bonaldo

This is on the growth, survival and immune response of the Pacific white shrimp fed a blend of natural essential oils immunostimulator.

Essential oils (EO) are natural antimicrobials and with the prevalence of diseases, particularly in shrimp farming, they offer solutions in improving survival and immunity. EO also act as sources of natural antioxidants, acting initially at the oxidation of polyunsaturated rich fatty acids and secondly at the tissue level to control and manage the oxidative process and metabolism. With recent changes in feed formulation and replacement of fish oil with plant oils, EO may compensate for the functional properties of fish oils. It is a green product and offers an alternative to antibiotics for sustainable aquaculture.

Studies on the effects of EO are limited in aquatic species. In hybrid tilapia, Ndong et al (2011), showed the immunostimulant properties of garlic *Allium sativum* which significantly improved leucocyte count, respiratory burst, phagocytic activity, phagocytic index and lysozyme activity. The immunity status of the tilapia with a low dosage of allicine was clear but the immunostimulatory properties of garlic seem to disappear at high concentration. This confirmed the opinion that synergy and the right dosage is important.

In rohu *Labeo rohita*, garlic EO improved immunity and survival of fish infected with the bacteria *Aeromonas hydrophilia* (Sahu et al, 2007). Origanum EO have an inhibitory effect on microorganisms and spore-forming organisms in the sharpsnout sea bream *Puntazzo puntazzo*. Although the prevalence of myxosporean infections was reduced, the researchers suggested more work to confirm these observations (Athanassopoulou et al, 2004).

The Mix oil-GrowNat of AWP srl, Italy, is a range of EO, designed specifically for pig, poultry and cattle production. The main actions of EO included in Mix-Oil – GrowNat are represented by their antioxidant action and the stimulation of the natural defences of animals. It has been shown as an effective substitute of growth-promoting antibiotics and strengthens the immune system in land animal production and particularly in controlling coccidiosis in broilers. The next step is to demonstrate the efficacy of EO in aquaculture.

The aim of this study was to demonstrate that the supplementation of Mix-Oil™-GrowNat™, in feeding *Litopenaeus vannamei* can exert an improvement in growth performance, survival and resistance against disease outbreaks, even when a premium commercial feed is used as a control diet. The feed additive used in this supplementation trial is Mix-Oil™-GrowNat™, a blend of completely natural EO and may be considered a multi-purpose flavouring since not only it improves the taste of food, but also naturally works as a digestive and stimulant.

Experimental details

The trial was conducted in completely randomised design with 4 treatments, each with 6 replicates. In each treatment, the EO in liquid form was applied at concentrations of 0.1, 0.2, 0.4 ml/kg diet. Juvenile white shrimp of average weight of 4g were taken from a shrimp farm where pond water salinity averages 12 ppt. As an acclimatisation condition, the shrimp were fed a commercial feed (Charoen Pokphand, P9703) for two days.

Shrimp were stocked at a density of 25 shrimp in 240L aquariums. Shrimp were fed three times a day over a period of 35 days. The shrimp were fed 3-4% of their biomass. The EO liquid was added as top-dressing with lecithin and fish oil at 1:1 at 20 ml/kg feed. The feed was kept refrigerated at 4°C.

Challenge tests

After the first 21 days of feeding with the product, shrimp were subjected to stress tests by reducing temperature to 25°C and fed a balanced feed containing an inoculum of *Vibrio harveyi* at an inclusion rate of 1.9 X 10^9 cfu/kg feed. After feeding with the inoculum of *Vibrio harveyi* diet for a week, the immunological condition of shrimp was evaluated on the basis of total haemocyte count, phenol oxidase activity and heat shock protein-70 (HSP-70) using the Elisa technique following the method modified from Holliday (1985) and Cimino et al. (2002). Survival rate was recorded after the *Vibrio* sp. challenge. Water quality, dissolved oxygen, temperature, total ammonia pH, and nitrite, were measured weekly.

Growth performance and feed utilisation

The effects of EO liquid on growth performance and feed utilisation are shown in Figures 1, 2, 3 and 4 . The results showed that in normal condition during the first three weeks, the growth rate of shrimp fed treatment diets was higher than that of the control but were within the same range ($p>0.05$). In disease challenge condition, the results showed that growth performance in terms of average body weight, specific growth rate, feed conversion ratio and survival rate in the

Figure 1. Growth performance and feed utilisation of white shrimp fed diet supplemental Mix-Oil™-GrowNat™ liquid.

Figure 2. Weight of white shrimp fed diet supplemental the EO in liquid form.

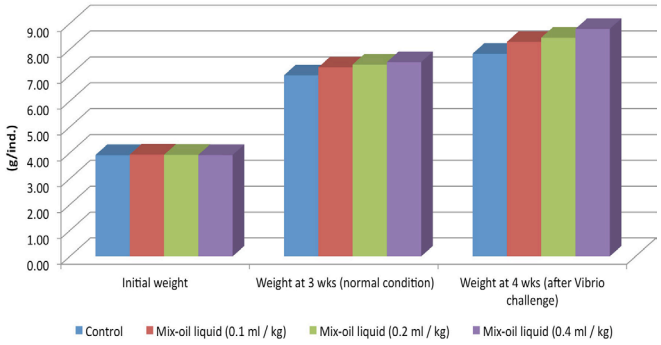


Figure 3. Growth performance and feed utilization of white shrimp fed diet supplemental the EO in liquid form.

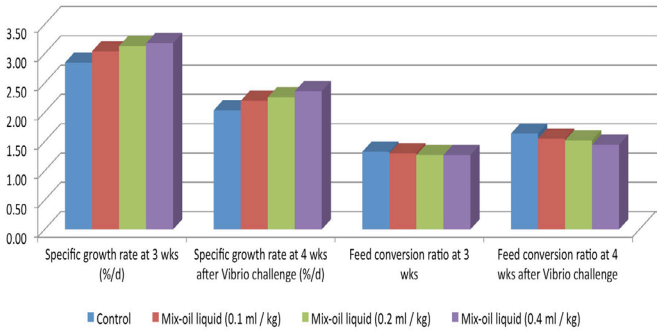
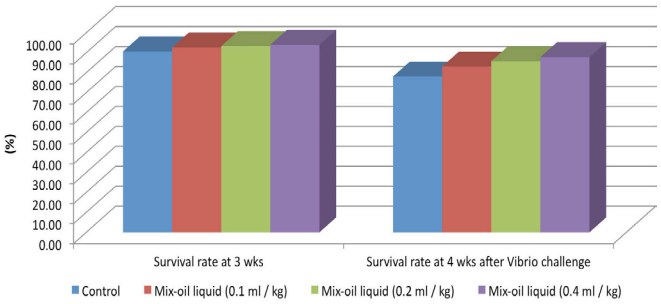


Figure 4. Survival rate of white shrimp fed diet supplemental the EO in liquid form.



group fed diets supplemental the EO in liquid form at 0.1ml/kg-0.4ml/kg were better ($P<0.05$) than in the control because the EO contained some antibacterial active ingredients. The higher the inclusion level, the better the performance but there were no significantly differences ($p>0.05$) on feed utilisation in terms of feed consumption, feed conversion ratio and protein efficiency ratio.

Immune response

The immunity of shrimp after oral treatment by *Vibrio harveyi* are presented in Figures 5-6. There was a good trend with the treatment groups even if results are not significantly different ($p>0.05$) on total haemocyte count, haemocyte cell type, phenol oxidase activity and level of heat shock protein-70.

Water quality improvements

The water quality measurements figure 4 showed that all parameters were in the optimal range for shrimp culture; temperatures, 27.95-28.40°C, dissolved oxygen, 5.61-6.51mg/L, pH, 7.10-7.47, total ammonia 0.028-0.257 mg NH_3-N/L and nitrite 0.051-0.312 mg NO_2-

Figure 5. Haemocyte of white shrimp fed treatment diets.

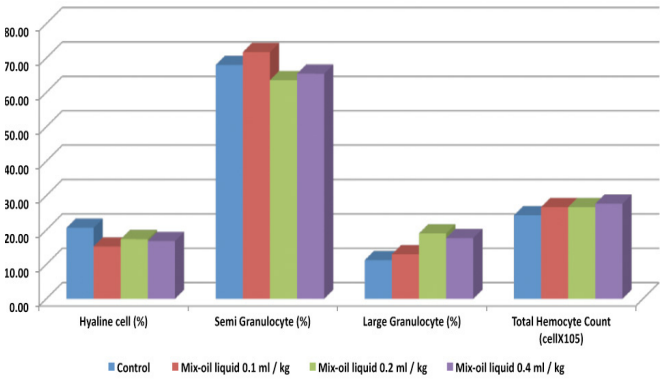
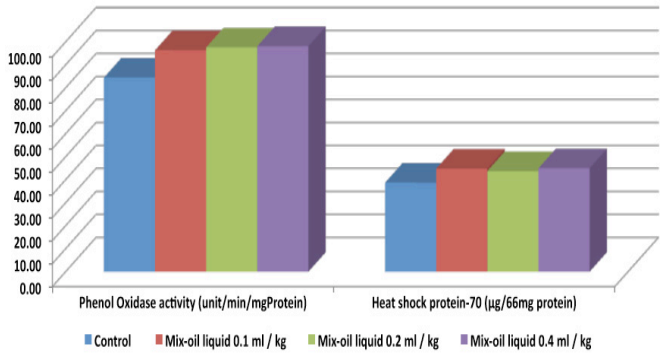


Figure 6. Immunity of white shrimp fed treatment diets.



N/L. In the three weeks trial, ammonia levels in aquarium with the group of shrimp fed supplemented diets was lower than in the control group which was related to the level of EO in liquid form.

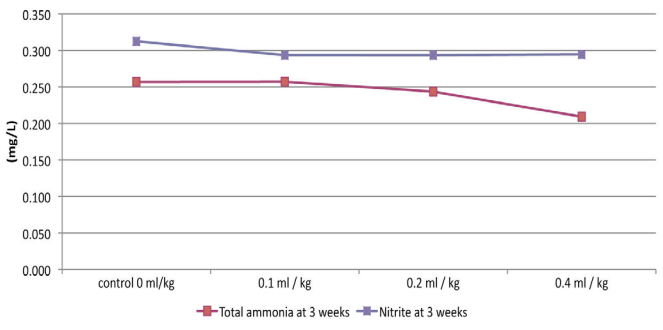
In the case of nitrite levels, the value tended to be lower in aquariums holding shrimp groups fed the treatment diets as compared to the control aquariums. We attribute the small reduction to the higher shrimp feed consumption leading to higher loading of faecal wastes. However, ammonia from nitrogen wastes accumulated in the form of nitrite and only a small proportion was oxidised to nitrate or released as nitrogen gas.

Conclusion

In these trials it was demonstrated that the inclusion of Mix-Oil™-GrowNat™ in the experimental diets;

- Increased the biomass production per aquarium by 14%, 17% and 22 % when the product was added at 0.1, 0.2 0.4% in diets, respectively.
- Resulted in higher biomass at the end of the trial. This was due both to higher survival and growth of the animals.

Figure 7. Water quality in aquaria during the trials.



- Survival of shrimp fed treatment diets was 7%, 11% and 14% higher than that of the control group after one week of challenge with *Vibrio* sp.
- Individual weight, weight gain and the specific growth rate of animals at the end of the trial increased with the inclusion rate.
- Gave better growth performance which was related to a better FCR after *Vibrio* sp. challenge. This showed that the inclusion of Mix-Oil™-GrowNat™ improved the utilisation of feed and nutrients (especially during pathogen challenge, which can normally occur in field conditions) without any detrimental effects on feed intake.
- Showed a higher protein efficiency ratio in shrimp fed treatment diets, demonstrating that the better growth is linked to a more efficient utilisation of protein.

However, even though data were not statistically different, the amount of ammonia in the aquaria of shrimp fed diet containing 0.04 ml/kg was reduced to 19% in comparison to the control. This trend confirmed that the inclusion of Mix-Oil™-GrowNat™ can exert a positive effect on protein metabolism, reducing the nitrogen emission in the environment. The immunity parameters gave indications of good conditions in terms of health of welfare of animals in all treatments.

Thus we have demonstrated the 'big challenge', that the supplementation of Mix-Oil™-GrowNat™ in diets can exert an improvement in growth performance, survival and resistance against disease outbreaks, even when a top standard feed is used as a control diet.

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Nutrition and changes in fish body colouration in catfish

by Dong Qiufen, Yang Yong and Su Shi

Environment and physico-chemical factors influence fish skin and flesh colouration and dietary manipulation can overcome abnormal colouration.

In recent years, changes in body colour have been more frequently observed in many Asian farmed fish species. The colouration of the marine fish, Japanese flounder *Paralichthys olivaceus*, red snappers *Lutianus* spp and large mouth sea bass *Micropterus salmoides* may change to white or black from natural body colour. Some scaly freshwater fish, black carp, grass carp, common carp and black tilapia often show abnormal white, black or yellow colouration. The biggest worry for freshwater catfish farmers is a banana colouration in *Clarias fuscus* and *Pelteobagrus fulvidraco* and totally white or yellow colouration in *Ictalurus punctatus*, *Ameiurus nebulosus*, *Silurus asotus* and *Leiocassis longirostris*.

Fish with abnormal body colouration may fetch lower market prices, reducing profit margins of farmers. This article discusses the reasons leading to changes in fish body colouration and regulation of skin colour through nutrition.

Physiological basis for colour change

There are two chromatophore cell bands located in fish skin. More of these aggregate between the epidermis and the dermis, and less are found between the dermis and the muscle. Chromatophore cells in fish can be classified into six types according to colour: melanophores (black), xanthophores (yellow), erythrophores (red) iridophores (iridescent, blue, silvery white and golden yellow), leucophore (white and offwhite) and cyanophore (blue). With different distribution and quantities, these cells allow the fish to exhibit different body colouration and patterns.

Based on the chemical structure and composition, the pigments in the fish skin and muscle are known as carotenoid, bile pigment, benzoquinone, melanin, pteridine and others. Carotenoids and melanins are responsible for the catfish body colour expression. Through nervous system and hormonal control, the pigment granules of the chromatophore cells in fish body can be transported swiftly by kinesin giving rise to dark colouration and by cytoplasmic dynein to aggregate, leading to light colouration in microtubules.

Factors influencing body colouration

Environment

Temperature influences carotenoid deposition and is important in fish ingestion, metabolism and growth. From an experiment with the glass eel, we know that chromocytes move slower at low than at high temperatures. Illumination makes the fish adapt their colouration according to that of the environment. When fish are stocked at high density their body colour will darken. The colour of water can also affect fish body colour, and pollutants in the water can destroy the nervous system and lead to colour variation. When cultured in water with low dissolved oxygen and high ammonia nitrogen, the flesh of the pangasius can easily turn yellow. Changes in salinity will change fish body colouration.

Physiology

Inherited characters determine the way pigments are deposited. Different individuals in the same rainbow trout population show different deposition abilities. In addition, fish age, size, physical conditions, internal neuroendocrine and paracrine systems, and androgenic hormones are factors influencing pigment deposition.

Nutrition

The pigments in feed are important for fish body colour expression, and adding commercial colourants into the feed artificially can influence colouration. With low quantity and bad quality of fat and premix in the diet, the pigment granules in the fish body cannot be transported and absorbed normally. Protein quality is also an important factor, in particular the non-protein nitrogen (NPN).

Regulation of body colour through nutrition

Pigment sources

Pigments in the fish come from feed ingredients and commercial colourants as well as natural sources. There are rich xanthophylls in corn-based raw ingredients (corn with 15~25 mg/kg, corn gluten powder with 130~290 mg/kg, DDGS with 10.6~34 mg/kg) and the yellow pigment can be seen with the naked eye when the amount reaches 11mg/kg in the catfish. This is the cut off level for fillet value.

