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in Thailand

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Offshore cages of Everspring Marine Aquaculture Co Ltd, Taiwan farming cobia and pompano (p54)

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Zuridah Merican

Feeding shrimp in Asia-*Quo Vadis?*

The situation in shrimp farming today remains tenuous. For those unlucky enough to be hit by diseases, whether EMS/AHPND, WSSV or RMS, there does not seem to be a light at the end of the tunnel. The industry has identified the causative factors for most of these but even preventive measures still seem a long way away. However, what has changed recently is a trend in shrimp feeds. For farmers, there is an increasing trend to switch to high density, high protein, high cost feeds, with and without functional additives. Compared with the standard vannamei feeds averaging USD1.10 per kg, these high density feeds can cost up to USD1.80 per kg. All of this started with the use of high protein feeds (formulated for monodon) for juveniles and early stage nutrition. This is now consequently followed through to the end of the farming cycle. Some farmers in Vietnam, Thailand and Malaysia have sworn testimonials that this has resolved their disease problems and improved survival rates. As a result, more feed companies are jumping onto the bandwagon and relaunching their high density feeds for vannamei. Could this be the answer to the industry's woes?

Let us take a step back and recount the history of shrimp feeds which follow the vicissitudes of the farming sector. Modern shrimp farming started with the monodon shrimp in Taiwan in the 1970s and Taiwan feed millers produced monodon feeds 'mimicking' *Penaeus japonicus* feeds with an adapted crude protein (CP) content of 38% (grower diets). The Japanese market for monodon encouraged larger scale farming in Southeast Asia in the 1980s, and Taiwanese shrimp feed was the benchmark. Monodon farming went through a boom followed by a bust in the early 2000s. The sector then replaced this shrimp with the domesticated vannamei which led to another boom cycle. However, feeds were adapted for vannamei following the Latin American semi intensive model with CP lowered to 32%. Was this the right move?

Vannamei farming, the Asian way, started with high stocking densities and today, some farmers use super intensive systems with stocking densities of more than 300 post larvae/m². Surely, this impacts feed specifications.

Another consideration is genetic selection. The vannamei strains used in Asia today are genetically selected for growth in intensive conditions. Current growth rates of 2 g/week are common compared to 1 g/week ten years ago. Are the feeds today compatible with the new strains? Surely this merits a relook at the nutritional requirements. There is also a school of thought that these new genetically selected (for growth) strains are lacking in robustness since growth and robustness are opposite genetic traits. Could functional feeds be the answer?

To advocate going back to basics with high density- monodon type feeds may sound logical but this would be mere speculation. There has been a void of research in shrimp nutrition since the early 1990s. The industry has not seen any published data on the protein or amino acid requirements of genetically selected vannamei while the role of fatty acids in improving disease resistance has not been researched upon either. To say shrimp nutrition research is lagging behind the advances in genetic selection is an understatement. Feed companies have been so focused on replacing fishmeal due to costs and NGO pressure that we have forgotten about the basic nutritional requirements for shrimp. There may not be a definitive answer at the moment but these considerations will certainly be hot topics at the upcoming TARS 2015 roundtable discussions in August, that will focus on aqua feeds from farm to plate.

Meanwhile, high density-high cost feeds may be the temporary solution or band-aid. We would like to caution that time is limited. Shrimp prices are falling across the board and soon the farming sector which previously operated with feed costs of USD1.80 per kg will be squeezed for profits. We need to encourage specific research in shrimp nutrition which will benefit the industry in the near future.

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We strive to be the forum for the development of self-regulation in the industry.



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Biosecurity strategies at AquaForum 2015

Challenged by disease outbreaks, producers joined experts to discuss solutions

AquaForum 2015 was held prior to the World Aquaculture 2015 conference and trade show in Jeju, South Korea. It brought producers, academics and other stakeholders together to debate on current issues and challenges, in particular in Asia. Some 600 participants attended the event on 26 May 2015 including producer groups from several Asian countries. There was a large group from Korea and Indonesia, the latter included shrimp farmers from Shrimp Club Indonesia. The forum was funded by the Jeju Provincial Government.

The Asian aquaculture industry is not only diverse but also vertically fragmented. Arriving at a consensus on the challenges and issues of interests to industry in Korea as well as the rest of Asia, was a difficult task for organisers of the forum, the World Aquaculture Society and Korean Aquaculture Society. This half day aquaforum focussed on three areas in three sessions: biosecurity, nutrition and production technologies. Each session began with 2-3 short presentations by leading experts outlining current developments and challenges. Panel members were selected from industry.

In the biosecurity session, Dr Leo Galli, Fish Vet Group Asia and Dr Victoria Alday-Sanz, National Aquaculture Group, Saudi Arabia, discussed aspects on assuring health and biosecurity in finfish and shrimp culture systems and biosecurity in controlling disease in marine shrimp culture, respectively.

In the session on nutrition, Dr Craig Browdy, Zeigler Feeds, USA looked at how new technologies can double aquaculture production by 2050. The sustainability of the aquaculture and aquafeed industry in China was discussed by Professor Kangsen Mai, Ocean University of China, Qingdao. In the session on aquaculture production systems, Dr Patrick Sorgeloos, Ghent University, Belgium looked at progress in marine fish and shrimp larviculture with a focus on opportunities for Asia and Professor Shuanglin Dong, Ocean University of China, Qingdao discussed integrated aquaculture systems in China.

The different levels of biosecurity

On biosecurity and health in shrimp and fish, Galli emphasised on the need to keep in mind the equilibrium of pathogens and the environment to ensure successful production. Other criteria are brood stock and post larvae quality, farm management, feeding and control of water and soil parameters.

"Biosecurity is becoming very important in aquaculture but many people think that by applying biosecurity, their problems are solved. It should always be part of the whole production process to be successful.

"Biosecurity is to control what we can control to reduce the risk of diseases. However, it is not only at the farm level. If we are

“ Write what we do and do what we write. ”
– Leo Galli



Dr Leo Galli is technical director, Fish Vet Group Asia (right) with Dr Patrick Lavens, INVE Aquaculture, Belgium

planning a national aquaculture biosecurity program, we may need to collaborate with neighbouring countries when rivers cross borders. It is also difficult to have only one country affected by diseases. Surveillance on diseases by competent authorities is crucial to avoid spread of diseases. Import risk analysis should be used in decision-making for imports."

Galli discussed the different levels of biosecurity, and the decisions and actions needed during disease outbreaks. He said that there should be clear emergency plans and concerted efforts by producers as they are most affected during an outbreak. At the producer level, a crucial step is to have standard operating procedures and a record for corrective actions. Galli said, "Write what we do and do what we write."

Controlling disease

According to Alday-Sanz in animal production, the objective of biosecurity is not just to avoid or exclude pathogen, but to reduce economic losses. "Once the economic impact has been defined for each pathogen, then the level and investment in biosecurity can be developed. Biosecurity is of little value unless there is good management, nutrition and suitable genetics. In the market, there are several 'silver bullet' products against diseases but these cannot work without good management systems."

In internal biosecurity which is to control the spread of a pathogen within the facility, country or region, Alday-Sanz said that before deciding on biosecurity options, be it to exclude or cope with the pathogens, or both, it is important to evaluate the culture systems, transmission modes (vertical or horizontal) and economic impacts. She cited the cases of Thailand and Ecuador in combating white spot syndrome virus (WSSV). "Thailand's industry with small ponds could exclude the virus with crab fences etc and showed a quick recovery. The recovery took a longer time in Ecuador where similar biosecurity measures were not possible with its large ponds."

“ Biosecurity is of little value unless there is good management, nutrition and suitable genetics. ”
– Victoria Alday-Sanz



Dr Victoria Alday-Sanz is director of Biosecurity, National Aquaculture Group, Saudi Arabia and consultant on aquatic animal health

On external biosecurity, which refers to the prevention of the introduction of pathogens, Alday-Sanz said that there are several examples on the movement of disease in shrimp between Asia and Latin America. "Mitigation measures are difficult especially when there is a need to access stocks of specific genetic characteristics. It is important to obtain the history on the sanitary background of the supplier and the importing country, should have a quarantine facility and a national reference centre which is competent. Screening for known and unknown pathogens by histopathology is important as the pond environment may manifest the effects of some pathogens.

Alday-Sanz also discussed disease introductions such as early mortality syndrome (EMS) and the microsporidian *Enterocytozoon hepatopenaei*

First public consultation on ASC feed standards

The Aquaculture Stewardship Council (ASC) opened the first round of public consultation on the initial draft of its Responsible Feed Standard on 30 June. The consultation will close on Friday, 11 September 2015. The feed standard is applicable for feed mills producing feeds for aquaculture. The standard will recognise producers who can demonstrate their environmentally and socially responsible feed sourcing methods and will allow them to gain recognition for their efforts. As well as being applicable to feed mills seeking ASC certification, the standard could be used by other certification programmes as a reference point.

During the 74 days of public consultation, stakeholders can review and comment on the initial draft of the ASC Responsible Feed Standard and its requirements. Four outreach workshops will be organised to present the draft standard and to gather feedback. The workshops will be held in Guangzhou (China), Ho Chi Minh City (Vietnam), Bangkok (Thailand) and Santiago (Chile). The draft standard is available at http://www.asc-aqua.org/upload/ASC%20Responsible%20Feed%20Standard_v0.1_FINAL.pdf

Record high of US shrimp imports with banned antibiotics

In June, the US Food and Drug Administration (FDA) reported refusing 112 seafood entry lines. Of these, 29 (26%) were of shrimp entry lines refused for reasons related to banned antibiotics. Through the first half of 2015, the FDA has now refused a total of 232 entry lines of shrimp products for reasons related to banned antibiotics. Since June, there have been more shrimp entry lines refused in 2015 than any previous year for which data are available through the FDA's Operational and Administrative System for Import Support (OASIS) database. The website of the Southern Shrimp Alliance named five companies from Malaysia and one from India; some of these companies have been listed on import alerts for nitrofurans and later some of them were found to be exporting shrimp contaminated with nitrofurans, veterinary drug residues and salmonella. It added that for 2015, the FDA has reported refusing 166 entry lines of shrimp shipped from Malaysia for reasons related to veterinary drug residues, 30 from Vietnam, 26 from India, 9 from China, and one shipped from Indonesia.

High shrimp prices leading to market loss in Thailand

Prices for shrimp in Thailand are going in the opposite direction to India, which has emerged as a benchmark in the world of vannamei shrimp production, according to an early July report in *Undercurrent News*. Satasap Viriyantawanit, managing director of Siam Canadian Group, a Bangkok based frozen seafood supplier said, "Thailand is the only country that is moving in the opposite direction." Thai shrimp prices for the week June 22-27 were up between THB 10-THB 15/kg. Prices for size 70/kg went up to THB 160-165/kg, from THB 150-160/kg. On the contrary, prices in Indonesia were low and in India, prices have been falling.

Satasap also said that the very long summer, droughts, and low shrimp prices meant that farmers were losing money over the last three to four months. These affected supply which is expected to be tight at least until the end of July. "Unfortunately, the majority of pending orders in Thailand are required to go between June and July. Although there are some buyers who may prefer "product of Thailand", most buyers are ready to switch their sources of supply immediately. Higher prices may mean that Thailand will be losing more businesses to other countries and in addition, some US buyers are negotiating new contracts and some are spreading out their orders among Thailand, Vietnam, India and Indonesia. Apparently, demand is not strong enough to shake the markets."

Increasing tilapia production in Odisha

The Worldfish Center, the international World Bank organisation whose mission is to reduce poverty and hunger by improving fisheries and aquaculture has proposed to the Odisha government in India, a partnership to use the genetically improved farmed tilapia (GIFT) technology to double fish production in the state within 5 years. The Odisha Sun Times reported that the aim is to improve the quality of seed stock and good aquaculture practices. Although the state's per capita fish consumption increased to 9.40 kg/year in 2013-14, it is still below the national average (9.8 kg). Supply is below demand and it imports 100,000 tonnes of fish annually. Currently, tilapia farming is being carried out on an experimental basis at the Central Institute of Fresh Aquaculture (CIFA) at Kausalayaganga using the Chitralada variety of tilapia from Thailand. However, environmentalists have warned that the government should carefully study tilapia farming before launching the project to avoid adverse impacts on the environment.

'cont'd from page 4

(EHP) through brood stocks via the use of fresh feeds including polychaetes. The option available is for feed companies to develop maturation diets that perform as well as fresh feeds or to have production of biosecure fresh feeds. She also discussed the role of currents and ballast waters in the marine environment in the spread of diseases.

Genetics as a biosecurity strategy was discussed. In Asia, selection for fast growth is also used as a biosecurity strategy as with faster growing animals, the chance of infection is lower. In the case of domesticated stocks, she said, "We have susceptible, tolerant and resistant animals which are

the genetic characteristics. In addition, they can be specific pathogen free (SPF) or non-SPF stocks (i.e. pond raised). From a biosecurity point of view, we want to work with animals, which are tolerant/resistant and have SPF status. Although we have developed SPF shrimp for WSSV in Latin America, their growth rate is low. We need to improve on this aspect."

Finally, Alday-Sanz emphasised on the role of veterinarians or aquatic disease professionals. "They need to be involved in the design of the production cycles. Their role should not be limited to diagnostics after an outbreak as by that time, it will be too late."

Polychaetes for shrimp brood stock maturation

By Soraphat Panakorn

The long road to success was not easy, but with hard work, drive and passion, Thailand's Siam Sand Worm farms now supply quality and disease free live polychaetes for its major shrimp hatcheries.

Recently, shrimp farmers are encountering a multitude of disease problems, from early mortality syndrome (EMS), running mortality syndrome (RMS), white faeces disease (WFD) as well as other bacterial and viral infections. To overcome diseases, farmers need to make changes to farming techniques. An important consideration requiring attention is the quality of post larvae, which industry leaders attribute as the main cause of EMS.

Industry is facing a shortage of good quality post larvae. In the EMS affected countries, farmers place orders for post larvae but have to wait for supplies. Farmers also reject post larvae, which are deemed as not healthy enough for them to stock their ponds.

Quality post larvae are a result of quality parent stock as well as cutting edge hatchery technology. With the latter, most operators are adopting the latest in knowledge, equipment and process for consistent supplies of quality post larvae. There is no doubt that there is a shortage of specific pathogen free (SPF) broodstock and this has reached a crisis level in some countries. Some hatcheries have even begun growing their own SPF broodstock since they are not able to get enough supplies of such brood stock.

Hatchery operators usually use fresh feed for maturation of brood stock and these feed include squid, oysters, krill, *Artemia* and polychaetes. The most preferred food is polychaetes, which produce healthy shrimp brood stock with a higher number of eggs and more spawnings. According to them, polychaetes supply beneficial enzymes, amino acids and essential hormones to stimulate reproduction. Local sources of live polychaetes in Thailand are from wild sources and with the sudden boom in shrimp farming, there is now a supply shortage.

Polychaetes in Thailand's shrimp industry

In Thailand, three types of polychaetes (annelid worms) are used as live feed for shrimp broodstock. There is the dark red colour blood worms *Glycera dibranchiata*, collected from mangroves areas, or mud flats. Its supply has been declining. According to Dr Surasak Dilokkeart, a shrimp industry leader, over 50% of this source is contaminated with harmful diseases. The grey to black colour lugworm *Arenicola marina* is imported from China from farms located in mud flats. Buyers usually check them for disease contamination and nutritional information before use. Lastly, there is the light pink sand worm *Perinereis nuntia* which local collectors harvest from sandy beaches. It is less contaminated than the other two polychaetes but volumes are small and its nutritional value varies from batch to batch, and from location to location.

In general, the larger hatcheries prefer to use the sand worm while small and medium hatcheries use blood or lug worms. Research showed that by feeding shrimp brood stock with the sand worms at 20-30% of their body weight per day, females could produce 2.5-3 million nauplii. This is double the production



Sandworm *Perinereis nuntia*

from broodstock fed with the other two worms. In addition, the survival rate from nauplii to post larvae is also 20% higher.

Today, in Thailand, most of the larger hatcheries depend on high quality, disease free live polychaetes from Siam Sand Worm Company. This is the story of the company, which won the Golden Shrimp award from the Surat Shrimp Club during the last shrimp exhibition in 2015.

Farmed versus wild sand worm

There are many benefits to controlled farming of the sand worm. Besides a steady supply, farmed sand worm can be enriched with nutrients such as astaxanthin, omega 3, 6 and 9 polyunsaturated fatty acids (PUFA) and multivitamins, to improve nutrient composition. The farming location and conditions can be controlled. Farms can be in a small area with minimal impact on

Table 1. Comparison of the nutritional value of farmed polychaete *Perinereis nuntia* according to age with wild polychaetes according to season.

	Farmed polychaete				Wild polychaete	
	Month of culture				Winter	End summer
Fatty acid (mg/g)	2	4	6	8		
Linolenic (LA)	13.65	11.00	9.50	10.26	2.87	3.41
α-Linolenic (ALA)	1.11	0.69	0.92	0.48	0.84	0.65
Arachidonic (ARA)	3.54	2.56	3.52	3.37	4.13	4.76
Eicosapentaenoic (EPA)	2.88	2.39	3.05	2.45	4.62	2.72
Docosahexaenoic (DHA)	2.04	2.28	2.17	2.25	0.61	0.62
Fat (%w/w)	17.27	18.15	17.42	20.56	13.81	12.97
Total saturated fatty acids (SFA)	33.85	35.09	34.74	33.56	40.45	40.05
Total monounsaturated fatty acids (MUFA)	27.56	25.56	24.40	24.95	22.82	22.93
Total polyunsaturated fatty acids (PUFA)	27.46	24.82	25.45	25.35	15.56	15.50

Source: National Research Council of Thailand



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Table 2. Comparison of fatty acid composition of polychaetes from Siam Sand Worm Company with wild type.

Fatty acid (mg/g)	Farm		Wild capture	
	Early years (2008-9)	2014	Summer	winter
Linolenic (LA)	9.5	10.14	3.41	2.87
α-Linolenic (ALA)	0.92	1.16	0.65	0.48
Arachidonic (ARA)	3.52	5.14	4.76	4.13
Eicosapentaenoic (EPA)	3.05	4.24	2.72	4.62
Docosahexaenoic (DHA)	2.17	3.26	0.62	0.61
Total saturated fatty acids (SFA)	34.74	40.36	40.05	40.45
Total monounsaturated fatty acids (MUFA)	24.40	19.92	22.93	22.82
Total polyunsaturated fatty acids (PUFA)	24.45	42.06	15.50	15.56

Source: National Research Council of Thailand and Dr Thanya Duanchinda, Taksin University



Sharing his experience at the annual Surat Thani Shrimp Farmers Meeting

“ I have customers who complimented me on the quality of my premium polychaetes. They are pleased with the consistent supply and on time delivery. I always produce more than the demand to guarantee supply. ”
 – Punkawee Angsumalee

the ecosystem. Most importantly, it is easy to control the health status and quality of the sand worms at harvest. The sand worm is at its best quality at 5 months old. However, it will not be possible to determine the age of wild worms.

Siam Sand Worm Farm

The farm is located in Lungsuan District, Chumpon Province Thailand. It was established in 2008. The current production is 5 tonnes/month. The road to reach this production level has been difficult for Punkawee Angsumalee or Khun Toom. A graduate in civil engineering from Prince of Songkhla University, Punkawee worked in the construction business in Bangkok for 10 years. However, in 2003 he left his job to return to his hometown to take care of his ailing mother.

Since he has always been interested in the aquaculture business, he started farming the sea snail, spotted *Babylonia*, which failed. Together with Dr Surapol Chunhabundit, he carried out market research on the demand for polychaetes in shrimp farming. At that time there was no commercial farming of the sand worm except for some pilot units. The Thai shrimp industry requires about 500 kg/day. As for the seed stock, Punkawee was lucky as there were natural sources of *Perinereis nuntia* in front of his spotted *Babylonia* farm.

A steep learning curve

During the first two years in this new venture, Punkawee spent his entire time learning the life cycle of the sand worm. He slept on the beach to observe its behaviour, and dug the sand worm hole to observe their feeding and mating habits. At the same time, he collected brooders and started a small farming unit for research using money from the sale of his car. The production was only 300 g/m² and each polychaete at 5 months old weighed only 0.7g. In the first year, Punkawee had 600 culture units (plastic boxes of 0.4x0.6 m). There was no regular income but he continued to learn more about the worm.

His target for the third year was 1.5-2 kg/m². He used his engineering knowledge to select and test many farming materials. He started a selection program to get stronger, bigger and more stable size polychaetes along with developing feeding regimes,

feed formulation and farming techniques. Gradually, he built up to 2,000 units with a total area 400 m² producing 1 kg/day.

“However, the demand from hatcheries is much higher at 3-5 kg/day and these farms needed a continuous supply for three months. It was also important to change the mind-set of hatchery operators, as they believed that farmed polychaetes were of lower quality compared to wild ones. Some even believed that shrimp broodstock fed with farmed polychaetes will not spawn,” said Punkawee.

“Such misinformation made me seek more knowledge and pushed me to conduct research on its nutritional value with a university and research institute in Thailand. I then developed a specially formulated feed for enrichment of the polychaetes and sent out the polychaetes for analysis (Table 2). I use such information to convince my customers on the nutritional value of the polychaetes.”

Siam Sand Worm increased production to 2-3 kg/m² and 500-600 kg/month in year 4 with 10,000 culture units in a farm area of about 3,000 m³. The four biggest hatcheries in Thailand were regular customers. By year five, he expanded the business with a second farm. This has a 20,000 culture units within an area of 6,000 m³ and produces 1.2-1.5 tonnes/month.

“I have customers who complimented me on the quality of my premium polychaetes They are pleased with the consistent supply and on time delivery. I always produce more than the demand to guarantee supply.”

In the sixth year, the farm modified the farming system. Cement tanks replaced the use of plastic boxes resulting initially in a drop in production from 3.5 kg/m² to only 2.5 kg/m². In this sixth year, production was 2.5 tonnes/month. Today, in its eighth year, the farm produces 5 tonnes/month.

Farm models

Punkawee started with an open-air building where he had plastic boxes of 0.4x0.6x0.2 m filled with sand. Aeration was in the form of air stones throughout the entire crop. A stable internal temperature was maintained simply with windshields.

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Feeding the polychaetes

In his new model, he changed the culture units to cement tanks (1x12x0.3 m) filled with a layer of sand. The cement tanks were not aerated but he pumped water in and out of the tanks to simulate natural tides.

“Previously for every 2 tonnes of production, I use electricity costing THB 100,000. With this new model, I only use THB 25,000 of electricity,” said Punkawee.

Spawning is natural using 9-month-old worms. Three days after hatching, 2,000 larvae polychaetes are moved into culture boxes for 5 months until the time for harvest. The survival rate is 50% from the egg to 3-day larval stage and by harvest time, only 300 polychaetes remain in the box.

The farm uses black tiger shrimp feed as well as a special formula supplement for nutritional enrichment. Feeding rate is once a day and feed conversion ratio is 1:1. However before harvesting, feeding is twice a day. In-coming water is treated prior to use and during the culture period, probiotics are applied regularly to control water quality and toxic gases such as hydrogen sulphide are removed.

Hygiene and diseases

A hygienic system is required, as all batches need to pass strict checks for diseases. The health certification covers checks for shrimp diseases and parasites such as white spot syndrome virus (WSSV), Taura syndrome virus-(TSV), infectious myonecrosis virus (IMNV), vibriosis, parasites and protozoa. However, Punkawee said, “There is a constant need for specific and new



View of the culture tanks



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Marketing polychaetes

In Thailand, there are 14 large hatcheries with facilities for broodstock maturation. Eleven of them are customers of Siam Sand Worm. Daily, staff will harvest 5-6 month old worms, clean them with water and pack them in plastic bags supplied with oxygen similar to packing shrimp post larvae. These are for delivery within 6 hours. Polychaetes are also frozen at -13°C. The shelf life for frozen polychaetes is 3 months.

The future with polychaete farming

On the future for his business and that of polychaete farming, Punkawee said, “Since polychaetes have a high nutritional value, they could be used to feed many other aquatic animals and vertebrate. It may be used as human food too. Its farming has a bright future but still requires close attention for the culture process to be successful.

“To produce disease free post larvae, the brood stock must be free of diseases. Therefore, the feed must be disease free and farmed polychaete is the best solution. Also, we have this culture system which has very little impact on our ecosystem.”



Soraphat Panakorn is Commercial Development manager, Aquaculture Asia Pacific, Novozymes Biologicals, Thailand. Email: january161975@hotmail.com



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A field study on probiotic applications in closed water systems

By Jutta Zwielehner and Anwar Hasan

The key to all closed water systems is managing pond water quality and the experiences of farms in Indonesia demonstrate how this can be achieved.

Shrimp aquaculture faces many challenges, among them diseases. Since the 1990s, white spot syndrome virus (WSSV) caused major losses in many countries. After 2000, infectious myonecrosis virus (IMNV) was a major problem in Brazil and Indonesia. Now, early mortality syndrome/acute hepatopancreatic necrosis disease (EMS/ AHPND) caused by a virulent strain of *Vibrio parahaemolyticus* has a very big impact on shrimp production in several countries, particularly in Thailand. At the same time, white faeces disease (WFD) regularly occurs too, further threatening shrimp production in several countries.

In many cases, the causative agents are indigenous to the pond environment and proliferate as soon as the conditions are favourable. Shrimp then are infected in every crop cycle. For example, WSSV always appears in several locations such as in north of Java and east of Sumatra. Other examples are IMNV incidences in Indonesia, and also EMS in Thailand. With these outbreaks, such locations can be called endemic disease areas, since endemic means a constant presence and/or usual prevalence of a disease or infectious agent in a population within a geographic area.

Many farmers continue to operate their ponds even though they are located in endemic disease areas and learn to actively manage the risks. High biosecurity standards help to minimise disease incidences. Daily culture practices are of prime importance to get the crop through critical periods and achieve a harvest. Farmers learn to be creative to minimise disease outbreaks in their farm through biosecurity, feeding management, and a focus on stable water quality.

In this article we will discuss the benefits of probiotic (AquaStar® Pond) application in closed water systems to control diseases in shrimp farms in endemic disease areas. The closed water system in this study is very simple but needs discipline to apply.

Closed water system

Biofloc and recirculating systems are examples of closed water systems in aquaculture. The simplest culture system is limited water exchange, where farmers do not change water in the pond. In the worst case, evaporation and leakage can reduce water levels from 1 m to 80 cm within 15 days. Therefore, topping up water to compensate for evaporation and water leakage might be required to control salinity and water quality.

The key to all closed water systems is managing water quality and waste in the pond. Biofloc is an excellent system to maintain normal and stable water quality. This heterotrophic system manages waste in the pond very well but it is not easy to apply full biofloc in shrimp ponds, particularly for large size and outdoor ponds. Here the main challenge is cost and water stability.

Many farmers practise a simple limited water exchange protocol. Farmers keep the same water until 30 days of culture, then they top up water every 5 to 7 days to compensate for evaporation, leakage, siphoning, and sludge removal (with an open central drain). Sources of water are important and usually farmers use treated water from a reservoir.

However, in reality many farmers start to replenish water before 30 days of culture. Often farm managers claim to use a closed water system (and use treated water to top up water), but in fact they fill ponds with water from reservoir too early such as 10 days after stocking. Farm managers are often nervous when the water depth reaches 105 cm i.e. 10-15 cm less than the normal water level, even though this is still acceptable. Typically, reservoir water is treated using disinfectant to avoid high pathogen loads, but nevertheless re-filling the pond with any water runs the risk of altering the water composition.

Disease free vs endemic areas

In shrimp farming, water exchange serves to reduce the concentration of organic waste compounds such as nitrite and ammonium, and the plankton population (blue-green algae bloom) and to compensate for evaporation, leaking and siphoning. Water exchange works well in disease free areas.

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In endemic disease areas or when diseases appear in the region, water exchange should be avoided for the following reasons:

- Pathogens can enter the pond. Treated water (by using chemicals) in the reservoir could help to minimise pathogen load, but these chemicals cannot sterilise the water.
- Altering water stability or composition (chemical, biological and physical). Fresh water can introduce new plankton seeds, new nutrient composition, and alter water parameters. It is easy to change the chemical or biological composition in the water, thus resulting in the introduction of opportunistic pathogens and triggering stress in shrimp that might finally cumulate in a disease outbreak. Mature water in contrast to fresh water limits the growth of opportunistic pathogens by offering few available environmental niches.

When applying a closed water system protocol, we need to control chemicals and biological parameters such as nitrite, ammonia, hydrogen sulphide (H₂S), plankton and pathogenic bacteria (*Vibrio*) in the system without changing water stability. Probiotics should be used to fulfill that role.

To demonstrate this, we used a very simple closed water system. This system requires that we keep the water as long as possible without water exchange of any sort to replace evaporated or seeped out water. Farmers are only allowed to fill in new water if the water depth is below 90 cm. We then allow the probiotics to work in the pond optimally to maintain water quality.

Probiotics

An important criterion is to select a good quality probiotic. This is essential to successfully control organic wastes, plankton and pathogenic bacteria.

There are many species of beneficial probiotic bacteria and in every species there are many different strains. Every species and strain has different characteristics and effects. In a laboratory experiment we demonstrated the different enzymatic activities of two different strains of *Bacillus subtilis* and a strain of *B. licheniformis* (Table 1).

Table 1. Enzymatic activity of probiotic bacteria (source: BIOMIN Research Center).