In China, the careless use of corn-based ingredients in tilapia feed often makes the fish skin and muscle colour yellow. However, for some other catfish, such as yellow catfish and white spotted freshwater catfish, some

Catfish Pelteobagrus fulvidraco. Normal (A) and various abnormal colouration (B,C,D) due to nutrition.

Catfish Ictalurus punctatus. Normal (A) and various abnormal colouration (B,C) due to nutrition. (D) Normal colour (white) and abnormal (Yellow) flesh

commercial colourants are used artificially to improve its economic value and cater to the market and consumer demand.

Some research results showed that the rainbow trout muscle was yellow from the carotenoid in natural food (algae with yellow pigments ingested by fish) but not from dietary intake from feed. Farmed sea bass showed yellow and red muscle tissue following daily feeding of shrimp and crab. It is necessary to monitor water quality to control the transparency, salinity, dissolved oxygen, ammonia nitrogen and the blue-green algae to avoid abnormal skin and muscle colour change.

The quantity and quality of fat

The fat content in the feed influences pigment absorption, transportation and deposition in the fish cells. Almost all farmed fish need fat soluble carotenoids, to express body colouration. Fish cannot synthesize carotenoids internally and must assimilate them from the feed ingredients, such as corn gluten meal, cottonseed meal, rapeseed meal and some others with high carotenoid content. A shortage of fat not only influence growth rate, but also affects the absorption of the pigment materials especially the carotenoid in fish gut (enteron) and optimal fat content can ensure a good absorption of pigments. The carotenoid deposition efficiency in the fish chromatophore cells and muscle is directly correlated with the adipose cells and fat deposition level in the fish. Lipid sources from soybean oil, rapeseed oil, pork oil or fish oil without oxidation with a level no less than 5% in the feed shows good pigment absorption in fish such as *Clarias leather*, rice field eel, loach, yellow catfish and ornamental fish with high level carotenoid content.

Fat quality decreases with oxidation. In the fish body, oxidised fat can generate more oxygen free radicals and some other free radicals. This causes fragmentation of the unsaturated bond in the carotenoids,

Tilapia. Normal (A), abnormal (B) skin colour of tilapia. C. Normal colour (white) and abnormal colour (yellow) in tilapia flesh

allowing it to lose pigment function and lead to fish body colour degeneration. On the other hand, oxidised fat also affects physiological functions. Chromatophore cells especially melanophores will not differentiate, grow and mature normally and decrease notably in the skin and scale with lower density. The result is that farmed fish show white or yellow colouration. Thus it is prudent to avoid oxidised lipid sources, in the feeds for fish with changeable body colouration such as yellow catfish, *Clarias leather*, blunt-snout bream, black carp, tilapia and pangasius.

Antioxidants

Many anti-nutrient factors in the plant ingredients, soybean meal/cake, rapeseed meal/cake, can influence the fish to make use of the nutritive materials in the feed. Adding enough antioxidant in the ingredients and feed products can prevent the carotenoid from oxidation with lipoxygenase and prevent fat oxidation and body colour change.

Premix

Vitamins act as coenzymes to facilitate chemical reactions in fish metabolism to ensure the normal cell structure and function of the tissues and organs, and maintain good health condition and biophysical activities.

Pangasius catfish. A. Normal skin colour. B. Varying flesh colour with increasing value from left: yellow, pink and white.

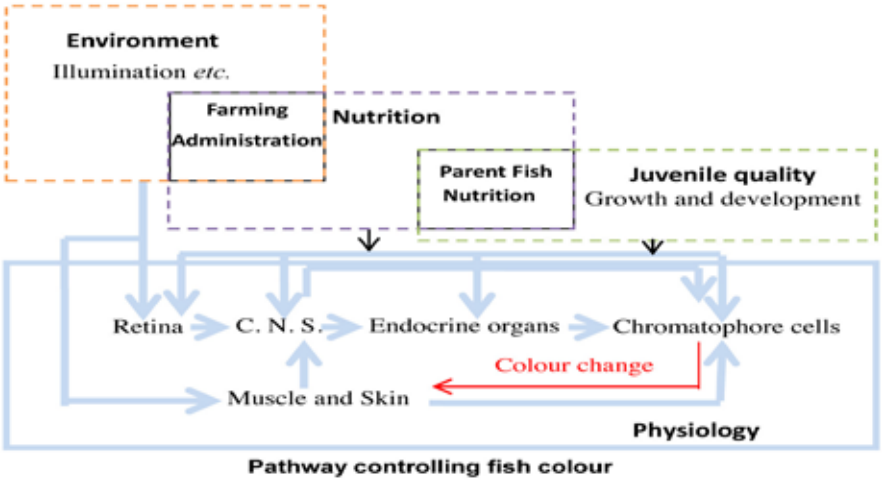
Research reported that Vitamin A and Vitamin E can improve carotenoid absorption but we should ensure that the vitamins perform their nutritive functions in a holistic manner.

Taking into consideration fish body colouration, the requisite amount of 13 types of vitamins should be set as the basis for premixes and feed formulations to maintain a holistic biophysical function and to keep the normal fish colouration. This is also a nutritional technique in aquaculture health management. Some fish, *Clarias leather* and yellow catfish, can show normal body colour when fed with pelleted feed. In contrast, they show 'banana colour' when fed with extruded feed with the same feed formulation, as the high temperature during the extrusion destroys some of the vitamins. In turn, this reduces the number of melanophores and affects body colouration.

When developing the premix formulation for farmed fish, normally it is suggested to increase the vitamin volume at 30% to ensure good fish body colour and body surface mucus remains in normal physiological status. Increasing vitamin supplements is a good way to recover the farmed fish body colour when the colour is abnormal.

Mineral substances act as coenzymes in the regulation metabolism in the fish to maintain the normal functions and metabolisable actions of chromatophore cells. As mineral elements can influence the fish body colour by osmotic pressure, we should try to avoid high salt content in fish feed.

Catfish should be fed with feeds with a premix formulation different from fish with scales, as the latter have different requirements for vitamins and trace elements, iron, copper, manganese, zinc, etc.



Pathway controlling fish colour

Dr Yang Yong

Dong Qiufen

Su Shi

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Animal origin soluble proteins contain an interesting mixture of valuable nutrients for fish and shrimp

The high digestibility makes these potential ingredients for aquatic animals such as shrimp and fish larvae.

By Eric De Muylder and Geert van der Velden

During the production of bone meal, three fractions are separated; bone meal, animal lipids and a water soluble fraction. This water-soluble fraction contains a mixture of interesting nutrients: water soluble proteins, nucleotides, minerals and phospholipids.

Food-grade porcine bones originating from EU-registered porcine slaughterhouses and cutteries are unloaded in reception bins. Impurities and metals are removed. By hydrolysis and flushing with hot water and acidification, meat parts and fat are disposed of the bone chips. The protein water is heated to over 100°C, concentrated by evaporation until approximately 40 % dry matter. This liquid can also be spray-dried and delivered as Gelko Powder.

Proteins and amino acids

Water-soluble proteins have always shown a high digestibility for fish and shrimp. The solubility of the proteins and amino acids in those

products makes them suitable for animals with rudimentary digestive systems, like larval fishes and shrimp.

Water soluble proteins consist in a higher fraction of water soluble amino acids such as arginine, proline, glycine and glutamic acid. These amino acids might not be the first limiting, and some are not essential, but they have been shown in the past to play an important role in feed attractability and palatability and to play a role in osmoregulation in cell walls when the animal is cultured in high salinity water.

Meat solubles or hydrolysables were able to replace partly fish meal in diets for grouper (Milamena et al, 2001) and shrimp (Hertrampf et al, 2006). Gelko also contains 4.08 % hydroxyproline (6.15 % of protein) which is an important building block of connecting tissue collagen and has recently been shown to be an essential element in replacing fish meal in aquafeeds. The soluble protein contains contains 66% crude protein.

Table 1. Amino acids of Gelko (in % of crude protein) in comparison with anchovy fish meal, soybean meal and nutritional requirements of trout, seabream and shrimp.

Amino acid	Gelko	Anchovy Fish meal	Soybean meal	Rainbow trout	Seabream	Shrimp
Arginine	6.12	5.9	6.9	3.3	5.0	5.8
Histidine	2.43	2.5	2.6			2.1
Isoleucine	1.9	4.7	5.0	2.3		3.4
Leucine	4.71	7.7	7.5	4.0		5.4
Valine	3.29	5.4	4.7	2.9		4.0
Lysine	4.99	8.0	6.3	4.2	5.0	5.3
Phenylalanine	2.50	4.2	5.0			7.1 (+tyr)
Methionine	1.04	2.9	1.3	3.0	4.0	2.4
Cystine	0.47	1.0	1.4	0.5		1.2
Threonine	2.47	4.4	4.9			3.6
Tryptophan	0.32	1.2	1.2	1.4	0.6	0.8

Digestibility

Protein availability of this soluble protein was assessed by the capacity of shrimp's own proteases to digest protein ingredients. Protein digestion in shrimp digestive tract was simulated through the reaction of ingredient protein and shrimp proteolytic enzymes under a pH and temperature controlled assay. Enzyme extracts from the hepatopancreas (digestive gland) of *Litopenaeus vannamei* with average weight of 6g were used in the present analysis. The assay is based on monitoring the breakage of peptide bonds of ingredient protein through digestive enzyme action.

Under stable pH 8.0, protein peptide bond breakage results in the release of H+ and medium acidification that is automatically neutralised by alkali (NaOH) titration (pH-stat reaction). The degree of protein hydrolysis (DH%) is the percentage of peptide bonds cleaved under the amount of enzyme used and is calculated by the volume of alkali spent during hydrolysis.

Gelko shows a very high digestibility for shrimp. This digestibility is higher than fish meal. Spray drying improves digestibility slightly.

Ingredient	CP(%)	Digestibility (DH%)
Meat solubles (liquid)	32	8.34
Meat solubles (flash-dried)	73	8.74
Soybean meal (as reference)	46-48	3.38-5.16
Fish meal (anchovy)	64-69	2.70-4.40

Lipids

The lipid content at 15.8 % is higher than could be expected. Most of the lipids are present in the form of phospholipids (57-66%). This increases the digestibility of these lipids, even though most of the fatty acids are saturated or mono-unsaturated fatty acids.

Minerals

The mineral content is quite high at 16.2% but consist of water soluble ions (salts), mostly phosphorus (1.6 %), sodium (1.91 %) and potassium (1.76 %). Calcium (0.47 %) and magnesium (0.024 %) are low.

Nucleotides

Unlike hydrolysed proteins, the solubles contain interesting quantities of nucleotides (Table 2).

Table 2. Nucleic acids of Gelko compared to some other important protein sources (in mg/g product).

Nucleic acid	Gelko	Total Fish meal	Fishmeal press cake	Fish solubles	Soybean meal	Yeast	Yeast extract
Cytosine	0.70	1.21	0.84	1.05	0.016	1.75	1.3
Uracil	1.29	1.24	0.81	1.24	0.009	1.91	57.33
Guanine	10.48	9.4	1.28	23.31	0.003	2.54	6.24
Adenine	2.74	1.66	1.02	1.85	0.008	2.77	7.32
Total bases	15.21	14.04	4.19	28.28	0.036	9.21	72.52

The soluble protein contains important amounts of nucleotides. comparable with total fish meal. Both show high amounts of guanine. while yeast extract is richer in uracil.

Conclusion

The soluble animal proteins (Gelko) are an interesting source of proteins due to the high digestibility. which makes it a potential ingredient for animals with a rudimentary digestible system such as shrimp and fish larvae. But apart from the protein level, other nutrients are present such as nucleotides. phospholipids and minerals. which increases the nutritional value of this product.

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Shrimp production in Asia in 2011

Feeding shrimp in Bali

High prices but loss of opportunity for producers in most countries faced with disease outbreaks and crop failures. India records an astonishing growth in vannamei shrimp production. AAP reports.

In general, shrimp producers enjoyed high ex-farm prices in 2011. High international shrimp prices which began in 2009, continued throughout 2010 and stabilised only in mid- 2011. The short shrimp supply is the main reason for the firm prices in international markets. The most significant change in 2011 was the large increases in vannamei shrimp production in India which marginally affected international prices in mid-2011.

Production was lower in Thailand, at 590,000 tonnes in 2011, according to Dr Chen Ming Dang, Charoen Pokphand Foods Public Ltd, Thailand. Elsewhere, the major problems have been due to new diseases working their way around the major Asian shrimp producing countries, especially China, Vietnam and Malaysia, said Dr Matt Briggs during a presentation in Bangkok (see page 20). These were allied to periodic problems with existing diseases such as WSSV-white spot syndrome virus, both within its established areas, and increasingly new areas which are now starting to suffer from this virus. This disease affected both monodon and vannamei shrimp.

Vannamei shrimp farmed in Soc Trang, Vietnam

Emerging markets

These are Brazil and China. In Brazil, the survival of the sector was the market shift since 2010 when 98% of production was consumed by the domestic market compared with 22% in 2003 (Rocha, 2011). This growth trend is expected to continue in the coming years, although in smaller increments than in the past, with practically 100% of production directed to the domestic market. It has been reported that China has become a net importer in 2011 although its shrimp production is still high. It continues to export due to tax incentives. However, there are reports that China has begun sourcing shrimp from South America to feed its 200 million emerging middle class.

Reshaping Thai shrimp

Thailand's production was down because of floods in the south in the early part of 2011 and later floods in the central region affected farms in Suphanburi, Nakorn Pathom and Angthong, said Thomas Wilson, Thai Luxe Feeds. There were more cases of WSSV in 2011 and farmers were nervous about bringing in new water.

"Already at the beginning of the year, the first harvest was delayed by 6 weeks to March and April. Most people did not realise the side effects of the floods in early 2011 and then the massive floods in November and October. Thai exporters were in a dire situation with the

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Marketing shrimp at Vietfish 2011

floods which increased transport costs," said Dr Panisuan Jamnarnwej, President of the Thai Frozen Foods Association, at the Association's booth during the China Seafood and Fisheries Exposition in Qingdao in November.

"Thai farmers were happy with the good prices but due to higher prices, US importers changed their marketing strategy. Instead of long term contracts, they asked for shorter contracts and shipments of 100 to 200 containers have been reduced to 25 and 40-50 respectively. The supply is reduced to 3 months instead of 6 months to a year. Nevertheless, the US market will continue to be the major one for Thailand. It was down by 0.5% in 2010. We are exporting more to China. This increased from 4,000 tonnes to 24,000 tonnes in 2010. The preference is head on shell on (HOSO) shrimp usually 65-70/kg and the colour does not matter for the Chinese market."

Thailand's advanced culture technology has the potential to double output. Three crops a year is common with post larvae (PL) selected for fast growth and this can further increase with the introduction of nursery culture systems. However, seeing the effects of high supply on local prices and that profits are already low for Thai farmers, especially with the exchange rate rising to THB 30 from THB 40 to the USD, the industry strategy is not to increase production but to produce quality shrimp (www.thaivest.com). An oversupply will reduce profits further and the Thai Shrimp Association has suggested a cap on annual production at 640,000 tonnes.

Astonishing volumes from India

In early 2011, stakeholders were very concerned that the quarantine procedures for imports of specific pathogen free (SPF) brood stock would curtail farming of the shrimp. In mid-2011, the restrictions with quarantine of SPF brood stock were alleviated with additional facilities. Despite these issues, there was a rapid increase in production in 2011. Total production estimates ranged from 180,000 to 240,000 tonnes with 80,000 to 130,000 tonnes of vannamei shrimp. In 2010, vannamei shrimp production varied between 20,000 tonnes (Chen, 2011) and 30,000 tonnes (MPEDA).