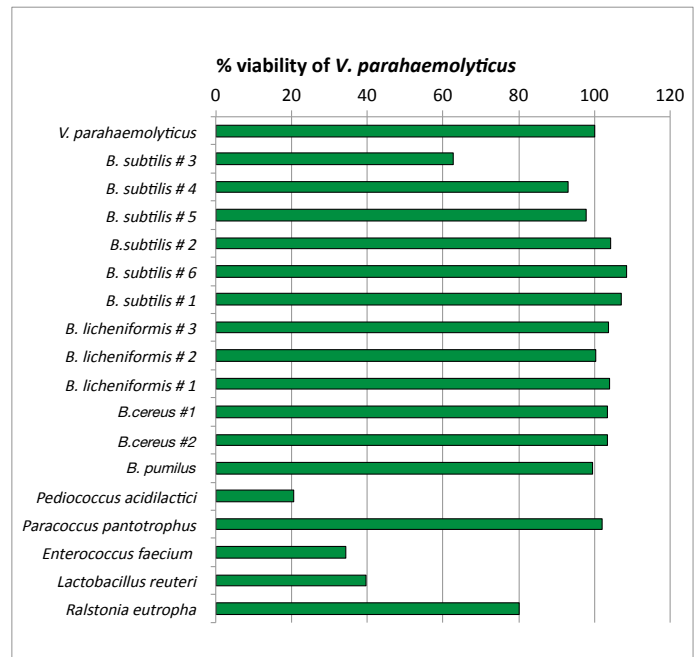
Probiotic Bacteria	Enzymatic activity (mm clearing zone)		
	Protease	Amylase	Cellulase
<i>B. subtilis</i> strain 1	25	7	19
<i>B. subtilis</i> strain 2	17	15	13
<i>B. licheniformis</i>	8	0	7

It is clear that each strain shows different enzymatic activity. *B. subtilis* strain 2 has good amylase activity, but has a lower effect on protease and cellulase activity than *B. subtilis* strain 1. It shows us that although many probiotics in the market contain a *B. subtilis* species, the effectiveness will not be the same because the strains are different.

We also demonstrated the different effects of different species and strains to pathogen inhibition. Figure 1 shows the ability of various probiotic species and strains to inhibit *Vibrio parahaemolyticus* growth.

Similar to observations for enzyme production and pathogen inhibition, the removal of nitrogenous compounds is a species and strain-specific property. This again shows how important it is to select the best probiotic bacteria (strains) for your farm.

Figure 1. Varying effectiveness of probiotic bacteria against pathogenic *V. parahaemolyticus* after 8 hours (source: Biomin Research Center).



Field information

In general, few farms have the confidence to apply zero water exchange for as long as possible or until harvest. However, we found several farms practising this. Among them is the Ricky farm in North Sumatra and a farm in West Java, Indonesia. We then duplicated this system with a number of farmers in Rawajitu, Lampung Province and a shrimp farm outside Indonesia. These are examples of how the probiotic (AquaStar® Pond) works in closed water systems in several locations with a history of WSSV.

Water quality

Nitrite is a major concern in closed water systems. A farm in West Java that applied AquaStar® Pond showed that with a low dose of the probiotic (500 g/ha every 3 to 4 days), the nitrite concentration was maintained without top up of new water until 90 days of culture (Figure 3). As control they used another probiotic which includes two species; *Bacillus* spp. and *Thiobacillus* spp. To assure that the ponds applied a closed water system, the farm manager emptied the reservoir during the culture period. The stocking density in this farm is 80 - 100 PL/m².

In the control pond nitrite increased between days of culture (DOC) 49 and DOC 70. In these ponds, probiotic was applied every 1-2 days with increasing dosage as nitrite and *Vibrio* load increased. In comparison, in ponds with AquaStar® Pond, the nitrite concentration increased slower even though the probiotic was applied only every 3 to 4 days. In spite of the increased probiotic dose for the control ponds, the nitrite concentration was above 25 mg/L from DOC 70 and DOC 91.

In the literature, the optimum level of nitrite for shrimp are described at <0.45 mg/L and <0.3 mg/L. Other studies investigated the acute toxicity of nitrite to *L. vannamei*. The LC50 (dose lethal for 50% of test shrimp) for 25 ppt salinity is 244 mg/L NO₂-N. At lower salinity, nitrite is more toxic with LC50 of 15 mg/L NO₂-N at 2 ppt salinity. Another factor that increases the toxicity of nitrite is ammonia.

In this study, nitrite values of >25 mg/L were observed. At that concentration, nitrite is lethal for *L. vannamei*. Nitrite stress between 5 and 22 mg/L was previously shown to reduce resistance to *Vibrio* spp. and other bacterial infections. This study was conducted through analysis of haemocyte (invertebrate red blood cells) counts.

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Increasing the dose of the probiotic in the control ponds successfully reduced total *Vibrio* count (TVC) to 10^4 CFU/ml from DOC 21 to DOC 49. However, the low dose of AquaStar® Pond successfully maintained TVC below 10^4 CFU/ml in pond water almost in every sampling, except at DOC 49 as shown in Figure 3.

Initially, we struggled to convince the farm in Rawajitu, Lampung Province, Indonesia to adopt zero water exchange, because the farm manager was afraid to let the water level go down until DOC 30. However, using the above test results we convinced him that this culture practice is the right choice for this endemic disease area. Other farmers in the vicinity subsequently tried this with success. Since last year WFD (white faeces disease) was a nightmare for farmers there and this compounded the ordeal of shrimp farmers in Rawajitu who were already suffering from WSSV infections.

Figure 2. Comparison of the nitrite profile in trial farm in West Java using a closed water system and probiotics

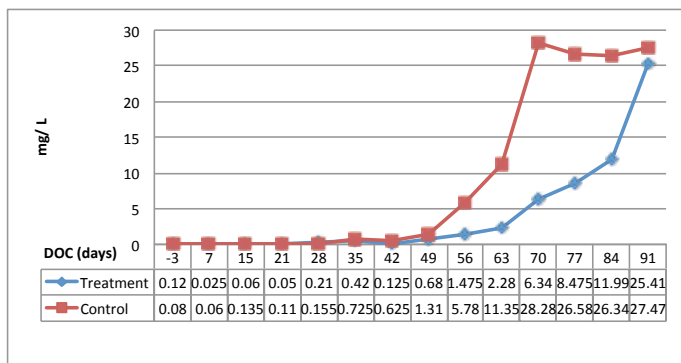


Figure 3. Abundance of *Vibrio* spp. in pond water treated with AquaStar® Pond (treatment) or a control probiotic (*Bacillus* sp. and *Thiobacillus* sp.) as assessed with a plate count method.

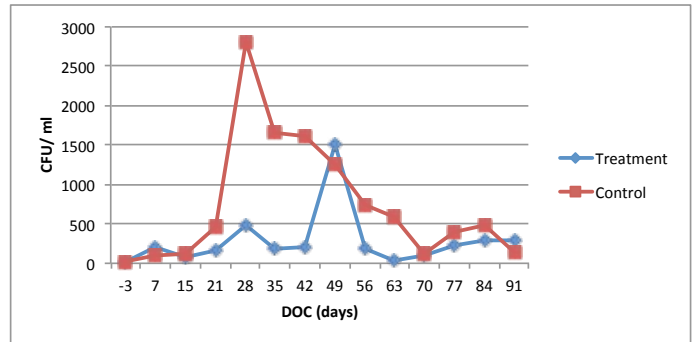
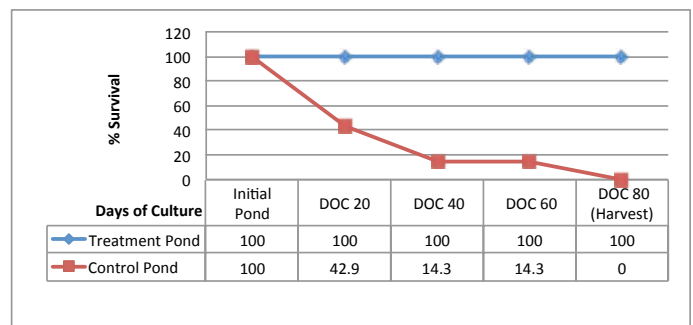


Figure 4. Shrimp survival in ponds using a closed water system applying AquaStar® Pond against control.



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Conclusion

A good quality probiotic can help closed water systems control diseases in ponds located in disease endemic areas or during an outbreak. However, it requires a thorough understanding of the characteristics of the respective pond such as: type of pond, water seepage and rate of evaporation. Again, it is not a silver bullet to solve disease problems. It must be integrated with other requirements, such as biosecurity.

In the case of earthen ponds, it is recommended that sediment waste of the pond must not be discharged into the surrounding aquatic environment. The sediment waste should be removed onto land. The promising results with this limited water exchange system may give some hope that our industry will overcome various disease challenges. We at Biomin continue to pursue research on natural solutions to combat the various challenges in aquaculture.



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The experience of Ricky Farm



Ricky

The farm located on the east coast of North Sumatra, Indonesia is an example of a successful farm applying a closed water system. The farm has been using this system for the past 3 years. Ricky, the owner of this farm also operates farms in other locations. Some of the ponds in his farm are earthen ponds and others with liners. Some of his farms are located in endemic WSSV areas, and since last year, were threatened by an increased prevalence of WFD.

As Ricky farm does not have any problem with water seepage in all the ponds, he has adopted a closed water system. In addition, he has never filled new water during the culture period (130 days) until harvest except in very urgent situations. He rarely faces critical situations in terms of water quality.

He understands that a closed water system can avoid plankton growth (green/ blue green) during the early stages. According to Ricky, applying AquaStar® Pond has been the key success to maintain plankton growth and water quality. In the early stage, he does not apply mineral supplements which can cause plankton overbloom in the ponds. In one of his ponds, we can see the water colour at DOC 70 which is light green despite no new water addition.

After using a closed water system, Ricky successfully minimised disease prevalence in his ponds. Even in several locations, he did not find acute disease outbreaks. In 130 days of culture, with stocking density of 70- 100 PL/m², he usually obtains shrimp with an average body weight of 25 - 30 g and survival rate of 70-90%. He also checked nitrite concentrations which were below 5 mg/L until harvest.



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Managing risks in shrimp farming through disease prevention and health

By Fernando Garcia Abad, Wee Kok Leong and Brendan Yeo Wee Leng

This year marks the 175th anniversary of the Behn Meyer Group in Asia. In Malaysia, celebrations include a series of aquaculture seminars covering shrimp disease and prevention. The first seminar for small and medium scale farmers was held together with Epicore Bionetworks, USA, in Subang Jaya, Malaysia. The seminar was conducted by Fernando Garcia Abad, Aquaculture Business Development director at Epicore Bionetworks Inc, USA and Dr Wee Kok Leong, Regional Technical manager - Aquaculture, Behn Meyer Animal Nutrition.

Overcoming shrimp diseases and improving profit for sustainable future

In this presentation, Garcia Abad focussed on three aspects: effect of early mortality syndrome/acute hepatopancreatic necrosis disease (EMS/AHPND) on global shrimp supply and prices, raceways/nursery systems and on current disease challenges, in particular that of microsporidian parasite *Enterocytozoon hepatopenaei* (EHP). The information on raceways/nurseries systems was an update of an article, 'Nursery phase in shrimp farming: Benefits beyond EMS,' in the March/April 2015 issue, Aqua Culture Asia Pacific.

In late 2012, Mexico farms were affected by EMS/AHPND. In 2013, its shrimp production went down to 50,000 tonnes from 100,000 tonnes in 2012. Production was better at 56,000 tonnes

in 2014. Although the recovery in production levels in Mexico was due to multiple factors, the improved raceway and nursery infrastructures have played major roles, together with *Vibrio* resistant brood stock lines imported from Ecuador and the use of probiotics and functional feeds during the culture cycle.

A major effect of lower production volumes in the affected countries in Southeast Asia was the increase in average farm gate prices which rose in 2014 to almost USD 4.5 for shrimp size 41/50/kg (CNA Ecuador). This declined to USD 2.90/kg in 2015 because of the higher supply, mainly from India, Indonesia and Ecuador as well as the discontinuation of shrimp supply from Vietnam into the Chinese market.

Current shrimp prices and profit levels still favour the investments in the implementation of nursery systems. The major advantages of these systems are that they improve two of the major cost components in shrimp production. The first is the reduction in the length of the culture cycle by 20 to 30 days; and the second is the improvement in feed conversion ratio (FCR). Due to compensatory growth, the FCR in the grow-out ponds improves by 10 to 30%.

As it is expected that shrimp production will recover further and prices will go back to the pre-EMS levels, farmers that implement nursery technology will have an edge and be more competitive and efficient.

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Shrimp diseases and tools to minimise risks

Some recent disease threats, besides EMS/AHPND, are running mortality syndrome (RMS), white faeces disease (WFD) and microsporidia (EHP) infections. In the absence of effective treatments, the implementation of prevention methods for RMS are crucial. We believe that WFD is a bacteriological problem caused by a strain of *Vibrio*, accompanied with other stress factors in the pond. To lower its impact, there is a need to lower the bacteria count in the ponds, through the use of hydrated lime, from days of culture 40 to 70 at 100 to 150 kg/ha. To lower the organic load in the pond, farmers can double the dosage of the probiotics in ponds after lime application. The animal can be protected via feed probiotics.

EHP

This is a top threat in many farms. EHP is confined to the shrimp hepatopancreas. It infects *Penaeus vannamei* and can be transmitted directly from shrimp to shrimp via the oral route. This is different from most of the common microsporidians that require an intermediate fish host for transmission.

Infection does not appear to cause mortality but is associated with severe growth retardation in *P. vannamei*. Detection is through nested PCR and LAMP methods. It is advisable to check faeces of broodstock and whole post larvae for EHP presence. EHP can also be detected with the microscope with magnification of 100X but it is very difficult to see because of its small size and the spores are present in small numbers.

Specific pathogen free brood stocks of *P. vannamei* imported to Thailand were free of EHP but maturation and hatchery facilities (possibly from polychaetes or clams) become infected due to poor biosecurity. The best chance of controlling the disease is to avoid using fresh and live feed for shrimp maturation. Today there are several processed maturation feed alternatives. Epicore has been working with this alternative for over a decade and has developed Epifeed MBF which is widely used in Latin America bringing a higher level of biosecurity to maturation facilities. If this is not an option, then we should do pasteurisation or gamma radiation to sanitise the fresh feeds and lower the risk of these feeds becoming disease vectors.

“ Throughout the cycle, the farmer needs to recognise *Vibrio* problems in the shrimp to carry out management protocols when necessary. ”

Vietnam's recovery from EMS

Vietnam is the first country in Southeast Asia to recover production levels after EMS/AHPND infections. There are several factors accounting for the increase in production figures, but if we ignore import figures for re-export to China, Vietnam still showed a recovery in production. One factor is because many farmers have improved infrastructures and use locally adapted alternatives of raceways/nursery systems. They also adopt better management practices, including the use of feed additives and probiotics in water, sediment and feed.