The industry reported two scenarios. The small farmers facing frequent power supply disruptions, limited infrastructure and aeration devices, stock at 40-70 PL/m^2 and produce large shrimp of 40/kg. Yields ranged from 8-12 tonnes/ha. The larger corporations with adequate infrastructure and financial resources could stock at more than 70 PL/m^2 and some have even gone further to 200 PL/m^2. Survival rates average 70% with two crops a year. The large size shrimp are for export markets whilst smaller shrimp (70/kg) are for an emerging domestic market.

The cost of production at INR 200/kg (USD 4.4/kg, calculated at INR45/USD) gave good profits to farmers when ex-farm prices were INR 350/kg (USD 7.8/kg) for 40/kg shrimp during a supply shortage. However, the high demand for the limited processing capacity during the harvesting season such as in December resulted in processing plants extending credit and low offer prices of INR 250-260/kg (USD 5.6/kg). Post larvae prices escalated to INR 800/1000PL (USD 17.8/1000PL) from INR 300/1000 (USD 6.7/1000PL) during peak demand such that farmers book early to secure stocks. A concern is that this shortage will encourage the use of pond reared brood stock for post larvae production.

In 2012, industry said a conservative production increase of 25-30% will depend on the success rate of farming which in turn depends on the severity of disease outbreaks. There are already reports of WSSV, slow growth and vibriosis. It will be either a 50:50 ratio of vannamei: monodon or 60:40 ratio, said industry.

Production trends

China

Industry estimated a lower production at 800,000 to 1,000,000 tonnes of vannamei shrimp in 2011. Production woes from early mortality syndrome (EMS, see page 8), poor post larvae quality, water pollution with chemical and agricultural wastes and climate change were worst in 2011 compared to 2010. There was no outbreak of WSSV but white faeces syndrome was reported in Guangdong and Guangxi. In Guangdong, in four culture areas, losses reached 80%-90% and in Hainan, 80% and Fujian, 30% (Briggs, 2011)

Vannamei shrimp production in freshwater was less affected by EMS. Generally, shrimp farms in Guangdong and Guangxi lost 40% of production whilst production was good at almost 100% in the new areas in Zhejiang and Jiangsu. Industry also said accurate figures on production are difficult as data on harvests are not reported when shrimp go direct to the local markets. The estimate for Hainan's production was 150,000 tonnes from 200,000 mu (11.25 tonnes/ha) whilst in Guangdong, 550,000 tonnes were produced from 600,000 mu (12.5/ha). Other shrimp growing areas are in Guangxi (250,000 mu), Fujian (150,000 mu) and Zhejiang, Shandong and Jiangsu (300,000 mu).

In general, there has been no major change to culture technology but some farmers have adopted new feed management protocols, in line with the changes in weather (see Aqua Culture Asia Pacific. Volume 7 (4) pp10-15). The cost of production ranges from a low of USD2.8 to USD6/kg for sizes 60-80/kg, which is the most common size. This varies with the season. The high cost of production is no longer an issue as demand exceeds supply in the domestic market for live shrimp. In Guangdong, ex-farm prices for 80/kg was RMB 30/kg (USD 4.7/kg) in summer and RMB35-40/kg (USD 6.32/kg) in winter. In Jiangsu, the average price was RMB 50/kg (USD 7.9/kg). During the Chinese New Year period (late January to early February), prices can reach RMB 70/kg (USD 11/kg) in Guangdong. In restaurants, prices reach USD30/kg.

Indonesia

In 2010, Indonesia produced 332,097 tonnes of shrimp and up to October 2011, the official figure for 2011 was 259,471 tonnes. However, in July, industry was confident that total production in 2011 would rise to 350,000 to 400,000 tonnes as all stakeholders have been working together to recover production. However in 2011, there were reports of shrimp dying slowly after 40 days and it was not clear whether these were linked to the IMN virus.

Industry expected the 400,000 tonnes to be 132,000 tonnes from intensive farms, 150,000 tonnes from traditional farms, 50,000 tonnes from semi intensive farms and 80,000 tonnes from integrated farms.

In general, production of monodon shrimp is expected to decline as culture is limited to traditional and semi intensive farms in Sulawesi, Sumatra and Kalimantan. Jawa Island only has intensive farms, culturing the vannamei shrimp.

In their efforts to increase production, many farms have adopted biofloc technology with low water exchange to achieve a stable pH and to control water quality. Probiotics are used and most farms have also increased aeration whilst reducing stocking density to 100-125 PL/ m^2. Better quality post larvae cost IDR 33-35 each (USD 3.7/1000 PL). However, there are farms which continue to stock at 250-300 PL/ m^2 such as in Sumbawa. Farms strived to achieve FCR of 1.3 to 1.5 and cost of production in the IDR 30,000 to 35,000/kg (USD 3.8/kg) range for size 70/kg over 95 days.

Ex farm prices for the vannamei shrimp were higher than in Malaysia but have been fluctuating. In July, prices for large size shrimp of 30/kg was IDR 76,000/kg (USD 8.4/kg) and in August, it went down to IDR 55-65,000/kg (USD 6-7.2/kg). Prices for 70/kg size was IDR 47,000/kg (USD5.2/kg) in July but was IDR 53,000/kg (USD 5.8/kg) in May. In 2012, industry expects a higher production but this will depend mainly on how farmers adapt to climate change and diseases.

Vietnam

The production in 2011 was estimated by industry as 90,000 tonnes of monodon shrimp and 150,000 tonnes of vannamei shrimp. This drastic drop underlines the loss of production from EMS for both the monodon and vannamei shrimp, which worsened in spring 2011. Reports showed that survival rates for monodon shrimp dropped to a low of 10 to 20% and 50-60% for the vannamei shrimp. In the first 10 months of 2011, crop losses affected a total of 85,000 ha of shrimp ponds and this was a three-fold increase compared to 2010.

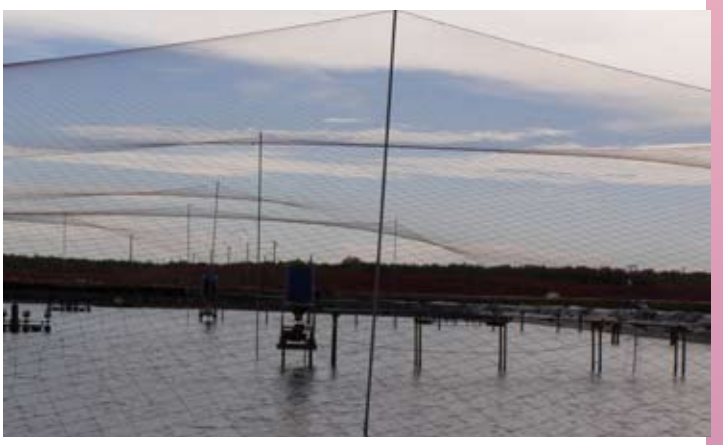
In intensive monodon shrimp production, the stocking density is 40-60 PL/m^2 and the average yield was 7 tonnes/ha of 35-40/kg size shrimp. There are 2 crops/year and each cycle is 120 days. Vannamei shrimp is now farmed throughout the country. In the north, 2 crops/year of only vannamei shrimp and in the south, 2-3 crops/year of only vannamei shrimp or a combination with the monodon shrimp are produced. The average stocking density is 100-150 PL/m^2. Yields vary from 13 tonnes/ha of 80/kg shrimp in the south to 10 tonnes/ha of 60-80/kg in the north. Partial harvesting is common, with the first harvest at 100/kg shrimp and the last at 40/kg.

The lower production and lack of raw materials for processing plants have pushed up ex-farm prices for monodon shrimp to record highs. According to Ca Mau Association of Seafood Exporters and Producers, prices for monodon shrimp (20/kg) was VND 260,000/kg (USD12.4/kg) and VND 190,000/kg (USD 9/kg) for 30/kg size. Prices for vannamei shrimp was VND 85,000/kg (USD 4/kg) for 100/kg size. The cost of production was VND 85,000/kg (USD 4.0/kg) for the monodon shrimp (40/kg) and VND 58,000/kg (USD 2.76/kg) for the smaller vannamei shrimp of 80/kg. During the year, cost of production has increased, due to higher feed costs, 15% increase in electricity costs and 20% increase in gasoline prices and 22-23% interest rates. The government mandated a significant wage increase for all workers.

Hatcheries, mainly located in the provinces of Binh Thuan, Ninh Thuan, Khanh Hoa, Ca Mau, Bac Lieu and Kien Giang supply 90% of the demand for post larvae. In 2012, the government's strategy will be to develop shrimp hatcheries in the southern provinces of Kien Giang, Soc Trang and Bac Lieu. To meet demand for quality post larvae, Uni-President Vietnam is planning to establish more hatcheries in Quang Tri in the north and in Soc Trang in the south to reach a 10 billion/year production.

Malaysia

Producers started the year well with higher prices, in comparison with those in Thailand. Gradually, many farms began to succumb to EMS, slow death and also WSSV which started in November 2010, according to industry. Mid-year, the estimate was a 30% decline but by end of 2011, this changed to a realistic 50% loss in production in the peninsula. No reports of diseases were reported for farms in Sabah and Sarawak and their production was stable at 26,000 tonnes annually for both shrimp. A final estimate for 2011 was 70,000 tonnes with only 3,000 tonnes of monodon shrimp.



Enhanced biocsecurity and autofeeders in a farm in West Malaysia

Malaysian farms are relatively cautious in the management of stocking density. With diseases, some have reduced to 80 PL/m^2, from 110 PL/m^2. Biosecurity measures are quite stringent in the ten large farms managed by corporations, individuals and Star Feedmills, part of Charoen Pokphand Thailand. These contribute to almost 70% of production. Harvesting is partial, normally 3-4 times and the first starts at 10g shrimp with the final at 120 days for larger shrimp of 20g size. Large farms export shrimp to Japan as headless shell on (HLSO) while individual processing plants export to Japan and the US as HLSO and peeled deveined (PD) respectively. There is also a significant domestic market and ex-farm prices are good, averaging MYR14/kg (USD 4.4/kg) for size 70/kg for the year.

Stakeholders are working to bring back production. At a seminar for farmers in Malaysia, in December, Mati Nitibhon, Charoen Pokphand, Thailand said the best way is to improve biosecurity and to use better probiotics to suppress vibrio infections. He also proposed a nursery culture system with rearing of PL10 in either covered tanks at the pond sides; raceways converted by blocking supply canals and completely lined; floating cages in ponds and dedicated, HDPE lined nursery ponds. Transfer of juveniles from the nursery is recommended after 25-30 days (PL35-40) or depending on size. The nursery system will require changes such as additional feeding with live feeds, increased feeding rate to 8 times/day, aeration with venturi airblowers instead of paddle wheels, monitoring of shrimp health daily and high water exchange.

With regard to production in 2012, industry proposed different views. A pessimistic outlook with production increasing by only 15% to 80,000 tonnes (lower than in 2010 at 100,000 tonnes) and if diseases can be managed, meet their planned targets for a production of at least 100,000 tonnes in 2012. These estimates exclude the projected production of 2,800 tonnes of vannamei shrimp from a large farm with 160 ha of ponds on the east coast of Peninsula Malaysia which started operations in late October 2011. Further south is another resurrection of 170 ha of shrimp ponds expected to resume operations in 2012.

Monodon shrimp

Bangladesh and Myanmar are the only remaining countries in Asia where monodon shrimp farming dominate. However, processors and

Table 1. Marine shrimp production (tonnes) in 2009 to 2011.

	Production in 2009[a]		Estimates of production in 2010[b]		Estimates of production in 2011[c]	
Country	*P. vannamei*	*P. monodon*	*P. vannamei*	*P. monodon*	*P. vannamei*	*P. monodon*
China	1,118,142	60,210	1,200,000	61,000	800,000	60,000
Thailand	535,000	3,500	635,000	5,000	590,000	6,000
Vietnam	36,000	316,000	136,719[d]	333,174[d]	150,000	90,000
Indonesia	170,969	124,561	206,578[e]	125,519[e]	147,435[e]	112,036[e]
Malaysia	52,926	16,351	100,000	3,000	70,000	3,000
India	1,730	96,880	20,000	120,000	130,000	110,000
Philippines	2,204	47,830	9,000	32,000	20,000	23,000
Bangladesh	2339	49,710		50,000[f]		50,000[f]
Others	9,563					
Total Asia	**1,928,873**	**761,146**	**2,307,297**	**729,693**	**1,907,435**	**454,036**
Latin America[f]						
Ecuador	179,100		145,000		150,000	
Brazil	65,188		75,000[g]		75,000	
Mexico	125,778		91,500		100,000	
Others	65,674		67,300		75,000	
Total Latin America	**435,740**		**378,800**		**400,000**	
Total	2,364,613	761,146	2,686,097	729,693	2,307,435	454,036
Total Asia and Latin America	**3,079,655**		**3,415,790**		**2,761,471**	

[a] *Published production figures in 2009 (Fishstat Plus, 2010).*
[bc] *Estimates from industry in China, Malaysia, India, Vietnam. Estimates provided by Chen Ming Dang, CPF were used for Thailand and Philippines.*
[d] *Ministry of Agriculture and Rural Development, Vietnam for 2010 figures;*
[e] *Ministry of Marine Affairs and Fisheries, Indonesia. Figures for 2011 until October 2011*
[f] *Data for 2010 and 2011, GOAL 2011 review. Production: Global shrimp review. The Advocate, January/February 2012*
[g] *Itamar P. Rocha, 2011. Current status in Brazilian shrimp Farming. Infofish 5/2011*

exporters in Bangladesh are asking for the government to allow the culture of vannamei shrimp which they say can give a yield of one tonne/ha as compared to 200kg/ha for the monodon shrimp.

In Malaysia and Thailand, farmers continue farming the shrimp because of the niche market and long term commitments to particular customers. In Thailand, production increased to 6,000 tonnes in 2010 (Chen, 2011) as more farmers returned to farming the shrimp recently. Some combine culture with vannamei shrimp. Monodon post larvae are produced by small hatcheries and demand exceeds supply. However, as almost 95% production is of vannamei shrimp in the country, the main auction market will only take vannamei shrimp. Thus, the small numbers of monodon shrimp farmers in the south and eastern provinces will need to have a contract with processing plants and the size produced will depend on the demand but is generally from 40 to 60/kg.

Demand for the monodon shrimp is high. It is the second most popular shrimp variety in Japan. VASEP reported that in 2010, Japan imported 49,000 tonnes of monodon shrimp and 55,000 tonnes of vannamei shrimp. There could be a preference for monodon shrimp in the luxury shrimp market in China. At the recent China Seafood and Fisheries Exposition in November 2011, buyers were looking at products from Unima, which farms only monodon shrimp in Madagascar and sells at 20% premium prices to Europe.

Dr Manoj Sharma, Director, Mayank Aquaculture in Gujarat, India said that the shift to vannamei shrimp is a forced migration because of the persistent crop failures with the monodon shrimp. He is convinced that farms in India will revert to monodon shrimp once SPF post larvae are available. In India shrimp farmers wait in anticipation for the success of the domestication and selective breeding program in the Andaman. By January 2012, the first SPF post larvae will be available, said Thampi Sam Raj from the Rajiv Gandhi Aquaculture Centre.

In West Malaysia, ManjungJV will be marketing SPF monodon shrimp post larvae in early 2012. SPF post larvae, produced by Moana are available in Malaysia, Vietnam and Thailand but apparently farmers have been deterred by the high prices. These are developed through a genetic breeding program in Hawaii and have been in the Asian market since 2007. According to reports from farmers in Thailand, the post larvae have some strong points in comparison to those from wild brood stock. They show rapid swimming throughout the water column and grow faster because of the high feeding rates. This allows farmers to stock at 30 to 60PL/m^2. There is also uniformity in sizes.

A potential for marine fish farming in Saudi Arabia

by M.R. Kitto and C.Regunathan

A rapid growth in marine fish farming is expected with new hatcheries, cage farms and focus on various local and exotic species.

The Kingdom of Saudi Arabia which occupies 80% of the Arabian Peninsula is bordered by the Gulf of Aqaba, the Red Sea (78% of coastal length) to the west, and the Arabian Gulf (or Persian Gulf) to the east. The total length covers 2640 km. Although fish is not truly a staple of the Saudi diet, demand for seafood is spiralling up. Annual fish consumption increased from 3 kg/capita in 1977 to 6.5 kg/capita in 1998 and reached around 8 kg/ capita in 2007.

The major supply of seafood is from capture fisheries which increased from 49,080 tonnes in 2000 to 68,000 tonnes in 2008. However, commercially important species (groupers, snappers, emperors, spanish mackerel, tunas) have recorded a reduction or stagnation in landings due to overfishing by traditional fisheries (Kite-Powell, 2011). There are also reports of increasing catch per unit effort (CPUE; Tharwat and Al Gaber, 2006). This limited supply will become more severe based on United Nations estimation of a 60 million population by 2050.

Aquaculture production has been increasing at a rate of 25% per annum over the last 10 years, whereas fisheries recorded only a 7% increase. The combined fish production at 10% per annum is still inadequate. Thus, the country currently imports 70% of its annual seafood requirements. The Kingdom's total seafood imports for 2007 were 150,378 tonnes with a total value of SAR899 million (USD240 million). The government is boosting development of aquaculture sector for several reasons ranging from food security, employment potential, and socio-economic contribution to export earnings.

Marine finfish farming

Aquaculture development in Saudi Arabia began in 1980, with the establishment of Fish Culture Project at Saudi Arabian National Centre for Science and Technology (now called the King Abdulaziz City for Science and Technology) in Riyadh. With mariculture development, the Fish Farming Centre (FFC) of the Ministry of Agriculture and Water, established in 1982 at North Obhur, near Jeddah was a significant contributor with the cooperation of FAO. Commercial aquaculture started in mid 1980s and since then aquaculture production has been increasing.

Tabuk cage farm (courtesy - RAIS)

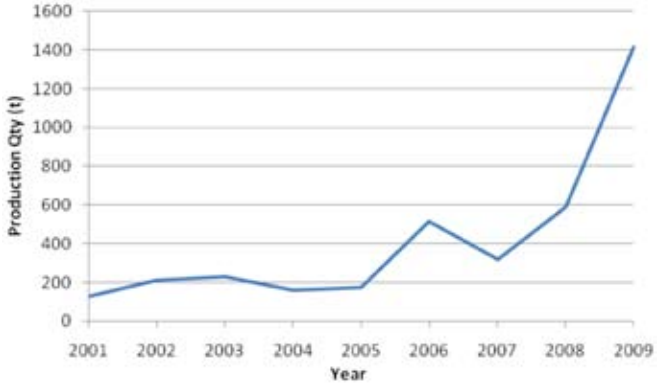
Prior to mariculture, fish supply came from freshwater based tilapia farms such as the first commercial tilapia farm in 1983 in Qassim. However, the sector faces severe water shortages, inbreeding of available fish stocks, remote sites, low level technology and foremost, competition with cheaper imports. Mariculture is targeted to fulfil Saudi's future food fish demand. The shorter Arabian Gulf is non-conducive for mariculture with its non-friendly conditions such as very high salinity at 40 to 50 ppt, low currents and limited tidal range (Hunter, 1983; Johns and Olson, 1998). The Red Sea coastline has better conditions; salinity from 36 to 41 ppt, coastal air temperature peaks only to 40 °C in summer and the average surface water temperature in summer is about 26 °C in north and 30 °C in south. The small 2 °C variation during winter facilitates culture of both temperate and tropical species. The tidal range is about 50 cm in the northern and southern Red Sea coasts and gradually decreases towards the centre and is close to zero near Jeddah (Edwards, 1987).

Map of Saudi Arabia

Table 1. Marine finfish aquaculture production in tonnes from 2001 to 2009 (FAO Fishstatplus; MoA, Saudi Arabia).

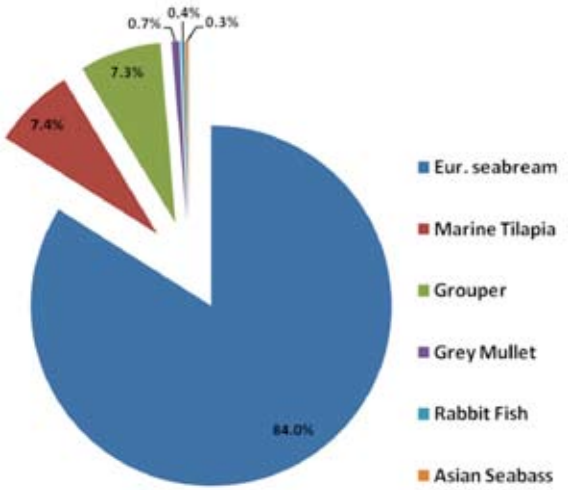
Species	2001	2002	2003	2004	2005	2006	2007	2008	2009
Asian Seabass	-	-	-	-	-	-	-	18	4
Croakers/Drums	-	-	-	-	27	35	5	-	-
Grey Mullet	35	20	22	18	-	-	12	10	10
European Seabream	-	-	-	-	-	-	-	400	1190
Grouper	-	-	-	-	50	55	<0.5	50	104
Sabaki Tilapia	63	165	180	120	85	379	285	105	105
Rabbit Fish	27	25	27	23	10	45	15	5	5
Total	125	210	229	161	172	514	317	588	1418

Figure 1. Trend in farmed marine fish production in Saudi Arabia (2001-2009).



Baobab system for culturing marine tilapia in the Fish Farming Centre

Figure 2. The contribution of various marine finfishes in 2009.



Commercial marine fish production

Initially marine finfish production was based on pond culture of sabaki tilapia (*Oreochromis spilurus*), native rabbit fishes (*Siganus rivulatus* and *S. canaliculatus*) and flathead grey mullet (*Mugil cephalus*). Farmed marine finfish include Asian sea bass (barramundi, *Lates calcarifer*), grouper (*Epinephelus coioides*), European seabream (*Sparus aurata*), sobaity seabream (*Sparidentex hasta*) and croaker (*Otolithes ruber*). The production by species is given in Table 1. At present, marine finfish aquaculture activities involves both pond and cage farming (mainly European seabream). Culture in recirculation water systems is still in its infancy.

A recent surge in marine finfish production was attributed to cage farming by Tabuk Fisheries in the northern part of the Red Sea area of Duba, in Tabuk emirate. The farm is located in 30 to 50m deep inshore area and is producing European seabream in medium-sized round circular high-density polyethylene (HDPE) cages. Production is approximately 30 tonnes/cage and average feed conversion rate (FCR) is 1.65:1. The cage culture system was imported from Greece (Selonda Aquaculture) and has been adapted to the Red Sea coast conditions. Juveniles for stocking cages are imported from UAE and Europe.

The Asian sea bass, locally known as gharous, is cultured along the Red Sea coast (Salama and Al-Harbi, 2007). In the grow-out phase after six months from stocking, an average weight of 500 to 700g was achieved from an initial weights of 20 to 30g with survival rates ranging from 90% to 96% and a FCR of 1.0 to 1.4 (FFC, 2002). Currently Asian seabass is cultured in commercial scale in ponds by Red Sea Aquaculture Co in Al Lith.

A potential domestic species is the greater amberjack (*Seriola dumerili*). It has interesting characteristics: high growth rate reaching 6kg in 2.5 years (Jover et al., 1999), excellent flesh quality, and easy adaptation to captive conditions and is farmed worldwide. The National Prawn Company (NPC), has been working with conditioning and spawning of amberjack broodstock in its new land-based recirculation facility developed with AKVA group which will allow the fish to spawn year-round, with an annual production capacity of 4 million fry and complete the one-year farming cycle from 'egg to plate'. Another marine fish hatchery presently being constructed by Tabuk Fisheries is in Duba. Both hatcheries have been designed to use recirculated water with temperature control to produce around 20 million 5g fry/year or 80 million 2g fry/year.

The future

Increase in marine fish production is expected to continue with more contributions from upcoming cage farms. However, only a limited number of native species have been considered for aquaculture. Successful year-round natural spawning and larval rearing of *E. polyphekadion* in captivity and under hypersaline water conditions of 42%-43% has been reported a decade ago (James et al., 1997). Similarly the potential of a grouper hybrid (*E. fuscoguttatus* x *E. polyphekadion*) and growth of these two species under grow-out has also been evaluated (James et al., 1998; 1999). Aqua farms company has plans to culture giant grouper (*E. lanceolatus*) (Donaldson et al., 2003) which is widely cultured in Taiwan. Research and trial production is also being conducted successfully by FFC with squaretail coral grouper, *Plectropomus areolatus* and roving coral grouper, *P. pessuliferus* (both locally known as 'najil' and listed in IUCN red list (Wang, pers comm.).

Croakers, red drum and snappers are some of the potential mariculture candidates for Saudi's mariculture industry. Experiments have been conducted related to culture feasibility and nutrition of the Karanteen sea bream, *Crenidens crenidens* (Mal, 2004). List of other potential native species for aquaculture is presented in Table 2.

Cage farming is set for rapid growth along the Red Sea considering availability of 3,307km^2 of potential sites (mainly between Jeddah and Yanbu) and 865km^2 in the Arabian Gulf as estimated by ADF (2011), with the potential production quantity of 4.2 million tonnes based on production capacity of 1,000 tonnes/km^2. For sea-based pen culture, the potential area in Arabian Gulf is estimated to be 1,810 km^2, sufficient to produce another 1.6 million tonnes. The calculations for

potential area considered areas with water depths of 20 to 50m for cages and 0 to 10m for pens.

Table 2. List of potential native species for commercial mariculture.

Common name	Scientific name
Giant trevally	*Caranx ignobilis*
Bluefin trevally	*C. melampygus*
Snubnose pompano	*Trachinotus blochii*
Golden trevally	*Gnathanodon speciosus*
Milk fish	*Chanos chanos*
Spangled emperor	*Lethrinus nebulosus*
Mangrove red snapper	*Lutjanus argentimaculatus*
Malabar blood snapper	*L.malabaricus*
One spot snapper	*L. monostigma*
Blubberlip snapper	*L. rivulatus*
Russel's snapper	*L. russellii*
Cobia	*Rachycentron canadum*
Tigertooth croaker	*Otolithes ruber*
Silver Sillago	*Sillago sihama*
Areolate grouper	*Epinephelus areolatus*
Giant grouper*	*E. lanceolatus*
Malabar grouper	*E. malabaricus*
Camouflage grouper	*E. polyphekedion*
Greasy grouper	*E. tauvina*
Spotted coral grouper	*Plectropomus maculatus*
White-spotted spinefoot	*Siganus canaliculatus*
Marbled spinefoot	*S. rivulatus*
Goldsilk seabream	*Acanthopagrus berda*
Yellowfin seabream	*A. latus*
King soldier bream	*Argyrops spinifer*
One spot seabream	*Diplodus sargus*
Gold-lined seabream	*Rhabdosargus sarba*
Silver pomfret	*Pampus argenteus*

**Giant grouper occurs in Eritrean Red sea coast.*

However, the farming strategy should be a combined program involving diversified species to minimise the quantum of risk involved in mono species farming systems. Successive breeding of a host of species in a multispecies flexible fish hatchery cushions the losses or mortality risked in any one fish species. An assured flow of farm gate products is also ensured, enabling a complete exploitation of fish processing facility to its fullest capacity.

In the list for offshore cage farming, we have a rating index which includes cobia, European seabream and sobaity. Cobia has not been farmed in the Red Sea so far, but successful farming was recorded in Abu Dhabi (Yousif et al., 2009).

Weaknesses

Although the country has realised the significance of aquaculture, there is a lack of a broader aquaculture development strategy, legal framework, clear legislation and even with prevailing laws they are not strictly enforced in some cases. For example, the Kingdom's 'National Aquaculture Policies and Practices' is yet to be recognised officially. Apart from this, there are other managerial issues and bureaucratic procedures at administrative levels which hinder the development of a sound aquaculture industry. Although the government indirectly supports aquaculture sectors in the form of subsidies and incentives (ADF, 2011), ADF does not lend for marine fish cage farms and the loan limit is set at SAR50 million (USD 13.3 million) aimed at small

Spotted coral grouper – a potential candidate for aquaculture (courtesy: RAIS)

to medium sized projects, but does not cater for larger aquaculture projects.

In culture technology, absence of local hatchery facilities or inadequate production from existing ones is leading to an erratic supply that affects farm's production planning and economics. The present culture technology also needs to be modified to make it more environment-friendly. The technology related to specialised finfish feed manufacturing is yet to be established.

With domestic marketing, steps are required to popularise seafood by emphasising on the health benefits. A comprehensive production and marketing strategy to meet the demand of various segments of population is essential.

Diseases have been a major issue leading to severe economic losses especially with tilapia farming. Saudi does have a policy effective enough to prevent entry and spread of pathogens. Meanwhile, regulations to ensure food safety must be strengthened. Inadequate disease monitoring is another pressing issue and such programmes are currently planned (RECOFI, 2008). Other key deficiencies are difficulties in accessing information, absence of specialists and inadequate facilities.

The shortage of well-trained personnel has been an obstacle, besides a lack of extension planning and lab-to-land programs due to insufficient funding. R&D studies related to culture aspects, larval rearing, genetic improvement, aquaculture-agriculture integration, polyculture, organic farming, and low-cost feed formulation, disease control, etc are essential too.

References are available on request

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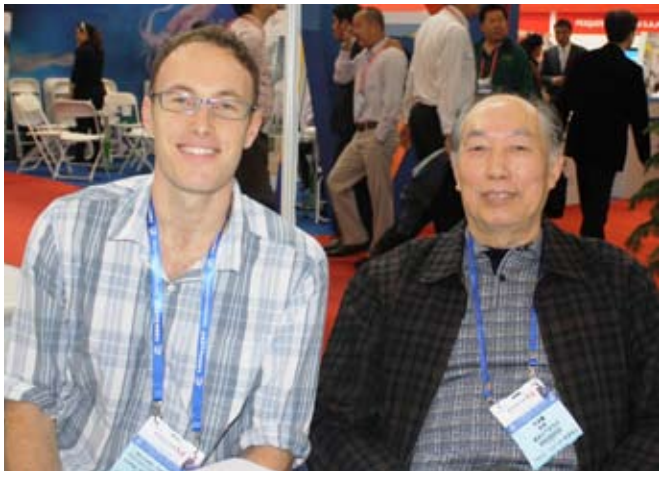
China Fisheries and Seafood Expo 2011

Meeting existing and new customers, buying and selling frenzy at Asia's largest seafood exposition.



Dr Jiaxin Chen, former director, Yellow Sea Fisheries Research Institute (right) with Dr Michael Fabinyi, Coral Reef Studies, Australia.

Malaysia Manjungjv, from left, Yong Kui Thing, managing director, Khoo Seng Yoaw, procurement manager, Wong Harng Jou, business development manager and Beh Chan Sin, Soon Heng Engineering. This is a well established integrated group with shrimp farming, shrimp processing factory, logistics and marketing teams. The new hatchery for SPF Penaeus monodon will be operational in January 2012 (www.manjungjv.com)

May, vice general manager, Zhanjiang Guolian Aquatic Products Co Ltd and Bob Liao

In its 16th year, the annual China Fisheries and Seafood Expo and China Aquaculture is now the second largest seafood and processing exposition. It is already the largest in Asia. It recorded more than 800 companies from almost 80 countries, filling up four halls in the Qingdao International Convention Centre from 1-3 November 2011. A record 15,300 visitors from all over the world attended. This was nearly a 50% increase from the show in Dalian in 2010. This year, the number of booths increased 20%.