One example is the Anh Khoa farm. Stepwise, the farm began by eradicating *Vibrio* bacteria using disinfectants. Next is the prevention of the bacteria from growing again in the water with probiotics and beneficial soil probiotics to digest the organic matter in the pond bottom. Gut health is improved with the use of feed probiotics. Throughout the culture cycle, the farmer needs to recognise *Vibrio* problems in the shrimp and to carry out management protocols when necessary.

The outcome of these steps has been several successful and profitable harvests. The average stocking density was 170 post

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From AQUA CULTURE Asia Pacific, Vol.11(3), May/June 2015: 43-46

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Thirty farmers came for this interactive seminar covering several issues in the industry. A seminar was also held in Sabah, Malaysia in May. Authors, Fernando Garcia Abad is on the right, front row, Brendan Yeo is 5th from right and Wee Kok Leong is second left, front row.

larvae/m² in ponds of 1300 m². In one pond, the harvest after 87 days was 4.2 tonnes of shrimp size 38/kg. The FCR was 1.5. In a second pond, the harvest was 4.4 tonnes after 82 days with shrimp size of 35/kg and FCR of 1.45. In the third pond, it was 3.6 tonnes with shrimp size 44/kg after 79 days and FCR of 1.4.

Trace minerals in the health of fish and shrimp

In his presentation, Wee described the importance of trace minerals in the health of fish and shrimp. On functions and requirements for trace minerals such as copper, zinc, iron, selenium, he highlighted their critical roles in the growth and immune functions of fish and shrimp. He also highlighted the reasons why the inclusion of supplemental trace minerals in the pond water or via feeds is necessary to overcome the effects of climatic changes, deteriorating quality of pond water and bottom, stress from poor husbandry techniques, and/or poor diet quality, to prevent disease occurrence.

The functions of minerals in animal nutrition range from being essential constituents of skeletal structures such as bones/scales and shrimp shell to structural constituents of soft tissues and components of the immune response systems. They are essential components of many enzymes, vitamins, hormones, and respiratory pigments or as cofactors in metabolism, catalysts and enzyme activators. Minerals play a vital role in the transmission of nerve impulses and muscle contraction, and maintenance of osmotic pressure, thus regulating the exchange of water and solutes within the animal body. They also have a vital role in the acid-base equilibrium of the body, and thus regulate the pH of the blood and other body fluids.

Minerals and moulting in shrimp

The vulnerability of shrimp to pathogenic attacks during moulting has been studied. Shrimp are most susceptible to pathogenic attacks during the post moulting stage and during injury.

Therefore, the faster the shrimp hardens its exoskeleton post moulting, the lesser is the risk from infection. It has been shown



Detecting *Vibrio* infections. First signal is expanded chromatophores as in shrimp on the left. Middle: Another early signal is reddish antennule. Right: A second sign is that shrimp stop feeding as in this shrimp over 5 days.

that the availability of minerals such as calcium, phosphorus, magnesium and the trace elements are critical at the post moulting stage.

Recalcification of the exo-skeleton starts immediately after moulting and shrimp sequesters minerals from its body first, and then from the water. The current high stocking density employed in shrimp farms using fast growing strains, has led to high biomass and with frequent moulting resulted in rapid and high consumption of both the macro and micro minerals from the water. It is therefore crucial that there is enough minerals especially trace elements, in the feed and in the water when the shrimp are moulting and subsequently losing valuable minerals in the exuviae.

Wee highlighted the events in the shrimp culture cycle which are stressful and which increase the animal's susceptibility to attacks by pathogens. Some examples include, climatic changes (heavy rain falls), deteriorating quality of pond water and bottom and poor husbandry techniques, and/or use of poor quality diet.

Trace minerals

Trace elements such as copper, manganese, chromium, and zinc play significant roles in the development of immune response in animals. The inclusion of supplemental trace minerals in the pond water is necessary to enhance their immune response capability. Diets formulated to contain the appropriate quantity of trace minerals have also become critical in the fight against stress and diseases. An additional concern for adequate trace element levels is the ongoing quest to reduce fish meal in aquatic diets. Besides supplying much needed fatty acids, fish meal also consists high amounts of trace minerals.

Wee discussed the use of Azomite (USA) a natural product containing 72 minerals including trace elements as one such product. It has been used in shrimp farms in Southeast Asia to ensure successful harvests. It could also be shown that the product introduced into the pond water at this stage helped the shrimp to recover and regain feeding intake.

Fernando Garcia Abad is Aquaculture Business Development director at Epicore Bionetworks Inc, USA. He has more than 22 years of experience in both academic and production areas of aquaculture. He has held management positions at the three levels in shrimp production; maturation, hatchery and grow-out. Email: fernando.garcia@epicorebionetworks.com

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Fresh and live shrimp from biofloc farm in Spain

By Hervé Lucien-Brun and Manuel Poulain

This unique concept allows farms located anywhere for local deliveries to high end markets and discerning consumers

Spain imports more than 150,000 tonnes of shrimp annually, making it an important shrimp market in the world. However, only 2% of these shrimp are imported fresh while the other 98% are imported as frozen from several shrimp farming countries. Spanish consumers are discerning connoisseurs of seafood and, if they can afford will readily accept higher prices for exceptionally fresh products.

However, to have a shrimp farm in Spain providing live and fresh products and near to the markets is a challenge. There is the biofloc technology, which was initially developed by the Aquacop team in Tahiti, French Polynesia, in the 1980s. Recently, several prominent scientists in different parts of the world are promoting this technology in aquaculture. Its realisation makes it possible to produce high volumes of shrimp in a small area.

Biofloc technology is a zero water exchange system where the quality of the water, in terms of nitrogen components is maintained by the action of autotrophic nitrifying bacteria. These are very specific aerobic bacterial populations which nitrify



Gamba Natural shrimp in an aquarium

ammonia wastes from shrimp and feed to nitrates. These bacteria need a high level of dissolved oxygen and there should be no accumulation of wastes which could create anaerobic areas. An efficient aeration system is key to the success of this technology.

This was the idea behind the investment by Norwegian engineer and entrepreneur, Bjørn Aspheim. Gamba Natural is a shrimp farm using biofloc with no water exchange during the whole culture

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The Gamba Natural building. Inside there are 24 ponds

cycle. The water is recirculated after the final harvest to eliminate the nitrates before reconditioning the water for a new cycle. This shrimp farm in Spain produces 25-30g white shrimp, *Litopenaeus vannamei*, which are sold live to local markets.

“We started 8 years ago and after 4 years of successful production, we can confirm that this biofloc shrimp farming in a 100% recirculation system is a viable venture. We can now commercialise this system anywhere in the world,” said Aspheim.

Gamba Natural farm

The project started in 2007, with the collaboration of French technical manager, Manuel Poulain. For biosecurity reasons, the farm management decided to establish the farm far from the sea, near the city of Medina del Campo, some 400 km from the ocean. This was no coincidence. The town has excellent connections with Madrid, the largest market for shrimp in Spain and with northern Spain, which has the largest demand for fresh shrimp.

However, this site presented several challenges. At an elevation of 700 m, and so far from the sea, pumping seawater faced many difficulties. There was also the incompatible atmospheric temperature for this type of aquaculture. From December to February, the air temperature varies from 9°C to 1°C. The team solved the seawater problem by using reconstituted seawater from sea salt used for marine aquariums. For the entire farm, it was necessary to make 5.5 million litres of artificial seawater. The entire farm was built indoors to provide a closed and insulated environment. This biofloc technology with zero water exchange reduces greatly the energy requirements for heating water. The water is heated initially to 28°C and is then maintained at this temperature.

The farm house, comprising 7,000 m² was built on a land area of 7 ha in 2007. The 24 ponds: 16 of 300 m³ and 8 of 200 m³ were constructed in stages with their completion in 2012. Twenty ponds are used for breeding and 4 are used for water treatment at the end of each cycle and the treated water will be reused for subsequent culture cycles. Water reconditioning involves denitrification reactions, transforming nitrate to nitrogen gas under anaerobic conditions. Thus, these ponds do not need to be aerated. The treated water is transferred to the new grow-out ponds where it is conditioned to allow for the establishment of a stable biofloc.

The use of reconstituted seawater is extremely expensive. Spanish and European laws also prohibit the direct discharge of used water into the environment. It is thus necessary to set up a water treatment system and 100% reuse of the water for the following culture cycles. Evaporation of water during the production cycle is very low and it will take almost 5 years before all the water for the farm needs to be replenished.

Each pond is covered by a single tent. The purpose of this type of cover is threefold:

- To improve the biosecurity by isolating each pond as much as possible
- To limit evaporation and therefore to reduce compensatory freshwater inputs, and
- To improve thermal insulation and keep temperature variations at only ± 1 °C.

The ponds are excavated and are fully lined. Twenty ponds used for the grow-out have very efficient aeration systems to maintain a high level of dissolved oxygen and to move water constantly to keep all the solids in suspension for a healthy biofloc.

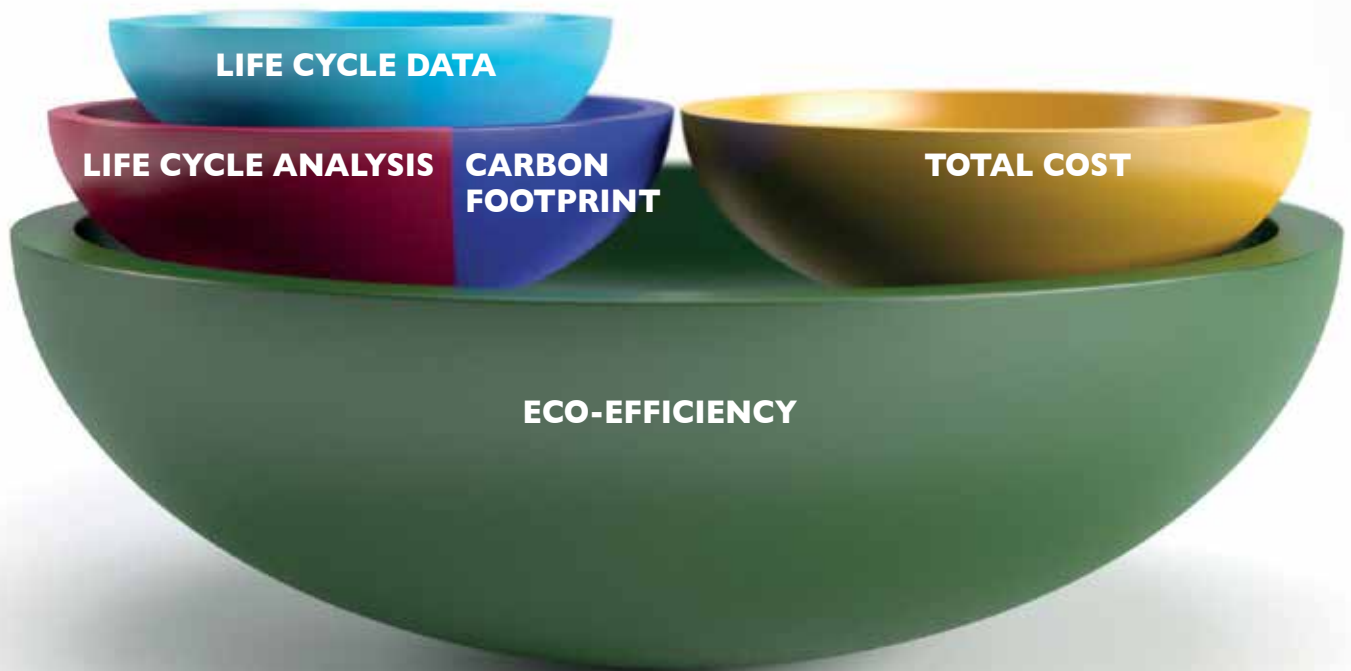
Ponds are located in a dark area, to help achieve a strong and stable biofloc. In normal outdoor biofloc ponds, the bacteria compete with algae but the algae population is not stable because of changing weather and sunlight conditions. At the Gamba Natural farm, this problem is avoided.

“Based on his experience with bioflocs in Mexico, Seychelles and Australia, Poulain believes the best is a biofloc system with no algae in closed tanks,” said Aspheim.

L. vannamei post larvae supply is sourced exclusively from a referenced shrimp hatchery located in Florida, USA, following strictly European Union rules on biosecurity for exotic species. The post larvae are stocked at PL12 at a density of 350 to 1000 PL/m². The ponds have zero water exchange during the entire cycle. Fresh water is added when necessary to compensate for evaporation.



The Gamba Natural team, Bjorn Aspheim (right) and Manuel Poulain (middle) with Hervé Lucien-Brun



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Indoor view of the farm



Grow-out ponds

Shrimp are fed a 30% crude protein feed produced by European feed millers. Within a biofloc system, shrimp also consume the floc and thus the feed conversion ratio is only 1. To date, the farm has not recorded any disease problem, which was attributed to its location. Shrimp reach an average body weight of 20 g in 120 days with a yield of 3.0 to 3.5 kg/m³.

"We are able to produce and deliver sizes according to demand, although the most common harvest size is the 40-60/kg size range. Our smallest is size 100-60/kg and jumbo shrimp is just less than size 40/kg," said Aspheim.

Unique in Europe

Today Gamba Natural is the only European farm of this type producing and marketing live and fresh shrimp all year round for the Spanish market. Delivery is 24 hours.

"Since 2013, the farm has been producing 30 tonnes/year. The actual selling prices are from €15 to €45/kg according to the shrimp sizes ranging from 18 to 35g. Costs are for electricity (which is low) and labour. We have two staff handling up to 50 tonnes annually," said Aspheim.

"Our wish is to produce and market live shrimp mainly of size 30-40/kg. We display live shrimp in supermarket aquariums for customers to see. This is a breakthrough for tropical shrimp in Europe because previously, such displays are only for lobsters or crabs.

"The shrimp from Gamba Natural are ultra-fresh or live, and they are free of antioxidant or metabisulfites. Sulfites are not needed because the shrimp are delivered to the customers within two hours. In terms of texture and colour, our shrimp are beyond comparison with those available in the market. We are, however, limited to the Spanish market as longer deliveries of more than 12 hours is very costly. This concept with biofloc is ideal when we need to locate farms close to markets and not near the coast.

"The fresh shrimp are mostly delivered to delicatessen restaurants. Gamba Natural shrimp have received the best scores from the most discerning culinary critiques in Spain. They are now available in the best restaurants in Madrid and are positioned as high-end products. The farm's customers include 12 Spanish star chefs and they have paid compliments to the product in professional and mainstream media," said Aspheim.

This is the only shrimp farm using biofloc, which has convincingly demonstrated its technical and economic success in Europe. Aspheim invested more than USD 8 million and is pleased that within 5 years in commercial production, Gamba Natural had demonstrated that the technology is reliable and secure. The production will reach 50 to 80 tonnes of shrimp size 40/50 by the end of 2016.