"No other country is more important to the global seafood industry. To say the Chinese market is red hot is an accurate statement. The Chinese have a natural affinity to seafood and China's more affluent population is eager to try new seafood from all over the world," said Peter Redmayne, president of Seafare Expositions, Inc, the show's co-organiser. "We have been at this for 16 years and the Chinese seafood consumption has always been growing. We have never seen anything thing like this."

In his speech at the opening ceremony, Redmayne said. "China is the engine that is driving the global seafood industry. Seafood consumption is declining in the traditional major markets such as Japan, US and EU. Fortunately for producers, that is not the case in China, the world largest seafood market. In 2010, China's international seafood trade exceeded USD 20 billion, making it the leading trading country for seafood. Growth is not slowing down as for the first six months of 2011, the value of its seafood was up by 25%."

"This is a show where people just come to meet their existing customers and to be seen," said Jennie Fu, marketing manager for Seafare Expositions Inc. "This is where people buy and sell seafood, lots of seafood."

In Qingdao, exhibitors were the who's who in China's production, processing and reprocessing industries, ranging from marine shrimp, tilapia, scallops to sea cucumbers. Farming of the latter is increasing in China's northern provinces in facilities formerly used for marine fish such as the turbot. Turbot prices have declined in recent years whilst land costs have gone up. High priced sea cucumbers fulfilled the Chinese penchant for health and wellness, said Dr Jiaxin Chen, Yellow Sea Fisheries Research Institute. At the show, more than 50 companies were marketing sea cucumbers, such as Yantai Shenshentang Aquatic Food with live, medium dried and dried sea cucumber.

Lobster was another example, said the organisers. More than 24 companies were marketing the lobster. Chinese imports of the American lobster soared to 1,000 tonnes in 2011 from 100 tonnes in 2010. In fact, China is an attractive market, not only for its bullish demand but prices are good, despite the 17% tariff and VAT on lobster imports. In fact, one company has directed all sales to the China market.

Many of China's top producers had large booths such as the combined booth of Zhanjiang Guolian Aquatic Products which farms, processes and imports marine shrimp and Guangdong Gourmet Aquatic Products, an integrated company for the farming, processing and export of tilapia. The top brand for Guolian's shrimp is Long BA, targeted for the domestic markets whereas for overseas markets, shrimp is also sold under the customer's brands. Demand is so strong in China that Guolian says that it is now importing 200 containers of shrimp to meet demand, said organisers. "The demand for the domestic market is for all sizes of HOSO (head-on shell-on), CHOSO (cooked head-on shell-on), PD (peeled deveined), PDTO (peeled deveined tail-on) and CPTO (cooked peeled tail-on); from 6/8 pcs/kg to 50/60 pcs/kg for CHOSO

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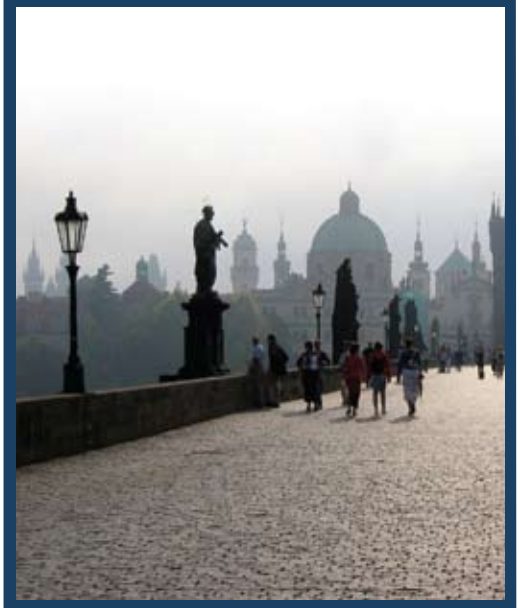

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William J Su (second left) and team at the Hainan Quebec Ocean Fishing, marketing HQ tilapia. Su is also deputy chairman of the tilapia chapter of the China Aquatic Products Processing Marketing Association (CAPPMA)

At TFFA booth, Dr Panisuan Jamnarnwej (middle) with Vorada (left) and Surapong Harnkrivilai, Thai Royal Frozen Co Ltd.

From left, Eva Yu, sales, Jane Yu, deputy general manager, Lillian Li, marketing director, and Cathy Chen at the Yunnan New Ocean Food Ltd.

At the Aqua Culture Asia Pacific booth, Santhana Krishnan, Marine Technologies, India (right) and Alsharif Nasser Almansour, Red Sea Aquaculture.

and HOSO and from 41/50 to 100/200/kg PD and CPTO. The smallest sizes of 100/200/kg of PD, CPTO are for supermarkets," said May, at the Goulian booth.

China is the leading exporter of tilapia. Prices of the tilapia have been fluctuating, said William Su at Hainan Quebec Ocean Fishing. The current target is the domestic market. In Qingdao, there was first time exhibitor, Yunnan New Ocean Food Ltd which produces 3,000 tonnes annually of tilapia at its farming area in Yunnan Province and exports frozen fillets to the US, Europe, Middle East and Canada.

Almost the whole of hall 2 was occupied by country pavilions; Canada, Chile, Ecuador, Estonia, Iceland, India, Ireland, Italy, Malaysia, Norway, Pakistan, Papua New Guinea, Peru, Philippines, South Korea, Spain, Thailand, Turkey, The Netherlands, United Kingdom and the USA. Producers from the Philippines, such as Alsons Aquaculture and smallholders under the USAID-Gem Program target China's live and chilled fish markets for pompano, seabass, groupers and seabass. Alsons sells under the Sarangani Bay brand. Asia's marketing associations included the Thai Frozen Seafood Association (TFFA), Malaysia's Fisheries Development Authority and Marine Products Export Development Authority of India (MPEDA). The region's top integrated shrimp producers were present. Malaysia's Blue Archipelago was marketing the Pelagos brand of shrimp from its integrated farm. There was Indonesia's CP Prima, the largest shrimp farm in the world and Thailand's Asian Seafoods, a leading seafood processor with 6 plants and an integrated shrimp farming business with hatchery, feed mill, farms and processing.

In the hall dedicated to aquaculture, Chinese companies dominated such as Shandong Wudi Huaxiang Aquaculture marketing artemia and other hatchery feeds and Dalian Huixin Titanium Equipment with products ranging from enclosed aquaculture systems and micro algae systems, live fish transport, cage technology to sea cucumber feed. Others include US based Aquatic Ecosystems (aquaculture systems), Belgian Inve Aquaculture (hatchery and health) and Taiwan's Avantron Micro Co Ltd (feed and food processing). Canadian company Agri Marine Holdings is using its proprietary containment technology for salmon and trout in China.

In 2012, the exposition will move to Dalian and will be held from November 6-8 at the Dalian World Expo Centre.

Sustainable seafood in China

The catch word is sustainability and there are challenges and opportunities unique to China. In Qingdao, several seafood leaders and NGOs deliberate the readiness of Chinese consumers for sustainable seafood.

The Third Annual Sustainable Seafood Forum was organised by the China Council for the Promotion of International Trade (Sub-Council Agriculture) and Sea Fare Group Inc., USA, organisers of the 16th China Seafood and Fisheries Expo on November 1, 2011 in Qingdao, China. The objective was to look at the demands of the seafood market in China and challenges and opportunities in China for sustainable seafood certification.

According to Peter Redmayne, president, Sea Fare Group, almost 80% of the top seafood buyers and retailers have implemented some measure or program for sustainable seafood. With limited supply and increasing prices of seafood, the sustainability ticket is important to meet the demands from buyers and consumers. Wal-mart stipulates that by 2011, all of the finfish sold in its stores should be BMP (Best Management Practices by GAA) or MSC (Marine Stewardship Council) certified. The goal of Mars Petcare is to use only sustainable sources of seafood by 2020. Several other buyers and retailers in North America and Europe are following.

What is sustainable seafood?

The basic principles were given by Philip Chou, senior manager, Seafood Choices Alliance. In farming, this is seafood with zero antibiotics, with an efficient conversion of feed and farmed without damaging the environment and with minimal impact on the surrounding ecosystem. Chou noted that there is strong demand from consumers and buyers in Europe, North America and increasingly, the rest of the world are also seeking this. The European Commission reported that 8 in 10 citizens base purchasing decisions on environmental impact and 50% believe in eco labelling. A substantial volume of the seafood exported to these markets comes from China.

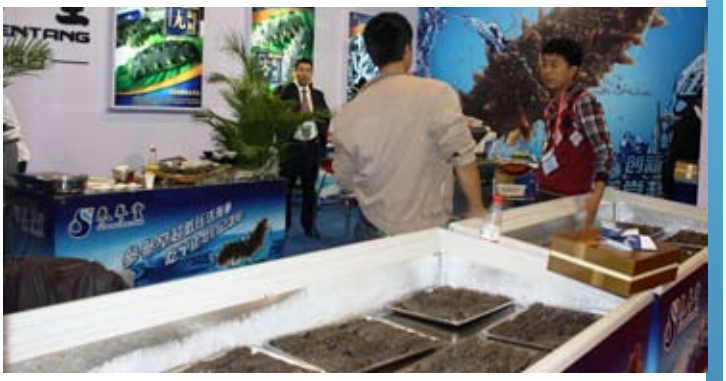
To be sustainable, Chinese producers need to focus on traceability, comply with sustainable standards and certification, and develop relationships with sustainable buyers. Certification allows for independent assurance of practice – environmental, social, organic, welfare, or others. The choice of certification will depend on the business, including MSC for wild caught seafood, BMP for farmed fish, and the forthcoming Aquaculture Stewardship Council (ASC), Fairtrade and Organic certifications. Business to business certification are catered to by ISO and GlobalGAP, while business to consumers include Label Rouge, ASC, certification with BMP and Soil Association's organic standards.

The market for sustainable seafood is also expanding. "China's growing middle class has more income to buy seafood too: 1970, 5kg/capita; 2008, 25.8kg/capita and Chinese consumers' sustainability consciousness is rising. Their greatest concern is food safety and safe food is also environmentally responsible and sustainable!" said Chou.

Sustainable seafood in China

What are supermarkets, their suppliers and NGOs doing to promote sustainable seafood? To answer this, Yasuyuki Yamamoto, Aeon Topvalu, general manager Grocery and Seafood Department, said that the company introduced MSC-labelled seafood for the Japanese market, including 22 items as of 2010. It buys MSC certified seafood from US, New Zealand and Norway for the Japanese market and it has two MSC certified producers. However, it has yet to insist on MSC certified seafood imports for the Chinese market.

Carrefour, the world's number 2 retailer with 9,564 stores has been working on sustainable sourcing since 1992, said Clotilde Pallier,



Sea cucumber producer, Shenshentang Aquatic Food Co Ltd

National Quality and Sustainable Development manager of Carrefour China. The company has an open dialogue with NGOs and works out the precise specifications with the suppliers. It works with WWF on the black and red list for seafood. From 2012, it will include a list of black listed products in its commercial contracts. Sustainable sourcing by Carrefour means sustainable fishing as close to the coast as possible and in aquaculture, controlling the full supply chain from feeding to transportation to Carrefour supermarkets. From 2013, Pallier said that the company will seek more aquaculture products under the its Qualité premium brand.

Lewis Allen, head of Buying Strategy, Sainsbury's, a leading supermarket chain in UK, said that the business values focus on 'best for food and health'. The company has 17% of the UK market share with GBP 400 million annual sales of seafood. Some five species comprise 80% of sales and there is a 50:50 ratio of wild and farmed products. In 2006, it introduced the sustainability rating; from illegal (red) to responsible and sustainable. It is the largest retailer of MSC certified products. 'Responsible' is used to denote production to be verified by third party. Responsible sourcing is important for Sainbury's as it has a duty to its consumers and brand position to uphold a high level of trust and integrity. High quality and freshness are essential. In UK, the media is hot on the heels on non-ethical practices and it is important for Sainsbury's to deliver.

"By 2020, all the fish we sell will be independently certified as sustainable and we will strengthen our position as the leading retailer for sustainable seafood", said Allen

Chris Hanselman, managing director of the Pacific Rock Resources group, which has been trading in seafood for the past seven years mainly in Hong Kong, gave a trader's perspective on sustainable seafood in the Chinese market. In general, there is lack of full understanding on sustainable seafood in China whereas in Hong Kong, there is increasing awareness. Chinese producers may seek such certifications to meet the demands of Western countries, but accreditations are too confusing to many and may not show benefits.

In China, the drivers of consumption are quality first, price second, brand third and accreditation last. The market is price and cost sensitive and brand and accreditation will not drive awareness. Domestic products are price point driven and a western brand carries no weight. Financial barriers are emerging such as increasing costs in production. Hanselman said that it will take a long time before consumers in China are convinced on the need for 'sustainable seafood'.

New line of hatchery feeds for vannamei shrimp in China

VANNA® was specially developed for the Chinese market based on local needs and culture conditions.

China is today the largest producers of the *L.vannamei* and other shrimp species, currently estimated at 800,000 tonnes for *L. vannamei* alone. However, this number has come down from 1.2 million tonnes in 2009. Production has been on the decline because of diseases and culture management issues arising from climate changes, higher temperatures, flooding and drought.

INVE Aquaculture has a strong foothold in the country's shrimp farming market with supplies of hatchery feeds to health products such as the Sanolife® range of probiotics. However, the market is fundamentally different from other parts of Asia. The Chinese farmer's demand on products is foremost price.

In cooperation with the Evergreen Guangdong Group, through a strategic collaboration in 2009, INVE Aquaculture has introduced a new line of feeds specific for vannamei shrimp hatcheries in China. The feed formulation is designed for the rapid turnover required in hatcheries and low assimilation efficiency typical for the herbivorous vannamei shrimp. It has been designed for post larvae (PL) production without the use of algae and with reduced Artemia feeding, a common practice in hatcheries in China. The feeds are for zoea stage 1 until zoea stage 3 (VANNA PZ), zoea stage 1 to mysis stage 3 (VANNA ZM), mysis stage 1 to PL stage 2 (VANNA MPL) and PL stages to PL15 (VANNA PL). The other option is VANNA black flakes to feed mysis stage 1 to PL15. The latter is designed to meet the special requirement for PL with strongly pigmented gut and hepatopancreas.

Technical performance trials conducted in hatcheries of the Evergreen Group showed that the VANNA range yielded better growth and survival as compared to competitor products. The feed requirement was also 30% less to obtain the same volume of PL8.

"In China, the culture conditions are entirely different from other parts of Asia. In larval rearing, the Chinese hatchery operator has difficulty in controlling algal populations. Their preferences would be to use less algae and use substitutes (BP types, Spirulina, enzymes and other mixtures). They also want the hepatopancreas to be black. We looked at these bottlenecks and worked at designing a special feed range. This is in addition to our LANSY® and FRIPPAK® range of hatchery feeds popular with operators in most of Asia," said Rudi Bijnens, commercial director, Far East Asia, at the annual China Fisheries and Seafood/China Aquaculture Exhibition held from November 1-3 in Qingdao.

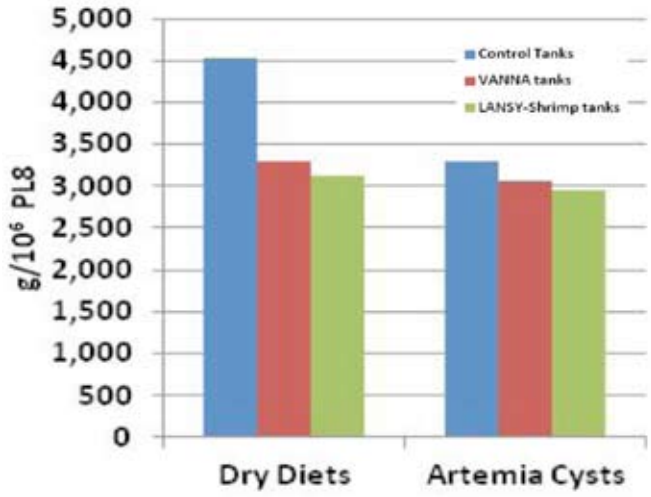
In Qingdao, Rudi Bijnens and Pepino Candreva (right).

"With the VANNA range, hatchery operators in China are managing PL production well. In China, there is tendency to stock low volumes of larva in large tanks. Cost of production with the VANNA range is lower by 20% as compared to earlier protocols. However, it is important that the team in China continue to teach hatchery operators how to use these feeds efficiently," said Pepino Candreva, business development manager.

Another adaption to the Chinese market is the specially designed probiotics for shrimp hatcheries and grow-out. The collaboration with Evergreen allows INVE technologies to test out new recipes of bacteria mixes. The unit price per kilo was drastically reduced by deciding to lower the CFU/ml of bacteria. However, this is not expected to reduce costs of production drastically as the recommended *Bacillus* levels remain the same, said Bijnens.

"As infections leading to mortality and poor yields are recurring in most farms, sales of the disinfectant PUR have increased 25%. The PUR line is the general range for Asia. The product can be used at low concentrations which suppress growth of *Vibrio*. At higher concentrations, it acts as a biocide. This is recommended in pond and water preparation and followed with probiotics at regular intervals throughout the culture cycle," said Bijnens.

Figure 1. Reduced feed consumption as a result of the superior nutritional quality of the INVE diet ranges.



The Movie

A CD released to celebrate 20 years of INVE Aquaculture. This is the story on the company, a pioneer in aquaculture. It was set up in 1983 as a spin off from Ghent University's Artemia Research Centre and to valorise research output on Artemia.

Creating concepts for agribusiness

The Asia Pacific Lecture Tour 2011 in Kuala Lumpur marked Alltech Biotechnology's 24th year in Malaysia. The theme was 'The game changers: creative concepts for agribusiness'.

This year's event steered away from outright technical presentations to focus more on business and management. The team identified the game changing strategies which could revolutionise the future of agriculture and animal health industries.

Dr Pearse Lyons, president and founder of Alltech, in his video message to the Malaysian audience comprising members from the livestock, aquaculture and feed industries identified the game changers as in genomics, fibre and algae.

On the 'key to advancement in agriculture', Lyons said, "Some 40% of world population are in areas growing at 8% annually and there are the 400 million middle class in India and China. Imagine the demand especially with China taking 5% of the US grains! In China, the need is on food safety issues. Programmed nutrition to provide better food with less feed and will not cost more. There is algae, with its incredible nutrition and as a new source of sustainable feed and energy. Alltech will be exploring what can be done with microalgae which are now used to feed fish larvae and young animals."

"Innovation has brought us success, better disease understanding, lower infant mortality and longer lives. But it also presents us with the challenge to adopt new technologies at a faster pace and communicate in a way which we never have before. This is a significant time for change in our industry. It is about making things happen."

"In livestock, 85% of the improvements in production come from genetic improvements and some 75% from feeding. Through gene chip technology, nutrigenomics, we can find the answers such as relationship between diets, genes, function and health."

According to Matthew Smith, Asia Pacific director, business is about improving the bottom line. It is reducing risks and creating solutions to answer and overcome challenges. Alltech's way is by having a production base in China for Bioplex for the Chinese market because the demand is there.

China is the world's largest pig producer at 600 million. Alltech has been growing 20% annually for three decades and in 2011 it expects a global revenue of USD700 million, with 10% from China. The target is USD 4 billion by 2015 with USD 1 billion from China.

Amelyn Yong, corporate account manager (left) with Steve Roberts, Kenyir Aquaculture (middle) and Hanan Mohd Yusof, Department of Fisheries.

Game changing strategies

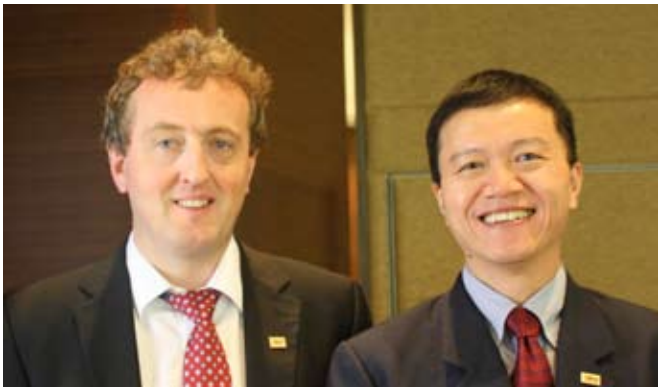
On a time for change in agriculture, **Dr Alison Leary**, technical account manager of Alltech Asia Pacific, looked at some 'game changers' in five companies. "It was 'just change' for Nestlé, 'be different' for Zespri, 'you are everything we do' for KFC which opened a store every 18 hours in China, 'where is the growth potential' for JBS and 'don't act now' for Liuhe," said Leary.

Swiss based Nestlé now describes itself as a food, nutrition, health, and wellness company. It has achieved this through renovation and innovation. In New Zealand, since 1992, Zespri was exporting kiwi fruits. However, with competition from other growers, kiwi fruit sales from New Zealand suffered. Leary said that they needed to differentiate. 'To be different', Zespri used technology to change the fruit and created Zespri Gold. Today, it has 30% of the world market and 70% of market value. This is a unique market alignment.

Brazilian beef processing giant JBS SA was already a leading meat producer when it began to acquire farms in the US and Australia. These deals led it to become the largest multi-protein producer in the world. As the largest company in the world, it could then dictate how protein is going. Liuhe became a major player in China's feed production and integrated livestock industry. Liuhe was started by two professors and over the years have kept to its own management style and to Liuhe's corporate core values 'Kindness, hard-working, keep on learning, and promoting harmony'.

Aquaculture

The future is in this industry said **Dr Fuci Guo**, SEA aquaculture manager. Seafood consumption is on the rise with growth of 3.6% per year since 1960. In developed countries, health benefits from seafood



Richard Murphy and Fuci Guo

Matthew Smith

are driving increased consumption. In 2011, China has become net importer of seafood, the projected demand will increase by 7% annually to 2050.

"In 2007, we already have 114 million tonnes of seafood with 50 million from aquaculture. An expected demand of 100 million tonnes from aquaculture in 2050 will require more than 70 million tonnes of feed. Asia has the lead with 88.9% of production but there are two challenges. How do we deal with shortage of raw materials such as fish meal? The answer comes from our yeast technology platform. Multiple enzymes produced from Solid State Fermentation unlock nutrients from vegetable sources. In trials we showed that a 30% increase in growth was achieved with 0.5kg/tonne of Allzyme®SSF. Good growth of the cobia fed with fish-free diets containing nucleotides from NuPro® has been demonstrated. Mycotoxin contamination is a major problem, over 98% of complete feed surveyed contain afflatoxin. As low as 29 ppb of afflatoxin induces jaundice, liver inflammation and stunt growth in tilapia. Supplementation of 0.2% Mycosorb® brings back normal growth.

"The other challenge is how to manage diseases to keep up the production. As there are no vaccines for any tropical marine fish and shrimp, our approach is to use nutritional tools to strengthen immunity by improving gut health and skin health. Aquate® increases the mucus production to reduce sea lice attachment. Lastly Alltech Algae, as our second technology platform, will provide nutritional solutions for aqua feed in particular in the replacement of fish meal and fish oil."

Performance and profitability

Livestock producers seek technology to reduce costs. **Dr Paulo Rigolin**, Allzyme® SSF global manager looked at the reduction of fibre with the enzyme in diets, even though with corn and soy. He said that without the enzyme, 88% is energy and 12% phosphorus whereas it was 92% energy and 8% phosphorus when Allzyme® SSF was used. In poultry, over 20 years, the genetic improvements allowed for maximum growth to 2.2 kg in 42 days instead of 54 days. But the current feed cannot reach this. More needs to be done to close the gap.

In presenting the practical solution for today's and tomorrow's challenges, **Dr Richard Murphy**, research coordinator, said, "Reducing feed costs is through overcoming infections and increasing survival. The solution is Alltech's Actigen. Improving mineral efficiency increases bioavailability. This is through chelating trace minerals. Finally, it is looking at fingerprinting nutrient effects and through nutrigenomics, we give alternatives/or ingredients for specific biological functions. This programmed nutrition will lead to less expensive formulation strategies."

Third International Symposium on Cage Aquaculture in Asia

The future for cage aquaculture in Asia

As cage aquaculture moves from the traditional small scale to industrial systems, the focus is on genetics, feed and health management for a sustainable industry.

Asian production of fish through cage culture in inland and marine environments is increasing. In 2009, Asia produced 1.3 million tonnes of marine fish, valued at USD 4.7 billion (FAO, 2009). The major producers are China (60%), Japan (20%) and Korea (8%). Others are the Philippines, Indonesia Thailand and Malaysia. Further growth of both freshwater and marine cage culture is expected in the next few years as aquaculture plays its role in the global supply of food fish, in light of depleting supply from capture fisheries.

"Since the first symposium in Taiwan in 1999, we have witnessed the growth and sophistication of cage culture in Asia and the innovative approaches taken to overcome the constraints of restricted space, vulnerability to typhoons, environmental pollution and use of trash fish as feed. The recent move to offshore cages and large scale hatcheries brings its own set of challenges, in particular finding the balance between small scale and large industrial scale farming," said **Dr Derek Staples**, President of the Asian Fisheries Society in his welcome address.

Derek Staples

The Third International Symposium on Cage Aquaculture in Asia (CAA3) was held in Kuala Lumpur, Malaysia from 17 to 19 November. It was attended by 326 participants from 24 countries. Majority were from industry in Malaysia. CAA3 was organised by the Asian Fisheries Society and Malaysian Fisheries Society in partnership with Universiti Putra Malaysia and Fisheries Development Authority of Malaysia. The Ministry of Agriculture and Agro based Industries (MOA) and the Department of Fisheries Malaysia (DOF) hosted the event. The Gold sponsor was Uni President Vietnam and trade show sponsors came from industry in Malaysia.

Similar to the last symposium held in Hangzhou, China in 2006, the objectives of the event were to provide updates on recent advances and trends in cage aquaculture, both within Asia and beyond; encourage networking between academia, aqua culturists and other stakeholders; and seek solutions to constraints to development. The six concurrent sessions dealt with site selection and environmental management, production technology and systems, species selection and seed production, biosecurity and health management, and feeds and feeding. A half day Farmer's Day session discussed the business of cage culture and health management, and steps for sustainable production.

Industry from Malaysia and symposium participants at the Farmer's Day session

The co-located event was the Malaysian International Seafood Exposition (MISE) which was in its second year. This is a biennial event of MOA/DOF. This show brought companies involved in the seafood production business and aquaculture, mainly from Malaysia, to showcase products and improve access to new domestic and international markets. Visitors comprise buyers for food services and restaurants, governments, importers, exporters, logistics and marketing companies, banks, aqua suppliers, certification and engineering companies.

A special session on the seafood trade and certification was held prior to the conference on November 16. Here regional market experts gave presentations on the global trends in seafood marketing, the changing role of China as a seafood importer, changes in Japan's seafood market after the tsunami in March 2011, regional trends in seafood demand and supply, and biosecurity in seafood production in Malaysia. This will be reported in the next issue.

Securing the future

In his plenary presentation, **Dr Mike Rimmer**, Faculty of Veterinary Science, University of Sydney, said that cage aquaculture will have to develop technologies and production systems similar to those seen in intensive animal production industries, including selective breeding programs, improvements in seed production technologies and more cost effective grow out systems.

"In Asia, tropical cage aquaculture is disadvantaged by the diversity of species and frequent shifts in production trends between various species. However, advanced technologies can be applied to only a limited number of species. The Asia-Pacific region should begin to focus its R&D efforts on species where technological interventions will provide significant benefits. Unfortunately, focussing technological improvements on a limited range of species will further exacerbate the gap between large 'industrial' farms and small-scale farms because small-scale farms are generally not well placed to implement improved technologies. Increasingly, the future will see a dualistic development, with large scale or 'industrial' farms that focus on a limited range of species amenable to large scale culture, such as pompano, barramundi or cobia, and which will serve the global 'white fish' markets. On the other side, the Asia-Pacific region will continue to have small scale farms which will increasingly focus on 'niche' markets such as the live reef food fish market. Given the focus that most national governments have on production quantity as a measure of success, it is likely that governments will give more attention to the large-scale farms which contribute more to national productivity. However, the needs of the small-scale farmers has to be taken into account by developing appropriate policies and regulations. 'Securing the future' means supporting a diversified production base and providing opportunities for all," said Rimmer.

In Malaysia, DOF is promoting industrial cage farming. In his plenary presentation, the deputy director-general, **Ismail Abu Hassan** said that this is practised in Temenggor Lake, located north-east in Peninsular Malaysia with the participation of Norway based Genomar. This is a vertically integrated system producing traceable

At the Dindings booth, Chong Kam Kin (middle), sales and marketing, aquaculture with his team.

Sean Lai (right) and team at the Star Feedmills booth

and sustainable tilapia for the local and export markets. It uses DNA technology for genetic marking. There are also large business models in marine farming. The prospect in cage aquaculture is bright with the introduction of the integrated icage development under the government's Entry Point Project (EPP).

The production target is to increase to 57,800 tonnes in 2015 and 102,800 tonnes by 2020 from the current 34,154 tonnes. However, a sustainable marine fish industry will require a balanced development of private hatcheries and grow-out farms and the use of domesticated and genetically enhanced broodstock, at least for a few selected major species (seabass and tiger grouper), said **Hussin Mat Ali**, DOF. The way forward is the use of environmentally controlled hatchery technology to ensure consistent and sufficient production of quality seeds to supply large farms.

Cage culture in Asia has been synonymous with the culture of high value species fed on fish which has good value as food for humans. This has resulted in public debates. As such intensive research to use less or no fish meal is required to provide a stimulus for the expansion of the sector, according to **Dr MC Nandeesha**, Fisheries College and Research Institute, India. "In addition, food quality and safety no longer remain as concerns for products for export but also for local consumption. As such, culture systems have to evolve to have food safety and quality aspects at all stages of culture."

Trade at CAA3

At the booth of Uni-President Vietnam, Cheng-Yen Hung (middle), assistant vice president Aquatic R&D and Overseas Business Division with his team from Vietnam and Malaysia. From left, Le Hoang Lam, Tran Sy Binh from Vietnam and from Malaysia, Kwek Sian Chai, director, aquafeeds and Benny Leng.

From left, Bluey Chew, Jessie Ngu and Sunny Low. The team introduced the fully foam drum board as floaters and polyethylene walkways cum working platforms for cage farms. Chew said that the inexpensive drum completely filled with polystyrene will not collapse under water pressure and has a life span of 25 years. The composite steel frame and polyethylene sleeve steel pipes give excellent structural strength to the walkways.

Feed producers and suppliers of cage/tank systems dominated the CAA3 component of the trade show. **Uni President Vietnam**, a leading producer of shrimp feeds in Vietnam started to export feeds to Malaysia in 2003. Currently, these comprise marine shrimp and marine fish feeds. For cage aquaculture, it produces slow sinking feeds for the grouper and floating feeds for the seabass, cobia and tilapia. Feeds are marketed as clean, natural and traceable. Marine fish feeds are being used by cage farms throughout peninsula Malaysia and in Kota Kinabalu, Sabah for seabass and grouper culture. In September 2011, the company increased its presence in Malaysia with a local office to provide technical support and services.