Finally on the future, Aspheim said, "Today, a serious constraint is post larvae supply and we will be working on a permit to set up

a hatchery to ensure supply to meet our operational needs. We are also working to obtain the EU authorisation to produce black tiger shrimp using the same technology in our farm to meet the demands of EU markets".

The team at Gamba Natural has demonstrated over the years a good mastery of shrimp production with biofloc technology. Aspheim would be able to contribute this expertise to other companies wishing to implement similar projects.



Live Gamba Natural shrimp in a supermarket in Madrid.

Hervé Lucien-Brun is a consultant in shrimp aquaculture since 1984. He started his career with a shrimp hatchery and later managed a 1000 ha shrimp farm in Ecuador. He has developed and assisted in several projects in several countries. He has worked with Poulain for more than 10 years to implement new projects all over the world. Email: hervelb@gmail.com

Manuel Poulain is Technical director at Gamba Natural since 2007 where he designed and developed the technology. Since 1996, Poulain is involved in the controlled and intensive broodstock production of monodon, vannamei and stylirostris shrimp in the first mixotroph biofloc technology developed by Aquacop in the 80's and later in Mexico, Seychelles and Australia. Email: manuel1274@yahoo.fr

Bangladesh: Improving productivity of tilapia in ponds

By Meezanur Rahman, Hasan Uz Zaman and Olivier Decamp

The efficacy of *Bacillus* probiotics in disease prevention and increasing yields.

Bangladesh has about 5 million ha of inland water resources such as rivers, estuaries, natural and manmade reservoirs, ponds and floodplains. The major species cultured are Indian and Chinese carps, tilapia and pangasius. However, in recent years, tilapia production has increased and expanded faster than carps and pangasius. Over the last 15 years, tilapia production increased to approximately 200,000 tonnes per annum, according to the Department of Fisheries (2014).

The increase in production and rapid expansion were achieved as a result of the successful adaptation of technology, such as high yielding all male seed, intensification, faster growth, and better profitability in culturing tilapia compared to other species. In Bangladesh, pond culture is the most common method for rearing tilapia. However, tilapia is often farmed in polyculture with Indian carp, Chinese carp and pangasius. This approach provides additional yields, better feed management and utilisation of natural productivity. The constraints include: disease and mortality caused by pathogens such as *Streptococcus*; ectoparasites; inappropriate health management protocols for antibiotic application for treatment and prevention of disease (Komar, 2008); higher feed costs; and low farm gate prices.



Tilapia farmers are looking for further improvement of rearing conditions to increase yields per unit area, prevent disease and mortality, reduce feed cost and increase average body weights at harvest. With rising production costs in China, tilapia farmers in Bangladesh see an opportunity to be the cheapest producers of farmed tilapia, alongside Vietnam.

The objectives of this study were to assess the impact of two types of probiotics and a formulation of natural plant extracts to prevent disease and to improve growth and yields in tilapia pond culture.

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The farm and hatchery

The study was conducted at K.K. Dairy, Poultry and Fisheries Ltd., located at Muhuri Irrigation project, Mirsharai, Chittagong, Bangladesh (commonly known as Meridian Tilapia hatchery and farm) between March and November 2014. The farm size is approximately 32 ha. It includes a hatchery producing all male tilapia, carp and pangasius, as well as 70 culture ponds. The annual production of fish at the farm is approximately 400 tonnes of tilapia, pangasius and carps at the ratio of 70:20:10. It produced 30 million all male tilapia fry, 3 million pangasius fingerlings and 20 kg of carp hatchlings.

Study ponds

In this study, we used two 0.3 ha ponds for nursery culture. All male tilapia fry from the same batch were stocked in nursery ponds at a stocking density of 60 fry/m² for 30-70 days. Nursery ponds were treated with the probiotic Sanolife PRO-W. The application rate at pre-stocking and post stocking application was 200 g per ha fortnightly. At the end of the nursing period, tilapia fingerlings of average body weight (ABW) of 3-10 g were stocked in grow out ponds at a density of 5 fingerlings/m². In addition, Indian and Chinese carps (catla, rohu, mrigal, silvercarp), and pangasius were stocked at a density of 0.5 fish/m². In total, 11 grow out ponds (2 control and 9 treatment ponds) were used in this trial. Pond sizes ranged between 0.2 and 0.8 ha. Total pond water area was 5.3 ha.

Treatment details

There were three treatments in this study. Treatment 1 used only Sanolife PRO-W. Treatment 2 used a combination of Sanolife PRO-W and PRO-F. Treatment 3 was a combination of Sanolife PRO-W and Sanolife GUT, an antimicrobial compound. All products are from INVE Aquaculture (Belgium). Each treatment was carried out in triplicate.

Sanolife PRO-W is a microbial water conditioner. It comprises strains of *Bacillus subtilis* and *B. licheniformis* with a minimum concentration of 5 x 10¹⁰ CFU/g. Sanolife PRO-F is a mixture of probiotic delivered with feed. It comprises strains of *B. subtilis*, *B. licheniformis* and *B. pumilus* with a minimum concentration of 1 x 10¹⁰ CFU/g. The application rate was 2 g per kg of feed. Sanolife GUT is a formulation with selected plant extracts and medium chain fatty acids. It is applied with feed at a rate of 2 g per kg of feed. Probiotics or antimicrobial compounds were not applied in control ponds.

Feeding regime

Fish were fed commercial feed (Quality Feed Ltd., and CP Bangladesh Ltd.). Powder feed was used for the nursery diet while sinking and floating pellets were used for the grow-out ponds. Crude protein composition ranged from 26% to 32% in these feeds. The feeding rate was adjusted in 10 day intervals according to calculated total biomass from the average body weight (ABW) and the estimated survival rate. Feeding rate

followed the size range of tilapia (Table 1). Floating feed was supplemented with sinking pellets after the tilapia ABW reached more than 50 g. Fish were fed two rations per day.

Table 1. Feeding rate

Fish size (g)	Feeding rate % of ABW
0.2-5	25 to 12
6-20	12 to 6
21-50	6 to 4
51-100	4 to 3
more than 100	3 to 2.5

The water temperature was between 26 °C to 33 °C. The study was conducted for a period of 157-196 days. After this period, fish were partially harvested from each pond. Total production was calculated on the basis of the partial harvest, ABW and estimated survival rate.

Disease and mortality

In two nursery ponds, tilapia fry did not show any signs of disease and mortality. Survival rates were 70% and 80%, a significant achievement compared to previous production data of that farm.

Tilapia in the grow-out ponds treated with Sanolife PRO-W and those fed a feed mixed with Sanolife PRO-F did not show any signs of disease. Major mortality did not occur in those ponds. However, in one control pond, there was an emergency harvest due to disease and mortality. In another pond (Sanolife PRO-W and Sanolife GUT), there were signs of disease on several occasions, but these sporadic mortalities did not require an emergency harvest. This clearly showed the benefit of the combined application of selected probiotics as a water conditioner and as feed additives to increase tilapia production.

Growth performance

The addition of *Bacillus* probiotics or the natural plant extract formulation in feed increased the ABW by 40-50 g (Figure 1). Probiotics in the water (Sanolife PRO-W) and or in the feed (Sanolife PRO-F) reduced FCR from 1.5 to 1.2 (Figure 2). Better yield was found in all treatments (probiotics in water, feed mixed with probiotics or plant extract formulation) than the control. The maximum yield reached approximately 13.0 tonnes/ha in 180 days in ponds treated with probiotics in water and mixed with feed. In 2012 and 2013, the average production in those ponds was only 9.0 tonnes/ha in the same period of year.

The average farm gate price for 180-200 g tilapia decreased from USD 1.65/kg in 2013 to USD 1.38/kg in 2014. At the same time, the feed cost increased from USD 0.45/kg to USD 0.58/kg. These changes have put more pressure on tilapia producers to improve the production efficiency, such as yield, growth rate and FCR.

Figure 1. Average body weights of tilapia after 180 days in treatment and control ponds.

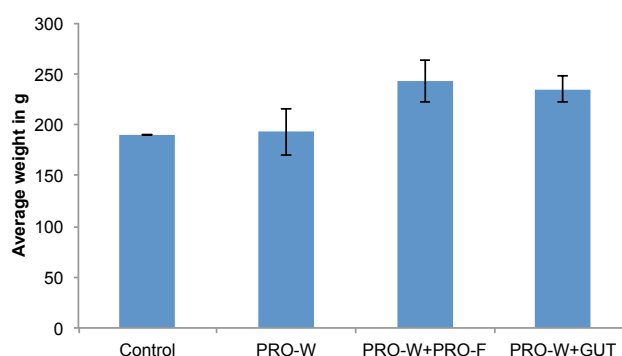


Figure 2. Average FCR of tilapia after 180 days in treatment and control ponds.

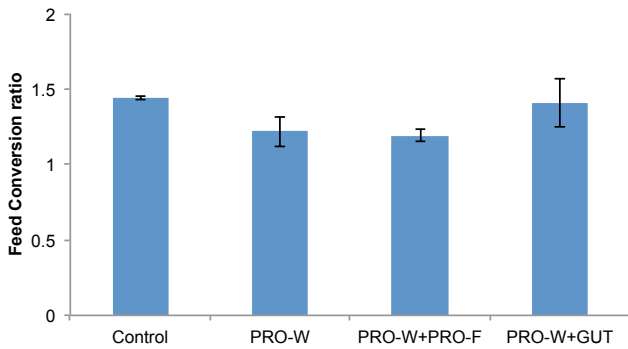
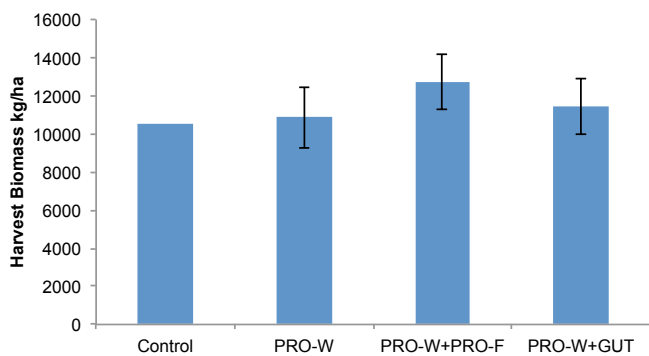


Figure 3. Average biomass of tilapia in ponds in treatment and control ponds.



These results clearly show the beneficial effects of selected *Bacillus* probiotics in preventing disease and mortality, improving FCR, ABW, and increasing yield in tilapia pond culture in Bangladesh.

References

DoF, 2014. Fisheries Statistical Year Book of Bangladesh. Department of Fisheries. Government of Bangladesh, 52 pp.
 Komar, C. 2008. Disease management in Tilapia. Global Aquaculture Advocate. 77-79 p.



Meezanur Rahman



Hasan Uz Zaman

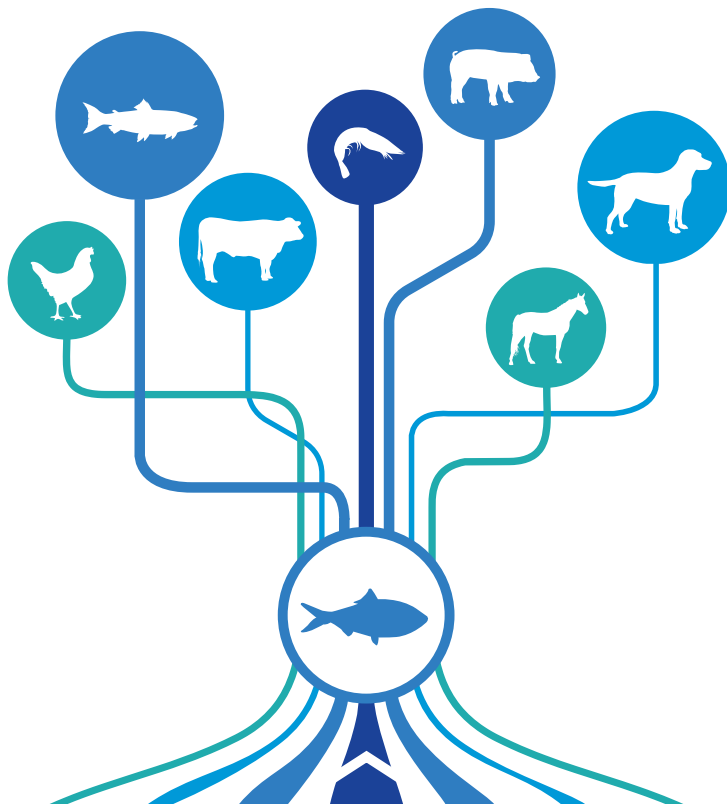


Olivier Decamp

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Micro Aquatic Feeds

By Joseph P. Kearns

Whether it is using cooking or a product densification extruder, the critical step before extrusion is fine grinding and after extrusion is drying.

Micro aquatic feed production is an expanding market to meet the increase in feed demand for feeding early stages in the farming of fish or shrimp. There is a long list of farmed fish and consequently there are many different feed styles. However, floating, sinking (which includes for the shrimp), and slow sinking feeds are generally the main types. This discussion is on micro feed production and I will walk you through the process and describe extrusion cooking based on the process flow of the ingredients.

Raw materials

The different ingredients are prepared in required quantities and sent to the extrusion system. The processes usually involve receiving, weighing, grinding, mixing, metal detection, conveying and addition of micro ingredients. The stream of ingredients undergo a final sifting process, right before the extruding step.

Fine grinding

With regards to micro feed production, grinding is the step which requires most attention. An extruder die will operate when the material fed through it has particles of a maximum size of 1/3 the die opening diameter. Therefore, if the requirement is to run a 0.8 mm die hole, the feed needs to pass 100% through a 250 micron sieve. This is not easy to do and generally, a micro pulveriser is used.

In Table 1, for the sample labelled #1B4 both “pulverised” and “pulverised and sifted” show the results of pulverising with and without sifting. Sifting ensures that the mixed ingredients are of a standard that will allow die passage. This will greatly assist in eliminating die blockage. This is critical when you are trying to make a specific density feed over an extended production run.

Table 1. Comparison of die passage of ground and ground and sifted raw materials

Sample#1B4 Pulverised		Sample#1B4 Pulverised & Sifted	
Micron size	% Through	Micron size	% Through
450	99.8%	450	100.0%
350	99.2%	350	100.0%
250	98.6%	250	100.0%
149	97.8%	149	99.8%
75	77.7%	75	80.8%

Table 1 shows that when ingredients are not sifted there are larger than desired particles even when using a micro pulveriser. This problem can be overcome by an external standalone grinding station placed at the feed mill site.

In a full production setting, all of these would be placed in a production line for continuous use. In either case, the factor to consider is to have a dedicated conveying method to feed the extruder and to minimise large particle contamination when conveying the micro ground feed. The extruder, however, can also be used for products that might not require finely ground raw materials at some point in the production schedule. Separate methods of delivery to the system, for either finely ground or standard grind feed, assure a reduction in production delays.