In Indonesia, 22 year old, **PT Matahari Sakti** is well known for its shrimp and marine feeds and since 2008, marine fish feeds have been exported to farms in Malaysia. According to Ku Azhari Ku Baharum, feed sales have been to small farms in the peninsula, mainly for tiger grouper and red snapper. These farms use weaned tiger grouper fry procured from

Introducing industrial offshore mariculture technology

This is the objective of Malaysian based Gagnar Engineering S/B, an exclusive distributor of semi-submersible cage technology in South-East Asia. The technology is a patented cage system developed and fabricated in Sweden by Farmocean International S/A. These are made up of steel structures with computerised feeding units to grow out fish offshore. Under normal operating conditions, the waves pass through the semi-submerged steel structure and do not cause stress to the biomass of fish in the net underwater. The concept behind the system is stable growth of fish, no loss due to the constant remote-controlled feeding, minimum manpower and few diseases because of favourable water conditions offshore. An experimental system has been installed by the Department of Fisheries, Malaysia in Layang-Layang, a remote island off Sabah, East Malaysia, which proved its suitability for industrial fish production.

Muhammad Nasir Yusof, Chief Executive Officer of Gagnar Group, said that its farming unit will soon be launching a commercial system 15km off Terengganu on the east coast of peninsular Malaysia. "We have planned for three cages, each measuring 4,500m^3. The net is approximately 20m across with a depth 20m. Each cage can easily hold 150 tonnes of fish at harvesting, and for our initial production cycle we will start with tiger and hybrid groupers."

"We will use autofeeders which will allow us to control feeding from the shore and our divers will go down to observe feeding behaviour of fish, clear up diseased or dead fish, if any, and routinely check on the general health and growth conditions of the fish stock. Once in two weeks, we will be cleaning the nets of any algal growths or barnacle formations to ensure sufficient flow of oxygen to fish in the net. When sea conditions are turbulent, we are confident that the net configuration will not collapse or shift greatly as there are sinker tubes to maintain the volume of the net space. The problem that we foresee will be sourcing of fingerlings, which initially will be obtained from local hatcheries and other external sources. In the near future, our goal will be to develop our own hatchery in order to secure our supply."

Gagnar's Muhammad Nasir Yusof (second from left) is pictured with Romano Rivadossi, managing director, Farmocean International AB (second right) and the rest of the team.

David Tan and staff at the booth of Super Artemia which markets artemia under the Golden Dolphin Brand.

Malaysian based Ku Azhari Ku Baharum (left) and the team from Indonesia, Edhi Guno Sumarto (middle) and Sandi Wahyu Kurniawan, marketing feeds at the PT Matahari Sakti booth.

hatcheries in Bali and fish grow to 800g in 8 months. The Megami range for the grouper, seabass and pompano, has premium feeds with 46% crude protein and standard feeds with 42% crude protein.

Malaysian **Dindings Soya and Multifeeds** is a 28-year old feed producer. It produces extruded, pelleted and mash fish feeds for the local market, at the feed mill in the northern state of Perak. Marine fish feeds are general feeds containing 44% crude protein for starter diets to 42% crude protein for grower feeds. **Star Feedmills**, part of Thailand's Charoen Pokphand Group is the market leader in aqua feeds in Malaysia. Sean Lai, general manager for marine feed sales and marketing department, said that the company is focussing on three species; pompano, seabass and red snapper. In Malaysia, by volume, seabass leads followed by pompano and red snapper. Sales of marine fish are increasing in Malaysia with more local consumption of live snappers and groupers. The current interest is the culture of hybrid grouper with an ex farm price of MYR 65-70/kg (USD 21-23/kg).

What does Europe have today and what will Europe need from aquaculture tomorrow?

This was addressed at the annual meeting of the European Aquaculture Society held from October 18-21, 2011 in Rhodos, Greece. Aptly, with the venue, the aim of Aquaculture Europe 2011 was to establish benchmarks for future research that will lead to a clear foresight of the development dynamics of Mediterranean aquaculture 2020. It was attended by 1,029 participants from 51 countries and is a new record attendance for an Aquaculture Europe stand-alone event. AE 2011 was hosted by the Federation of Greek Maricultures (FGM) and the Hellenic Centre for Marine Research (HCMR).

In Europe, aquaculture accounts for only 20% of the total fisheries production compared to 47% globally. Europe's annual growth in aquaculture is 1.7% but production from Spain and France has been on the decline. Some 300,000 tonnes of freshwater and marine fish were produced in 2010. Seafood consumption has been increasing to 24 kg/year/capita but the demand requires 65% of Europe's seafood supply to be imported.

Aquaculture is important and funding for European food, agriculture and fisheries and biotechnologies, has been extended up to 2020. **Maive Rute**, director for Biotechnologies, Agriculture and Food Research in DG Research and Innovation focussed on 'The contribution of aquaculture research to build the bioeconomy in Europe' which will provide the necessary knowledge and technology base to promote sustainable aquaculture and competitive development of aquaculture. In the early years, sea bream production which was 38 times smaller than that for salmon, was hampered by problems in the hatchery. Closing the gap in nutrition and a breakthrough in larval breeding, moved it to its current level. Production costs of sea bass decreased from Euro 8.00/kg to Euro 5.00/kg and that for the sea bream, from Euro 7.50/kg to only Euro 3.00/kg.

In the thematic sessions, three speakers provided reviews of the importance of aquaculture in EU food production; the implementation of selective breeding strategies in aquaculture and the sustainability of aquaculture feeds. **Lara Barazi - Yeroulanos**, CEO of Kefalonia Fisheries SA, Greece said that Europe has ideal conditions for aquaculture. However, it only needs to level the playing field, particularly on issues of labelling, transparency and standards. Greece is an example of sustainable aquaculture, an economically viable, highly competitive industry producing quality seafood at affordable price and guaranteeing fully traceable fish.

Greece produces 66% of the seabass and seabream in Europe. Production was 119,000 tonnes of sea bass and seabream in 2010. However, low price imports compete with production from EU producers and there is a lack of information on the production methods for imports. The irony is that there are high standards in terms of food safety and animal welfare, imposed on its own producers and yet consumer awareness on imported products and their production methods (from a health or environmental viewpoint in particular) is very limited. The price factor remains the main driver of choice.

Dr Albert and Marisol Tacon with Thampi Sam Raj, Program Director at the Rajiv Gandhi Centre for Aquaculture, India who presented on the Indian organic aquaculture project.

The future of aquaculture in Europe will need expansion in terms of areas. Challenges are with climate change. Temperatures are expected to rise which will exacerbate use of water. These will force producers to innovate such as using new areas. If European aquaculture were to increase to meet all of the EU's projected demand, almost 7 million tonnes from 1.3 million tonnes today, it would require half a million ha (land and water areas included).

Selective breeding

In 'Selective breeding:lessons learnt from terrestrial animals and status of aquaculture implementation', **Dr Marc Vandeputte**, INRA, France said that in the livestock industry all farm animals are selectively bred but this is not in the case with farmed aquatic animals. This dependence on wild stocks limits industry growth. Selection gives better adaptation to farming and animals can be modelled for market needs.

Domestication in fish is very recent and presents its own set of challenges. Vandeputte asked whether we need to "to concentrate on a few species and have global fishes such as global livestock" While selective breeding has shown its potential and is increasingly applied with most major fish species, some important points remained unresolved and need further investments. In the future, should the focus be on 'produce more with less inputs and impacts', i.e. with less importance given to growth rate as feed efficiency or should the aim be for more robust fish in controlled environments. The question is do selected fish need specific environments to perform well. This is important as fish is sensitive to the environment. Productivity

Nutriad International specialises in the development, manufacturing and commercialisation of animal and aqua feeds.

Future Fish EURASIA

6th International Fair for Fish Imports/Exports, Processing, Aquaculture and Fisheries

7 - 9/ 06/ 2012

İzmir - Turkey

EURASIA TRADE FAIRS

Organizer: **EURASIA TRADE FAIRS**

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Future Fish Eurasia

Juan Pablo Jimenez of Algaenergy

Refa Med's Darko Lisac and Maria Teresa Palomo

Trade show

The 70 booth international trade show, provided a platform to showcase European initiatives in aquaculture. Most of the companies are involved in supplying materials and technology for marine fin fish hatcheries and farms. Juan Pablo Jimenez of **Algaenergy** (www.algaenergy.es), Spain found a good response from the industry. Based in Madrid, Algaenergy has developed two microalgae strains, *Isochrysis galbana* and *Nannochloropsis gaditana* and is now producing them in an industrial scale. The Algaepiscis® range is the algae lyophilised. *N. gaditana* Premium is a concentrated paste product with 15% dry weight for green water technique and for the culture and enrichment of rotifers. Packed in 500ml and 1L, the product contains the optimal profile of polyunsaturated fatty acids of which between 25 to 30% are EPA (20:5n-3) and 6% arachidonic acid (ARA, 20:4n-6).

Visiofish, Spain (www.visiofish.no) presented Aquadef® a unique automated system for real time detection of malformations in individual fry of common species. This is a major breakthrough as the inspection system isolated those fry deemed not suitable. In this way the resources used in the fry rearing process is improved, reducing food and treatment expenses. Currently, detection is manual which is not only labour intensive. Human error is eliminated in the system which spots abnormalities accurately with a processing speed of a fish per second and can analyse more than 85,000 specimens a day. It can also operate 24 hours a day.

Cage technology was offered by **Refa Med** (www.refamed.com). It delivers turnkey farms, innovative cage systems, feeding systems, work boats and all equipment required for a project. In 2008, Refa Med delivered a 12 cage turnkey fish farm three miles off Tyrhenian coast of south Italy. Refa's Tension Leg cage is based on the dispersion of wave energy in the sea. It was developed by Maritek- Sintef Institute and has a worldwide patent. "With traditional cages, the buoyancy is concentrated at the surface and floating collar and respective moorings are subjected to violent stress and the net pen will deform. However, the TLC cage is flexible and remains stable under all conditions, retaining its volume," said Darko Lisac.

Dr Sunil Kadri introduced the SF200 sound feeding system from AQ1 Systems, Australia (www.aq1systems.com). This monitors shrimp feeding using passive acoustics. It features a hydrophone sensor which determines feeding activity by measuring shrimp feeding sounds. It connects to a variety of automatic feeders.

Gold sponsor **Biomar** showed its 'Biosustain', which is a sustainability thinking approach for the fish feed and fish farming industry. This comprehensive program, introduced in 2007 has progressed from focusing on marine raw materials to an integrated approach with tools to measure sustainability throughout the value chain, raw materials sourcing, farming methods, processing and transport of fish to markets. What this means is that Biomar suppliers must have adequate standards and guidelines. (www.biomar.com)

and efficiency is important in fish breeding but does the excessive focus on productivity decrease health and survivability. However with improvement in sanitary status, it will be possible to eliminate diseases. Globally, there are 97 breeding programmes (Neira, 2010). These are on tilapia, salmon, rainbow trout marine shrimp and oysters. Some major species such as milkfish have not been improved.

Feeds and Feeding

Dr Albert Tacon, Aquatic Farms Ltd, USA gave an extensive review on 'Sustainable Aquaculture Feeds: Global trends and outlook, with particular reference to marine fish feeds'. He said that the economic climate of steadily increasing feed ingredient and feed processing costs, but not prices of fish, presents challenges. Feed manufacturers, farmers and researchers alike focus on improvements in ingredient selection to reduce feed costs per unit of fish or shrimp production. He outlined the global trends in compound aqua feed production by major species group and country and specifically concerning feed ingredient usage by these species.

At present, the aquaculture sector is still highly dependent on the use of fishmeal and fish oil as the major source of dietary protein and lipid within compound aqua feeds, and in particular within feeds for marine fish species. Tacon referred to successful replacement of fish meal by balancing with proprietary combinations of micronutrients to simulate that found in fishmeal. His message was that the aqua feed industry need to keep up the pace with replacements of fish meal.

He then discussed future prospects concerning feed ingredient selection and usage, with specific reference to the issues surrounding the use of the major nutrient sources; aquatic animal protein meals and lipids; land animal protein meals and lipids; microbial feed ingredients, cereals and oil seeds. Tacon said that there is an absolute need to be able to use ingredients, in particular feed-grade ingredients that can be sustainably produced.

In 2012, Aquaculture Europe and World Aquaculture will be held together as AQUA 2012 in Prague, Czech Republic from September 1-5.

More information: http://www.easonline.org/images/stories/Meetings/AE2011/AE2011_Summary_Document.pdf

Opening of new R&D centre

Behn Meyer Animal Nutrition and Behn Meyer Aquaculture celebrated the official opening of their new Research & Development facility in Binh Duong on 16 December with more than 80 customers.

In 2009, the Behn Meyer Group of companies moved to the Vietnam Singapore Industrial Park and opened its own office and warehouse buildings. At the same time, it was decided to build a R&D complex in the same premises. This was completed in November 2011.

In her welcome address, Khau Thi Thien Kim, general director of Behn Meyer Vietnam praised the customers for their support and the animal nutrition and aquaculture teams in Vietnam for their efforts in making the R&D facility a reality. Professor Le Thanh Hung of Nong Lam University thanked the company for their long-term contribution to the aquaculture industry in Vietnam and encouraged industry players to invest more into research-driven sustainable solutions. Together with their aqua feed customers, Behn Meyer Aquaculture will invite students from local universities to carry out research on its broad portfolio of natural feed additives for fish and shrimp.

The R&D building is spread over 260 m^2 and comprises central and wet laboratories and others for future expansion. The central laboratory has state-of-the-art analytical equipment and will be responsible for enzyme analysis. The company's laboratory technicians in Vietnam will perform regular phytase and Hemicell analyses on customers' feed samples. The central laboratory also houses water treatment and biological analysis applications.

The wet laboratory is equipped with two separate recirculation systems for feeding studies with juvenile freshwater fish such as tilapia and pangasius. The first system consists of 24 tanks, each of 200L to provide sufficient replicates in each trial. The second system has 12 tanks, each of 500L. These will be used for trials using larger fish. In a covered outdoor facility, there are 1-tonne and 2-tonne tanks to simulate grow-out trials. These will be used to acclimatise fish prior to the experiments. The addition of more tanks for shrimp studies is being planned.

"The decision to build this wet laboratory in Vietnam is proof of Behn Meyer Aquaculture's commitment to the industry in Vietnam and in Southeast Asia. We look forward to conduct experiments together with our customers and to address important questions on nutrition and health of all farmed species," said Dr Dirk Lorenz-Meyer, regional director of Behn Meyer Animal Nutrition.

During the opening, customers and guests were shown enzyme assays for the key brands, Hemicell and Finase, benchmarks in the field of feed enzymes. A brainstorming session on immediate aqua research ideas followed. The day ended in the luxurious setting of Thao Dien Village and Lorenz-Meyer revealed what the customers could expect from the company in 2012 and beyond. His presentation was followed by updates on phytobiotic concepts in livestock and aqua nutrition by Dr Nguyen Van Dien, department manager Animal Nutrition and Aquaculture of Behn Meyer Vietnam, who also introduced the new natural feed additive 'digestarom' from Germany.

More information: www.behnmeyer.com/animalnutrition

9-10 March, Chennai India

Indian Aquaculture: Changing Era

This industry event in 2012 will have the theme, Indian Aquaculture: Changing Era. This gathering of members of the Society of Aquaculture Professionals (SAP), organiser of the event and other stakeholders in India's large aquaculture industry will discuss the global aquaculture scenario, overview of Indian aquaculture, culture of the white and black tiger shrimp as well as other topics such as marine and freshwater fish production. It will also look at issues related to finance and markets. The meeting will be held from 9-10 March at Green Park Hotel, Chennai India.