0.8 mm high fibre micro floating feeds for freshwater fish

We also suggest the use of two rotary sifters in parallel with by-passes. In this way, one is ready for use when the other needs checking or attention. The rotary sifters are positioned directly above the extrusion system. Two sifters keep the line running as this reduces a possible bottleneck when only one sifter is used.

A dedicated line

Firstly, let us review machine installation. The extruder is placed on a floor that allows for wash-down of the extruder. It should be designed where the feed bin, feed screws, preconditioners, down spouts and barrels can be thoroughly cleaned. This is especially critical, when it is not a dedicated line for micro feeds and all elements that can block the die are removed before running micro feeds. The best option, if possible is a dedicated line.

Extrusion of micro feeds

Extrusion of micro feeds is by either one of two methods - extrusion cooked or extrusion at lower temperatures. In either case, the system usually has a loss in weight feed system to accurately channel in the dry feed ingredients into a preconditioner.

This is where the systems vary. First, with the extrusion cooking line, the material enters into a rigorous environment, the preconditioner, for a selected time period to yield a material nearly 45 to 50% cooked (tested by the Modified Glucoamylase Method). However, it is still in a free flowing powder form with about 24 to 35% moisture.

The high moisture contents are needed to pump material through 0.8 mm holes or even finer. Fortunately, preconditioners available today are capable of including elevated levels of liquids and slurries. Also, it is not uncommon to see ground raw protein sources pumped into an extruder as an ingredient. These liquid streams also need to be strained for large potentially die blocking particles. The preconditioners in densification style systems ensure that the exact blend of liquids and dry materials enter the extruder in a flowing fashion.

The extruder barrel

With regard to extruder barrels, single screw extruders are limited as micro feed cooking extruders due to the inherent back flow in these designs. They are engineered for the extrudate to slip over, around and through flow channels in the screws so as to interact with the liners to create friction or heat for the cooking effect imparted into the material passing through the extruder.



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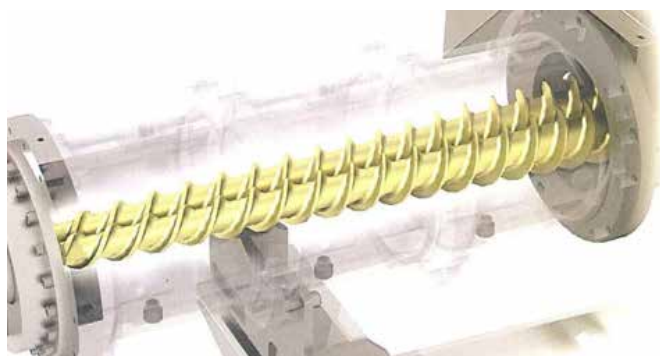
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In micro feed production for all specifications, floating to sinking, the needed positive continuous pumping characteristics when using a twin screw extruder are required. The extruder of choice is therefore one of two styles of twin screw machines available in the market.

There are the traditional twin screw extruders which have the shafts running in parallel over the full length of the shafts, or the conical co-rotating twin screw extruders. The C²TX has two solid screws which intermesh while tapering from start to finish. Both make excellent micro or small diameter feeds. However the advantage of the C²TX is that it does have an extremely positive pumping profile suitable for those very small diameter feeds with elevated rates of production. Aside from the barrel, die design is critical for final product specifications at acceptable production capacities. Knives are also important and need to be designed for the diameter produced.

The next point of debate is with using a pneumatic system directly attached to the end of the extruder surrounding the die and knife area. This will allow for proper extraction from the area in a clean and smooth operation. Besides moving the individual pellets, there is the added benefit of the removal of the flash off steam at the end of an extrusion die and an initial drying of the outer surface before dryer entry.



Conical Co-Rotating Twin Screw Extruder C²TX.

Systems control

With regard to systems control, a L-I-W system feeds into the conditioner while a computer controls injection of the liquids based on a percentage of the dry flow rate. Both steam and water for the preconditioner and extruder barrel and other liquids and slurries can also be easily handled. Motorised valves and flow metres interface with the system, ensuring proper percentages of ingredients are added. The system yields an even pellet in terms of specification measurements, moisture levels and density.

Measuring product quality

In-line product quality measuring devices are available. When these are positioned between the extruder and the dryer, the system can communicate allowing for the extruder conditions to

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The SAS extrusion system

be changed as well as increasing or decreasing the density of the feed automatically. Other functions can also be incorporated into the system. These include moisture readings and visual inspection photos to assure pellet dimensions based on length versus diameter. Extruders equipped with a back pressure valve or a device that permits increasing or decreasing pressure behind the die allows for almost instantaneous response with computer technology incorporated with in-line monitoring systems.

Low temperature extrusion

Lower temperature extrusion does have its followers. The Extrutech Shpere-izer Agglomeration System (SAS) allows for lower temperature extrusion for better retention of vitamins, some pre and probiotics and other additives which are usually destroyed by heat. The system is engineered to make starter aquatic feeds with homogeneous particles as small as 300 microns and potentially smaller. It is complete with a dry feed system at

controlled delivery levels, preconditioning to bring the moisture content up with minimal steam usage or enough to effectively control Salmonella.

The free flowing mix passes through a densification extruder, PDU or Product Densification Unit, belt conveyor and through the Spher-izer™. The PDU is a single screw design with low RPM making this a pumping extruder with low frictional development. Hundreds of product strands are extruded onto a belt which feeds the Sphere-izer. The Sphere-izer breaks up and rounds the strands off into balls of the initial strand diameter. Production capacities vary from 100 kg/hr for 150 micron pellets to nearly 3 tonnes per hour for 1.5 mm product.

The advantages of this SAS style system include the following: all the oil is added internally; low production temperatures; smallest of pellet sizes down to 150 microns; high yield post production sifting; pellets have extremely nice appearance when compared to crumbles, and it is ideal for medicated feeds. The disadvantages are: it can produce only sinking feeds; the product is not pasteurised; relatively low production rates and a dedicated line is required.

In contrast, the direct extrusion of micro feeds has certain specific advantages: the oil can be placed internally; feed is pasteurised; yields are similar and pellets have excellent appearances and good water stability.

Rotary dryers or fluid bed dryers

Notwithstanding which system, the feed needs to be dried before bagging. Typically horizontal dryers are currently limited to drying products 0.8 mm and larger. The recommendation for products below 0.8 mm is either rotary dryers or fluid bed dryers. Neither will depend on a perforated bed to hold the product in place for drying as in horizontal bed dryers.



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Rotary or fluid bed dryers can handle the smaller, under 0.8 mm feed sizes. Hot air and agitation of the system (either rotary, counter balanced weighted or air pressurised systems), convey and dry the pellets as they are transported through the dryer. Micro pellets have very low surface area to mass ratios. Therefore they give off moisture relatively easily when fluidised.

The advantage of the horizontal bed dryers is the flexibility of capacities and diameters they can dry; 0.8 mm and upwards towards 15-20 mm is standard. Larger pellets can also be dried. However, special conditions due to the reverse of a huge mass per surface area changes drying characteristics. The issue with small diameter products is similar to the old question- is the jar full?

Fill a jar with large pebbles, you can see easily the space between the pebbles. Similar to products in a dryer, the space in between is where the air flow picks up moisture for its removal. The same jar with sand instead of pebbles shows there is much less empty space for air to move around each particle. Thus, small diameter feeds are slightly more difficult to dry.

Capacities of extruders on different sized pellets yield a system which is multi-functional. On a given extruder the capacity of large pellets is high and small diameter feeds is usually lower. A large dryer can produce the full capacity of the extruder on large pellets and the same dryer is also generally sized for the maximum production on small diameter pellets even though the rates are less. This is a perfect set up other than being careful on the cleanliness of the system for small diameter production as noted above on die blockage by particles too large to pass.

Need for micro feed production

Having reviewed the production of micro feeds or smaller feeds, let us review the reason why this might be such a hot area of discussion. Firstly, feed equipment manufacturers receive and interpret information as to how feed sizes are determined.

The main factor is the mouth size of small fish. When the pellet is too large the fish cannot eat it. Another factor is the number of fish in the pond or tank. Calculations need to be made so every fish has a chance to eat. In theory the number of fish or shrimp for example, is known when originally stocked but subsequently, estimates on survival and biomass have to be made. A feeding strategy based on a certain amount of feed per biomass is then adopted, for example 3 to 5% of the total biomass per day. The number of feedings per day then dictates the amount per feeding.

Now for some questions: Have you ever weighed 100 pellets to see the number of pellets per kilo? Are you giving enough pellets for each and every fish or shrimp to have a chance at each feeding? Most definitely the feed diameter will have an effect on the number of pellets per kilo. It is believed that the size of pellets does have an effect on the size variance of fish when a pond is harvested.

Summarising, there are many aspects to consider in aquatic feed production. New novel ingredients from both terrestrial marine and vegetable sources, feed additives, diameter and pellet size requirements, semi moist feeds, pasteurised with elevated temperatures or low temperature production methods are just a few of the areas that are under scrutiny now. Soon we will be able to answer more and have a full understanding of the feed and animal relationship. Work will continue and advancements made in this arena will continue with developments in the science of extrusion for all aquatic feeds.



Joseph P. Kearns is vice president- Aquafeed Division, Wenger Manufacturing, Inc based in Sabetha, Kansas, USA. Email: jkearns@wenger.com



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A highly digestible, environmentally and economically sustainable single cell protein recycled from food and beverage nutrients is available in the market since 2014.

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With high protein content and a favourable amino acid profile, the single cell protein is heat treated to assure food safety and is processed under food grade conditions. Low moisture levels result in a longer shelf life, and significant cost savings. Produced daily for freshness, the product has a mild flavour and is highly palatable to animals of all types. Quality attributes of the product are favourable amino acids profiles, low microbiological activity, low heavy metals content, pesticide and mycotoxin free, undetectable histamine level, long shelf life and highly palatable to animals.

The single cell protein contains at least 55% crude protein, 4% oil, 17% NFE, 12% ash and 4% moisture. It is highly digestible, with amino acid digestibility ranging from 88-98% (NOVUS IDEA in vivo digestibility). The single cell protein is an environmentally and economically sustainable source of premium protein and is also a cost effective alternative to other plant and animal sources of protein.



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The Nutrinsic process involves modifying biological conditions in existing wastewater systems to favour the growth of protein producing bacteria that are safe, non-genetically modified and are native to the system. The process decreases GHG (greenhouse gas) emissions relative to traditional water treatment. The company then harvests these bacteria in a straightforward process of concentration, drying and sterilising to produce a single cell protein for inclusion in animal feeds.

Single cell protein in shrimp feeds

ProFloc was tested favourably among a variety of aquatic and terrestrial animal species, including Nile tilapia, rainbow trout, Atlantic salmon, vannamei shrimp, piglets and poultry. In the study with vannamei shrimp at the Mariculture Laboratory, Texas A&M Univeristy, USA, growth performance of shrimp fed 8% ProFloc was compared with those fed 8% fish meal. The single cell fed shrimp exhibited higher survival, faster growth and better feed conversion (see table). In a commercial field trial in shrimp ponds in Ecuador, shrimp growth rate was higher by as much as 10% when ProFloc was added into feeds.

Growth performance, survival and FCR in shrimp fed Profloc diets vs fishmeal diets

	8% fishmeal diets	8% Profloc™ diets
Survival	87.50%	91.67 %
Weight gain (7 weeks)	7.62 g	8.23 g
Growth rate	1.52 g/week	1.65 g/week
Total biomass (7 weeks)	1,599 g/m ³	1,786 g/m ³
Feed conversion ratio (FCR)	1.84	1.54

The Nutrinsic process works efficiently on many types of water soluble nutrients. CEO Leo Gingras said, "At Nutrinsic we ask how we can better utilise limited food resources to provide sustainable nutrition for a growing world population.

"ProFloc is an excellent source of high quality protein for animal nutrition applications. It has a favourable amino acid profile, high digestibility, long shelf life, and is highly palatable to animals of all types. It is sustainable and is produced from food and beverage nutrients that would otherwise be lost. It is highly cost effective as it is not subjected to commodity price spikes."

Nutrinsic constructed its first US production facility in Trenton, Ohio (see box). Another facility in China has been operational for over a year and is co-owned by Nutrinsic and other partners in a joint venture.



First US production facility



In May, Nutrinsic announced the grand opening of first US ProFloc™ facility. This production facility is co-located at MillerCoors LLC at their brewery's water reclamation facility in Trenton, Ohio. The facility has a name plate capacity of 5,000 tonnes per year of ProFloc, a high quality, protein ingredient for use in fish and animal nutrition.

"MillerCoors cares deeply about sustainability in all aspects of the brewing process, and believes waste is a resource out of place," said Denise Quinn, MillerCoors Trenton Brewery vice president. "That's why we're proud to partner with Nutrinsic,

to turn what was previously a waste stream into something of value."

MillerCoors Trenton Brewery has been landfill-free since 2009, meaning it reuses or recycles the majority of its waste and sends less than one percent to a landfill. Nutrinsic will work with the Trenton Brewery to turn waste from its water reclamation centre into a protein source for animal feed.

More information: www.nutrinsic.com



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HIGH GROWTH RATES

ProFloc™ outdoor commercial shrimp pond study demonstrated rapid growth rates equal to and better than fishmeal.



Effect of yeast prebiotic on *Vibrio parahaemolyticus* resistance in white shrimp

By Orapint Jintasataporn

Vibrio parahaemolyticus is one of the bacterial pathogens that causes early mortality syndrome (EMS) or acute hepatopancreatic necrosis disease (AHPND) in white shrimp. EMS is a dangerous disease in Asia. Since EMS was reported in China in 2009, it has spread to Vietnam, Malaysia, Thailand and Mexico causing annual losses of more than one billion USD. EMS outbreaks typically occur within the first 30 days after stocking a newly prepared shrimp pond, and mortality can exceed 70%.

The disease is transmitted orally and the bacteria colonise the shrimp's gastrointestinal tract producing a toxin that causes tissue destruction and dysfunction of the shrimp digestive organ known as the hepatopancreas.

The goal of this trial was to evaluate the effect of a prebiotic additive (Yeast Cell Wall, ImmunoWall®, ICC, Brazil) on the juveniles of white shrimp (*Litopenaeus vannamei*) infected by *V. parahaemolyticus*. This prebiotic additive comprises mannan oligosaccharides (MOS), and β 1,3/1,6 glucans. The yeast prebiotic promotes balance and integrity in gut microflora due to its efficiency in agglutinating pathogenic bacteria such as *Salmonella* and *E. coli* and also promotes immune system modulation.

Study details

Healthy white shrimp *L. vannamei* post larvae PL8 were purchased from a commercial hatchery in Chachengsao Province. Prior to

the start of the trial, shrimp was acclimated for 5 days, before distribution to treatment tanks. PL12 were stocked in 100 L glass aquarium at water salinity of 20 ppt. The stocking density of the experimental animals was 180 PL12 shrimp per aquarium (360 individuals (ind)/m²). Feeding frequency was 4 times per day at 07.00, 11.00, 15.00 and 19.00 hr. Duration of the growth trial was 28 days

Feed composition

This is presented in Table 1. The proximate composition of treatment diets such as moisture, protein, lipid, fibre and ash, was analysed as described by AOAC (2000). The treatment diets comprise a standard commercial vannamei shrimp feed and two treatment diets where the prebiotic additive ImmunoWall® was added at 5 kg and 10 kg per tonne of feed respectively.

Stress tolerance tests

At the end of the study, shrimp were transferred to a study tank for tests on stress tolerance to temperature at 35°C and to salinity at 35 ppt, respectively as in Table 2. Each treatment had four replicates and 10 shrimp per replicate. The temperature was continuously increased until 35°C and maintained at this level. Mortality rate was recorded daily for 10 days.

The salinity stress tolerance study was conducted in water at 35 ppt. Shrimp were transferred to the test unit and reared under

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Studies show Immunowall® is effective in drastically reducing mortality in shrimp *Litopenaeus vannamei* submitted to *Vibrio parahaemolyticus* and *Vibrio harveyi*, also improving growth performance and immunity status.

Research conducted at Kasetsart University – Thailand

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Table 1. Experimental diet composition

Materials	Control	0.5% *	1.0%*
Fishmeal, tuna	25	25	25
Shrimp meal	10	10	10
Squid meal	8	8	8
Wheat flour	29.3	28.8	28.3
Soybean meal 45%	10	10	10
ImmunoWall®	0	0.5	1.0
Wheat gluten	12	12	12
Tuna fish oil	0.5	0.5	0.5
Soya oil	0.5	0.5	0.5
Squid liver oil	0.5	0.5	0.5
Soy lecithin	1	1	1
Polymethyl cabamide	0.7	0.7	0.7
Vita-mineral premix	2.5	2.5	2.5
Total	100	100	100
* Yeast prebiotic at 5 kg and 10 kg per tonne of feed respectively.			
Proximate composition by AOAC (2000)			
Moisture (%)	6.82	6.59	6.69
Protein (%)	46.53	46.13	46.58
Lipid (%)	5.11	5.52	5.20
Fibre (%)	1.87	1.95	1.93
Ash (%)	10.91	10.78	10.92
Calcium (%)	2.38	2.35	2.56
Phosphorus (%)	1.37	1.46	1.40
Gross Energy(Kcal/kg)	4,706.53	4,716.68	4,712.31

this condition. Each treatment had three replicates and 15 shrimp per replicate. Mortality rate was recorded daily for 10 days.

Disease challenge

Thirty days after the initial period, the experimental animals in each treatment were transferred to the challenge aquarium and stocked at 20 ind/aquarium. Each treatment was replicated four times. The virulent bacteria, *V. parahaemolyticus*, was introduced by immersion treatment to determine the ability of shrimp to resist against *Vibrio*.

One day before the challenge, *V. parahaemolyticus* was cultivated in nutrient broth with 1.5% sodium chloride (NaCl w/v). Thirty hours after cultivation, the broth was centrifuged to collect the bacteria cell. The pathogens were washed 2-3 times and adjusted to 10¹²CFU/ml before use.

Immersion treatment

The *V. parahaemolyticus* challenge test was carried out by immersion treatment on normal salinity condition (20 ppt) and under high salinity concentration (35 ppt) for a day before the challenge.

Normal water condition

Eighty shrimp from each treatment were randomly collected and transferred to aquaria of 50 L with a water level of 20 L and 20 ppt sea water for normal condition. The challenge test was replicated four times per treatment with 20 shrimp per replicate. Shrimp were challenged by immersion treatment at an infection dose of 1.0-2.9 x 10¹² CFU/ml. Strong aeration was supplied to the water during the challenge duration. Mortality rate was recorded every day for 10 days. *Vibrio* spp. counts were taken from the hepatopancreas of each group after 5 days of challenge by TCBS agar to confirm pathogen contamination and shrimp immunity to defend themselves from bacteria.

Salinity stress condition

For salinity stress condition and challenge by immersion, 45 shrimp from each treatment were transferred to aquaria of 50 L with water level of 20 L and 35 ppt sea water. The challenge test was replicated four times per treatment with 15 shrimp per replicate. Shrimp were challenged by immersion treatment at an infection dose of 3.0-3.5 x 10¹²CFU/ml. Strong aeration was supplied to the water during each challenge duration. Mortality rate was recorded every day for 10 days. *Vibrio* spp. counts were taken from hepatopancreas of each group following the same protocol as described earlier.

The whole study was conducted in a completely randomised design (CRD). Data were analysed by one-way ANOVA (analysis of variance). The Duncan's Multiple Range Test was used to determine the differences between the treatment means. This research was conducted at the Nutrition and Aquafeed Laboratory, Department of Aquaculture, Faculty of Fisheries, Kasetsart University, Bangkok, Thailand.

Mortality rates

The results of temperature and salinity stress tolerance of white shrimp fed different diets are presented in Tables 3 and 4. The results showed that there was no significant difference (p>0.05) on mortality of shrimp after temperature and salinity stress for 10 days. High temperature of 35°C induced mortality during the 4 initial days. After that shrimp can tolerate this high temperature condition. For salinity stress, all shrimp survived under the proposed condition. This implies that shrimp post larvae can adapt their physiology to a high salinity environment.

With regard to the effect of the yeast prebiotic additive on disease resistance of white shrimp by immersion treatment (Table 5 and 6), the results showed significant differences (p<0.05) after being challenged by *V. parahaemolyticus* both under normal and salinity stress conditions. Under normal condition (Table 5), the mortality rate of control group was higher (p<0.05) than the group of shrimp fed yeast prebiotic.

The survival rate after immersion by *V. parahaemolyticus* for ten days under normal condition of 20 ppt salinity was presented. Shrimp fed yeast prebiotic 0.5 - 1.0% exhibited the high survival rate and better than control without yeast prebiotic.

Under 35 ppt stress condition, the mortality of shrimp after the challenge by *V. parahaemolyticus* (Table 6) showed a significant difference (p<0.05). Shrimp fed the additive exhibited lower mortality (p<0.05). The *Vibrio* spp. count from shrimp

Table 3. Percentage of accumulated mortality rate of white shrimp stress test by temperature 35°C.

Day after challenge	Control	ImmunoWall®		P-value
		0.5%	1.0%	
Mortality rate (%)	60.00 ^a	57.50 ^a	47.50 ^a	0.816
Survival rate (%)	40.00 ^a	42.50 ^a	52.50 ^a	0.816
Note: ^{a,b} Values with different superscripts in a row showed significant difference (P < 0.05).				

Table 4. Percentage of accumulated mortality rate of white shrimp salinity stress test at 35 ppt.

Day after challenge	Control	ImmunoWall®		P-value
		0.5%	1.0%	
Mortality rate (%)	0	0	0
Survival rate (%)	100	100	100
Note: Values in each treatment were the same, there was no statistical analysis				

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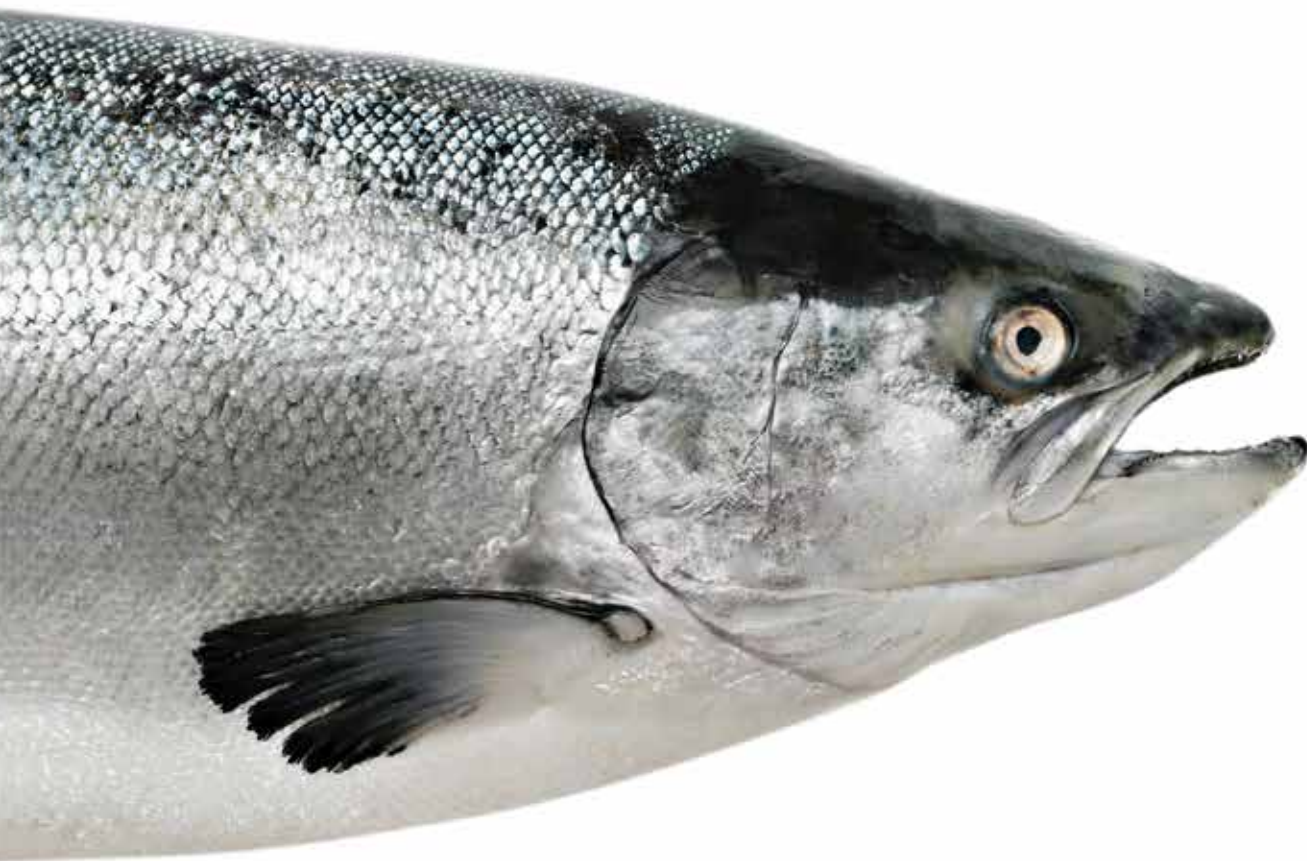


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Table 5. Percentage of accumulated mortality rate of white shrimp challenged by immersion treatment of *V. parahaemolyticus* infected dose 10^{12} CFU/ml at 20 ppt

Day after challenge	Control	ImmunoWall®		P-value
		0.5%	1.0%	
day1	0.0	0.0	0.0	...
day2	6.3 ^a	2.5 ^b	0.0 ^b	0.003
day3	11.3 ^a	6.3 ^b	2.5 ^{bc}	0.001
day4	15.0 ^a	6.3 ^b	5.0 ^b	0.008
day5	18.8 ^a	6.3 ^b	6.3 ^b	0.004
day6	18.8 ^a	6.3 ^b	6.3 ^b	0.007
day7	18.8 ^a	7.5 ^b	6.3 ^b	0.010
day8	18.8 ^a	7.5 ^b	6.3 ^b	0.010
day9	18.8 ^a	7.5 ^b	6.3 ^b	0.010
day10	20.0 ^a	7.5 ^b	6.3 ^b	0.004
Mortality rate(%)	20.0 ^a	7.5 ^b	6.3 ^b	0.004
Vibrio spp. count (CFU/g*)	2.6X10 ^{4a}	3.2 X10 ^{3c}	1.3 X10 ^{3c}	<0.001
Vibrio spp. count (Log CFU/g*)	4.41 ^a	3.50 ^c	3.12 ^d	<0.001

Note: ^{a,b} Values with different superscripts in a row are significantly different ($P < 0.05$). *CFU/g in hepatopancreas after 10 days



Temperature stress test

hepatopancreas after challenge demonstrated that the group of shrimp fed 1% of the additive had better haemolymph ability to defend themselves against virulent bacteria. It was better than shrimp fed the 0.5% additive diets and the control diet, respectively. As *V. parahaemolyticus* is a halophile bacterium, it develops and thrives better in medium to high salinity by enhancing the immune modulation activity of yeast probiotic. This increased the survival of shrimp by 50% compared to control group (Table 6).

The *Vibrio spp.* count from shrimp hepatopancreas after challenge with *V. parahaemolyticus* demonstrated that the group of shrimp fed diets at an inclusion rate of 1% yeast probiotic had improved haemolymph ability to defend themselves against virulent bacteria followed by those fed diets with an inclusion rate of 0.5% yeast probiotic and control, respectively.

Conclusion

In this study, we showed that yeast probiotic was effective in reducing mortality in white shrimp submitted to stress temperature, high salinity and immersion with *V. parahaemolyticus*. The best results were obtained at inclusion levels of yeast probiotic 5 and 10 kg/tonne of feed.

Table 6. Percentage of accumulated mortality rate of white shrimp in a salinity stress test at 35 ppt and challenged by immersion treatment of *V. parahaemolyticus* infected dose 10^{12} CFU/ml.

Day after stress	Control	ImmunoWall®		P-value
		0.5%	1.0%	
day1	51.11 ^a	28.89 ^b	24.44 ^b	0.020
day2	66.67 ^a	42.22 ^b	35.56 ^b	0.020
day3	73.33 ^a	48.89 ^b	40.00 ^{bc}	<0.001
day4	82.22 ^a	53.33 ^b	44.44 ^{bc}	<0.001
day5	86.67 ^a	53.33 ^b	46.67 ^b	<0.001
day6	93.33 ^a	55.56 ^b	48.89 ^b	<0.001
day7	95.56 ^a	55.56 ^b	48.89 ^b	<0.001
day8	95.56 ^a	55.56 ^b	48.89 ^b	<0.001
day9	95.56 ^a	55.56 ^b	48.89 ^b	<0.001
day10	95.56 ^a	55.56 ^b	48.89 ^b	<0.001
Mortality rate(%)	95.56 ^a	55.56 ^b	48.89 ^b	<0.001
Vibrio spp. count (CFU/g*)	9.6 X10 ^{6a}	2.5 X10 ^{6bc}	3.2 X10 ^{5d}	<0.001
Vibrio spp. count (Log CFU/g*)	6.98 ^a	6.38 ^b	5.43 ^d	<0.001

Note: ^{a,b} Values with different superscripts in a row are significantly different ($P < 0.05$). *CFU/g in hepatopancreas after 10 days



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Reduction of super prime fish meal in diets for olive flounder with graded levels of functional hydrolysates

By Mikaël Herault, Vincent Fournier, Sanaz Khosravi and Kyeong-Jun Lee

Supplementation with functional hydrolysates compensated for adverse effects of fish meal reduction but supplementation levels should be adapted to fish meal grades and substitution rates.