SAP is a non-profit, non-government organisation established for and by a group of aquaculture professionals in India in 2003. The role of the society is to promote the art, science and practice of aquaculture for sustainable food production. SAP encourages the continuous professional development of industry members through research and helps education in aquaculture with relevant and practical training. It is the voice of all stakeholders in the aquaculture industry in India.

Participation is expected from farmers, hatchery operators, feed manufacturers, aquaculture suppliers, seafood and exporters, government and academia. The number of participants will be limited to 300. There will be a poster presentation. Early bird registration will end on 31 January 2012.

More information: Contact: Senthil Kumar, Email: aquaguys@gmail.com / aquaindia2012@gmail.com; Web www.aquaprofessional.org

TARS 2012: Shrimp Aquaculture - Shaping the Value Chain

August 15-16 Phuket, Thailand

In 2011, the first in the 'The Roundtable for Aquaculture Series (TARS) was held in Singapore and looked at aqua feeds and nutrition. In the second in the series, the industry focus will be **Shrimp Aquaculture**.

The shrimp aquaculture business in Asia continues to expand and today, the industry contributes 88% to the global shrimp supply. However, all along the value chain, producers are challenged. The global nature of the shrimp trade also means that economic uncertainties and vulnerabilities emerge at the complex intersection of changing market conditions, such as food safety and quality standards, and the threat of disease incidences. Moving it forward requires the concerted effort of all stakeholders.

As one of the industry's foremost opinion-leading events, TARS 2012 aims to take a holistic approach to tackle these challenges. The meeting presents a neutral forum for multiple stakeholders to come together, and through shared knowledge and expertise, provide substantial input to improve and ensure the sustainability of shrimp production in Asia. TARS 2012 is organised by Aqua Culture Asia Pacific Magazine and Corporate Media Services, Singapore.

The format for TARS 2012 will be similar as to that of the first roundtable series held last year. A host of international experts will present an overview of the state of the shrimp aquaculture industry, current knowledge, trends and emerging challenges impacting the various segments of the shrimp value chain in Asia and the global arena. These topics will be addressed at the plenary session to answer the questions 'Where Are We Today? The breakout session will review and provide recommendations as to 'Where Do We Want To Be Tomorrow'.

Tentative Program

Day 1 - Wednesday, August 15 2012

Plenary Session - Where Are We Today?

Session 1: Breeding and Hatchery Management

- Priority genetic traits for selection – learning from the poultry / salmon model
- Selective breeding of *Penaeus vannamei* – growth versus disease resistance, opposite goals?
- The future of SPF *Penaeus monodon*

Session 2: Culture and Health Management

- Shrimp immune system and future of vaccines
- Overview of current diseases and syndromes
- Biosecurity – does it help in preventing disease outbreaks? Living with climate change

Session 3: Feeds and Feeding

- Health and nutrition management – the success of nutraceuticals
- Biofloc culture in reducing FCRs
- Autofeeders – Feed extrusion and matching physical properties

Session 4: Marketing, Branding and Certification

- Demand and supply situation and price forecast
- Case study of Thailand – 'Kitchen to the world'
- Certification – costs versus benefits, then which certification?

Day 2 – Thursday, August 16 2012

Breakout Session: Where Do We Want To Be Tomorrow?

Participants will break into groups of 10 to discuss and deliberate on issues and challenges facing their segment of choice. (Participants will be required indicate their choice for the breakout group in the registration form prior to the meeting and will be assigned to the respective groups accordingly).

Led by a facilitator, there will be multiple groups discussing the four segments, namely:

- Breeding and hatchery management
- Culture and health management
- Feeds and feeding
- Marketing, branding and certification

The expected output from the breakout groups is a review of key challenges, identification of priority areas for improvement, and recommended strategies to steer the shrimp sector forward.

Panel Discussion:

All facilitators, each representing the respective segment group will present a summary of the output from the breakout sessions. This will be an interactive session.

More information: Email: conference@tarsaquaculture.com or visit www.tarsaquaculture.com

24 February to 16 March, various locations in China

2012 Hinter Symposiums on Nutrition & Feed Technology of Fish & Shellfish

This annual series of symposiums on nutrition and feed technology of fish and shellfish is organised by Guangdong Animal Husbandry and Aquaculture Development Centre of Guangzhou Hinter Biotechnology. The theme is 'encouraging communication and promoting progress of the feed industry'. The objective is to present the different aspects in feed manufacturing such as from operating management, quality control, formula technology to marketing. It will also cover selected aspects in aquaculture.

The extensive program with 24 presentations, in Chinese, will be conducted in four locations all over China, from 24 February to 16 March 2012. Presentations will be by experts from the Haid Group and co-organisers, feed additive producer, Evonik Degussa (China), feed manufacturer, Jiangsu Muyang Group, Thermo Fisher Scientific, Guangzhou Leader Bio-technology and Shenzhen Longreat. In Suzhou, Jiangsu Province, Alltech Biological products (China) and Shanghai Yixiang Biotechnology will be participating. In Tianjin, there will be the participation of feed additive producer, BASF (China) and in Yueyang, analytical equipment supplier, Foss.

Aqua feed production: New competition pattern in aquatic feed enterprises /Creating competitive ability in small and medium aquatic feed enterprises by Dr Yang Yong, Guangzhou Hinter Biotechnology; Key points of Haid Group service & marketing system by Lei Hejiang, Guang Dong Haid; Product position strategy of aquatic feed enterprises by Dr Zhang Song, Guangzhou Hinter Biotechnology; New thought of product management in aquatic Feed enterprises by Tian Pengfei, Guangzhou Hinter Biotechnology.

Feed formulation and processing: Influence of variation in amino acid content and optimization of amino acid profile on aqua feed cost by Dr Zhu Xuan, Evonik Degussa (China); Progress in the utilisation of amino acids in the common carp feeds by Dr Gao Wen, Evonik Degussa (China); Granulation technology developing process in aquatic feed by Mi Changyu, Jiangsu Muyang Group; Latest processing of extruded technology in aquatic feed by Sang Guangwei, Jiangsu Muyang Group; Formula points and development trend in extruded aqua feed by Dr Zhang Song, Tang Wubin and Wang Xin, Guangzhou Hinter Biotechnology.

Feed Ingredients: Application of grobiotic-A in aquaculture by Dr Xue Min, Feed Research Institute of Chinese Academy of Agricultural Sciences; The development and application of carotenoids in aquaculture by Dr Sun Dandan, Guangzhou Leader Bio-technology; Organic acids application in feed industry by Esther Jiang, New Business Development, BASF (China); Analysis of global fish meal industry by Xu Yingzhuo, Guang Dong Haid Group and Chen Minliang, Shenzhen Longreat.

Quality Control and Analytical methods: Quality control points of animal protein by He Fen, Guangzhou Hinter Biotechnology; Thermo Scientific FT-Near Infrared Technology and Organic Mass Spec application in detection of hazardous residence by Huang Wen and Ma Le, Thermo Fisher Scientific; Application of NIR (Near Infrared spectroscopy) in Feed Industry by Dr. Luo Haifeng, FOSS (China); Analysis of standardised terminal services mode in the aquatic feeds industry by Peng Zhidong, He Zhonghua and Xie Xiqing, Guangzhou Hinter Biotechnology; Swift identification method of fish meal and quality control points of animal protein by He Fen, Guangzhou Hinter Biotechnology Ltd.

Aquaculture: Farming and feed formula technology of *Ictalurs punctatus* by Zeng Mengzhao, Guangzhou Hinter Biotechnology; Enhancing the natural barrier protection of aquaculture species through nutritional regulation by Dr Huai Mingyan, Alltech Biological Products (China) and sharing of the R&D results on some freshwater fish species by Dr Chen Jialin, Guang Dong Haid Group R&D Centre.

Symposiums schedule

24-25 February - Wang Jiang Hotel, Chendu City, Sichuan Province
2-3 March- Apollo Regalia Hotel & Resort, Yuyang City, Hunan Province
8-9 March - Wujiang Haiyatt Garden Hotel Suzhou City, Jiangsu Province
15-16 March- Renaissance Tianjin Teda Hotel, Tianjin City
More information: Email: hintermeeting@gmail.com
Web: www.hinter.com.cn

What can you expect from Aqua Culture Asia Pacific in 2012

Volume 8 2012						
Number	**1 - January/February**	**2 - March/April**	**3 - May/June**	**4 - July/August**	**5 - September/October**	**6 - November/December**
Issue focus *Recent developments and challenges for the next step*	Aqua feed Production	Health Management	Sustainable & Responsible Aquaculture	Food Safety & Traceability	Culture models	Hatchery & breeding technology
Industry Review *Trends and outlook, demand & supply*	Marine Shrimp	Groupers	Catfish	Marine fish (Cobia/Sea bass)	Tilapia	Freshwater Fish/Prawn
Feeds & Processing Technology *Technical contributions influencing the final value of aqua feeds*	Feed additives Processing technology	Micro-nutrients Extrusion	Product quality Feed management	Feed enzymes Good manufacturing practices	Feed probiotics Post pellet additions	Novel feed ingredients Formulation
Production Technology *Technical information and ideas*	Pond Management & Biosecurity	Biofloc /Aeration technology	Genetic Improvement	Recirculation Aquaculture Systems	Certification and Regulations	Hygiene & Food Safety
Aqua business *Feature articles*	Experiences from industry, including role models, benchmarking and opinion articles in shrimp/fish culture					
Markets	Market trends, product development and promotions at local and regional trade shows					
Show Issue *Distribution at these events as well as local and regional meetings* **Show preview in prior issues*	**FIAAP Asia, VICTAM Asia & GRAPAS Asia 2012**, February 15-17, Bangkok Thailand* **Aquaculture America 2012**, February 29 - March 2, Las Vegas	**Skretting Australasian Aquaculture 2012 (AA12)**, May 1-4, Melbourne* **8th Philippines Shrimp Congress**, May 9-11, Bacolod	**Vietfish 2012**, June 26-28, Ho Chi Minh City, Vietnam	**TARS 2012 – Shrimp Aquaculture** August 15-16, Phuket, Thailand **AQUA 2012**, September 1-5, Prague, Czech Republic	**17th China Seafood & Fisheries Exposition 2012**, 6-8 November, Dalian, China	

The Next Ten Years'

May 1 – 4, 2012, Melbourne, Australia

Skretting Australasian Aquaculture 2012 International Conference and Trade Show will be at the '6 Star Green Star' Convention facility, Melbourne Convention and Exhibition Centre. This event represents an excellent opportunity via its technical program to showcase the latest developments in the aquaculture world. The theme of 'The Next Ten Years' promises an excellent opportunity to learn from each other while showcasing the best that our industry has to offer, said Program Chair, Dr Geoff Allan. "The 2012 Australasian Aquaculture program will provide plenty of thought provoking commentaries on the current state of the industry and where it is headed as we address the conference theme. Global leaders will gather to discuss best practices and generate discussions geared for open and honest debate."

The program will include a fully integrated trade show, workshops, technical tours, information-packed presentations, multiple networking events, open networking time and an area for one-on-one meetings.

Australasian Aquaculture's inaugural AAA Awards will take place at NGV Australia where industry nominees will gather for an evening of entertainment and vie for recognition of excellence in a number of categories. Trade show manager, Mario Stael said, "Companies interested in exhibiting should consider booking space as interest in the trade show has really started to take off. The trade show allows exhibitors to promote their products and services to business leaders attending from around the world. Exhibitors are provided with global exposure as the event is promoted through print, online and social media."

In addition to the main conference and trade show, Professor Thomas Losorda's popular Recirculating Aquaculture Engineering Workshop will once again precede Australasian Aquaculture on 28 to 29 April. The AquaEd 2012 Training and Education Workshop will take place following the event on 5 to 6 May.

More information: Email: sarah-jane.day@aquaculture.org.au (Conference Coordinator Sarah-Jane Day) or for European companies, Mario Stael, Email: mario.stael@scarlet.be Web: www.australian-aquaculturereportal.com

Details on the events below are available online at http://www.aquaasiapac.com/news.php
To have your event included in this section, email details to zuridah@aquaasiapac.com

January 29-February 3
Practical Short Course on Feeds & Pet Food Extrusion
Texas A&M, USA
Web : www.tamu.edu/extrusion
Email: mnriaz@tamu.edu;

February 8-9
Ildex Bangkok
Thailand
Email: info@ildex.com
Web:www.ildex.com

February 15-17
FIAAP Asia, VICTAM Asia & GRAPAS Asia 2012
Bangkok Thailand
Email: andrew.west733@ntlworld.com
Web: www.victam.com

February 24 - March 18
Hinter Symposium on Nutrition Feed Technology of Fish Shellfish
Web: www.hinter.com.cn
Email: hintermeeting@gmail.com

February 29 - March 2
Aquaculture America 2012
Las Vegas, Nevada
Email: worldaqua@aol.com
Web: www.was.org

February 29 - March 2
India International Seafood Show
Chennai, India
Email: mpeda@mpeda.nic.in
Web: www.indianseafoodexpo.com

March 9-10
Aqua India 2012
Chennai, India
Email: aquaguys@gmail.com; aquaindia2012@gmail.com (Senthil Kumar)
Web: www.aquaprofessional.org

March 22-24
Ildex Vietnam
Ho Chi Minh City, Vietnam
Email: info@ildex.com
Web:www.ildex.com

April 19-20
3rd Aquatech Aquaculture Expo and Convention Philippines 2012
Pampanga
Email: info@equipincinteractive.com;
Web: www.equipincinteractive.com

May 1-4
Australasian Aquaculture 2012
Melbourne, Victoria, Australia
Email: sarah-jane.day@aquaculture.org.au
Web: www.australian-aquaculturereportal.com

May 9-12
8th Philippines Shrimp Congress
Bacolod, Philippines
Tel: +63 34 433 2131/+63 34 434 2559/ +63 920 908 4620

June 7-9
Future Fish Eurasia 2012
The 6th International Fair For Fish Imports/ Exports, Processing, Aquaculture & Fisheries
Izmir, Turkey
Email: selin@eurasiafairs.com (Selin Akpinar)
Web:www.future-fish.com

June 26-28
Vietnam Fisheries International Exhibition (Vietfish) 2012
Ho Chi Minh City, Vietnam
Web: www.vietfish.com.vn

August 15-16
The Aquaculture Roundtable Series 2012 - Shrimp Aquaculture
Phuket, Thailand
Email:conference@tarsaquaculture.com
Web: tarsaquaculture.com

August 24-26, 2012
The Ninth International Conference on Recirculating Aquaculture
Email: aquaconf@gmail.com
Web: www.recircaqua.com

September 1-5
AQUA 2012
Prague, Czech Republic
Email: worldaqua@aol.com
Web: www.was.org

FIAAP Asia 2012

AQUAFEED INGREDIENTS, ADDITIVES, FORMULATION

VICTAM Asia 2012

AQUAFEED PROCESSING TECHNOLOGY

15 – 17 February 2012 · Bangkok International Trade and Exhibition Centre, Bangkok, Thailand

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The conferences
Aquafeed Horizons Asia 2012, The FIAAP Conference 2012, Petfood Forum Asia 2012, The Thai Feed Conference 2012

Co-located with GRAPAS Asia 2012
The show for rice & flour milling, grain & noodle processing, breakfast cereal & extruded snack production

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Thailand Convention & Exhibition Bureau

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Further information
For additional information and **free** visitor registration visit:
www.fiaap.com or **www.victam.com**

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