Dietary fish meal (FM) replacement by alternative protein sources is now necessary due to shortages in fish meal resources and subsequent increases in costs. However, marine protein substitution is still limited and is impaired by physiological and immune performances in fish. Productivity has been lower, in particular when dealing with carnivorous fish species. Long term studies have demonstrated the benefits associated with dietary supplementation of marine protein hydrolysates (MPH) in fish (Bui et al., 2014; Khosravi et al., 2015). Robert et al. (2014) linked these benefits to the bioactive peptides naturally encrypted in marine co-product native proteins and created by the sophisticated enzymatic hydrolysis. These bioactive peptides may show antioxidative, antimicrobial, immune modulating, hormone like, anti-stress or palatability attributes.

In this context, Khosravi et al. (2014) showed that it was possible to offset most of the adverse effects resulting from a 50% dietary FM (standard grade) substitution in the olive flounder *Paralichthys olivaceus*, when used between 3 and 4% MPH and an addition of soy protein concentrate (SPC) as plant protein source. As it is common knowledge that different grades of FM influence diet performances, a more challenging study was therefore implemented using super prime grade FM. The latter being more of an international reference and recognised as the best FM in class. It will define the optimal MPH dietary supplementation level to compensate reduction of 50% dietary super prime FM. This level should meet the target: optimal zootechnical and immune performances in olive flounder. The fish is an important marine fish species farmed in Korea, Japan and China.

Experimental trials

A unique source of FM (super prime grade) was used to formulate experimental feeds. The control and treatment diets were formulated to be nutritionally balanced and contained similar levels of crude protein, crude fat, gross energy, essential amino



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Table 1. Composition (% of dry matter) and proximate profile (% of product) of experimental diets.

	HFM	LFM	SH 1.5%	SH 3.0%	SH 4.5%	TH 1.5%	TH 3.0%	TH 4.5%
Super prime LT fish meal	46.0	23.0	21.6	20.2	18.8	21.4	19.8	18.2
Soy protein concentrate	5.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Corn gluten meal	6.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Wheat flour	31.5	30.3	30.2	30.1	30	30.4	30.5	30.6
SH (shrimp hydrolysate)	0.0	0.0	1.5	3.0	4.5	0.0	0.0	0.0
TH (tilapia hydrolysate)	0.0	0.0	0.0	0.0	0.0	1.5	3.0	4.5
Others	11.5	15.7	15.7	15.7	15.7	15.7	15.7	15.7
Proximate profile (%)								
Dry matter	91.0	89.9	89.6	89.9	91.3	91.2	89.6	92.0
Crude protein	51.0	50.8	51.0	50.7	51.0	50.8	50.8	51.2
Soluble Nitrogen compounds (<10kda)	7.7	6	6.5	9.4	11	8.6	9.5	8.4
Crude fat	14.2	13.8	13.2	13.5	13.9	13.9	14.0	14.0
Ash	9.7	7.1	7.0	6.7	7.2	6.7	6.9	6.8
Gross energy (MJ/kg)	19.9	20.2	20.3	20.1	20.1	19.8	19.9	19.8
Indicative formula costs (USD/tonne)	1541.4	1206.6	1226.9	1247.2	1267.5	1215.6	1224.7	1233.7

acids and taurine. High fish meal (HFM) diet was used as a positive control and a 50% FM substituted diet as negative control. SPC substituted for fishmeal in the latter control diet. Treatment diets were formulated with SPC and graded levels (0, 1.5, 3.0 and 4.5%) of shrimp hydrolysate (SH) or tilapia hydrolysate (TH) (Table 1).

Hatchery-reared juvenile olive flounder (22.4 g) were randomly distributed into polyvinyl circular tanks at a density of 33 fish/tank. Triplicate groups of fish were fed one of the experimental diets for 10 weeks. At the end of the feeding trial, fish were bulk weighed. Blood was sampled from three fish from each tank for further investigations on innate immune parameters.

Following blood sampling, 12 fish per tank were randomly captured and intraperitoneally injected with *Edwardsiella tarda* suspension ($2 \times 10^{4.7}$ CFU/ml, as defined during the LD50 pre-study). The bacterium, highly pathogenic to flatfish species, was provided by the Department of Aquatic Biomedical Sciences, Jeju National University. Injected fish were distributed into 60 L plastic tanks and their behaviour and mortality were monitored and recorded for 14 days.

Observations on zootechnical performances

We confirmed our past results, demonstrating that high dietary FM substitution had a negative impact on the growth rate of the olive flounder. This was mostly due to a lower feed and protein utilisation (Figure 1a and 1b). The relative feed intake and survival rates were not affected by dietary treatments. All supplemented diets, with the exception of SH 1.5%, resulted in significantly

better zootechnical performances when compared to the LFM group because of better feed and protein utilisation.

Contrary to our previous observations where lower grade FM was used, it was not possible to reach the zootechnical performances exhibited with HFM diet with the hydrolysates supplemented diets. This confirms the critical importance of FM quality into the design and outputs of fish nutritional studies. Indeed, the super prime LT FM used in this study contained a high concentration of soluble fraction, which is rich in low molecular weight nitrogen compounds (peptides, free amino acids and derivatives, nucleotides) which are responsible for palatable, nutritional and health performances of diets. This makes a 50% LT FM replacement more challenging than when using lower FM grades, containing no or low level of solubles. Protein hydrolysates are concentrations of soluble protein, peptides and other small compounds and are ideal candidates for compensating high FM replacement, even included at low dosages. TH appeared to be more performing than SH on olive flounder zootechnical performances in the way that it yielded maximum of its performances at only 1.5% versus 4.5% supplementation rates.

Enhanced resistance to bacterial challenge

At the end of the challenge trial, we observed that the survival rates for HFM and LFM groups were significantly different (77.8 and 27.8% respectively, $p < 0.001$) while graded levels of MPH supplementations resulted in intermediary survival rates (Figure 2). Maximum survival rates were obtained at 4.5% supplementation levels, for both SH and TH (61.1 and 66.7% respectively).

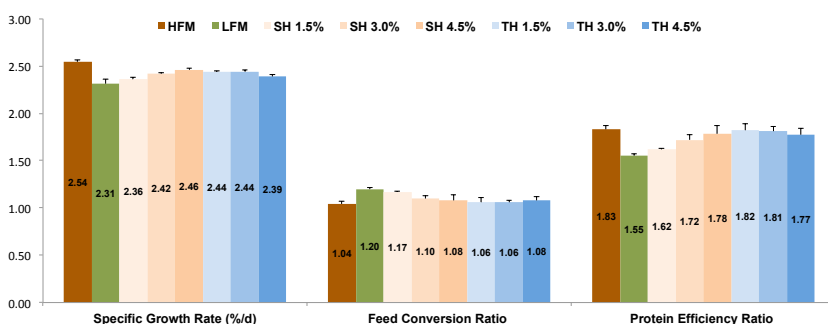


Figure 1a. Zootechnical performances of fish fed the experimental diets for 10 weeks.

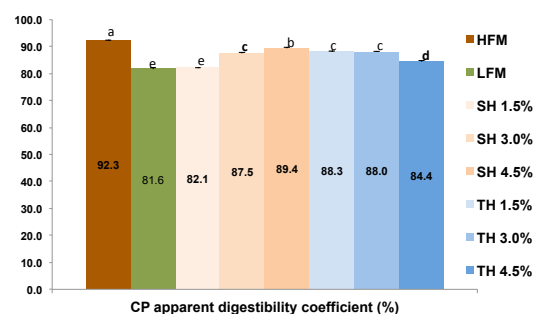


Figure 1b. Feed crude protein digestibility coefficients of fish fed the experimental diets for 10 weeks.



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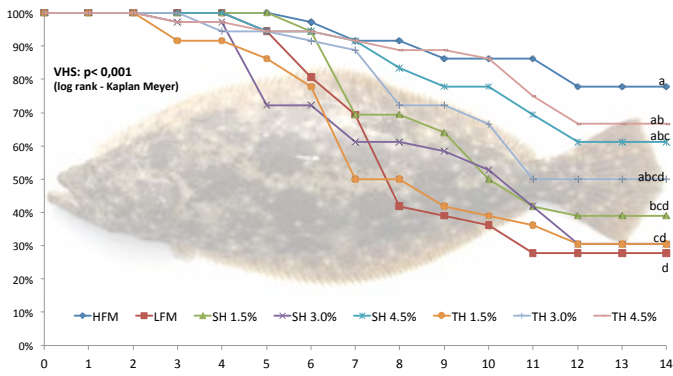


Figure 2. Survival rate kinetics of olive flounder during a challenge with *E. tarda* ($2 \times 10^{4.7}$ CFU/ml)

Differential immune response to supplementations

Fish innate immunity was negatively impacted by the FM substitution. The resulting differences were significant only for NBT, Ig and lysozyme activities but a similar trend was observed for MPO, antiprotease and SOD activities (Figures 3a and 3b). In all cases, fish supplemented with TH or SH expressed enhanced immunity parameters when compared to fish fed the non supplemented LFM diet, giving evidence for the health benefits of dietary hydrolysates supplementation. Fish supplemented with TH expressed higher Ig and lysozyme activity values than the ones fed with HFM diet or SH supplemented diets. There

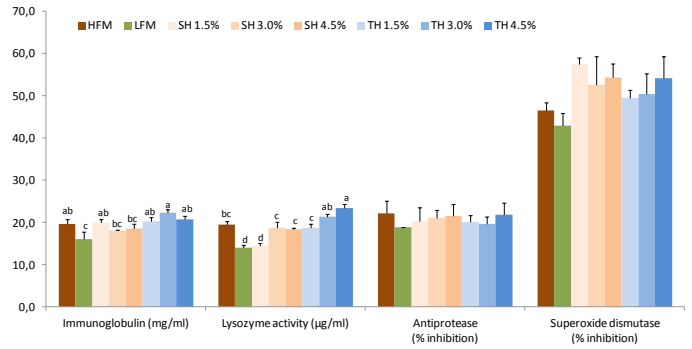


Figure 3a. Non-specific immune parameters of fish fed the experimental diets for 10 weeks.

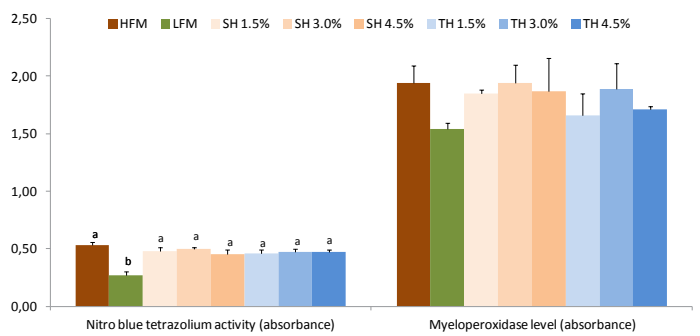


Figure 3b. Non-specific immune parameters of fish fed the experimental diets for 10 weeks.

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was no clear dose response of the supplementation level on fish immune performances, except for the serum lysozyme activity.

Conclusion

This study confirmed the benefits of using marine protein hydrolysates when reducing dietary FM to a large extent in a carnivorous fish species. Even supplemented at low dosage, the high content in bioactive peptides helped in balancing LFM diets and restoring high feed palatability and nutritional performances while enhancing the fish health status.

If Bui et al. (2014) recommended that levels for dietary hydrolysate supplementations would be close to 3% in cases of high replacement of standard grade FM, the present study conducted with a higher grade of FM would lead to higher recommendations. Indeed, it could be appropriate to increase this supplementation level up to 4.5% to reach immune and growth performances close to the HFM diet. Further studies could be conducted to determine more accurately the optimal supplementation levels by testing extensively different FM grades and replacement levels.

References

- Bui HTD, Khosravi S, Fournier V, Herauld M, Lee KJ, 2014. Growth performance, feed utilization, innate immunity, digestibility and disease resistance of juvenile red seabream (*Pagrus major*) fed diets supplemented with protein hydrolysates. *Aquaculture* 418 419: 11-16.
- Khosravi S, Bui H, Rahimnejad S, Herauld M, Fournier V, Jeong J & Lee KJ, 2015. Effect of dietary hydrolysate supplementation on growth performance, non-specific immune response and disease resistance of olive flounder (*Paralichthys olivaceus*) challenged with *Edwardsiella tarda*. *Aquaculture Nutrition* 21, 321-331.

Robert M, Zatylny-Gaudin C, Fournier V, Corre E, Le Corguillé G, Bernay B, Henry J, 2014. Transcriptomic and peptidomic analysis of protein hydrolysates from the white shrimp (*L. vannamei*). *J Biotechnol.*186C: 30-37.



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Dietary protease improves growth performance and size distribution of snakehead fed a low fish meal diet

By Do Thi Thanh Huong, Nicolas Isidori, Herve Lucien-Brun and M. A. Kabir Chowdhury

Better returns to farmers with addition of protease to lower protein diets

A shrinking profitability of pangasius farming in Vietnam has forced many farmers to diversify their operations. Two species, tilapia and common snakehead have appeared to be the species of choice to replace pangasius.

Unlike tilapia, the common snakehead, *Channa striatus* has a wide natural range covering China, South Asia and Southeast Asia. Farming of this species is becoming popular mainly because of the high market value, rapid growth and excellent tolerance to high-density. In nature, the species is a selective insectivore and carnivore, where food items of adults are generally composed of aquatic insects, worms, shrimp and small fish (Amin et al., 2014).

The common snakehead usually requires high protein diets, generally from 35-45% crude protein (CP). In formulated snakehead feeds, the majority of proteins are usually from fishmeal (FM, Abdul-Halim et al., 2014).

In recent years, increasing volatility in the price and supply of FM are forcing feed manufacturers to use more alternative plant and animal protein sources. These alternative sources are often inconsistent in quality, possess anti-nutrients, and have poor nutritional profiles, thus limiting their use in compounded aquaculture feed.

Replacing FM with these sources often resulted in poor growth performance (Abdul-Halim et al., 2014). It can be hypothesised that the use of dietary protease could become a cost-effective solution to improve the availability of proteins and amino acids when replacing a portion of FM with poorly digestible protein sources.

The addition of dietary protease, when partially replacing FM with alternative sources such as cottonseed meal in seabream (Leng et al., 2014), coextruded canola and pea meal in rainbow trout (Drew et al., 2005), and soybean meal in shrimp (Chai et al., 2014) and carps (Leng et al., 2008), has shown significant improvements in performance compared to those fed the same diets without protease.

With its rising economic importance and high percentage of FM in its diets, the common snakehead is deemed to be a suitable candidate to evaluate the effects of protease in low FM diets. This study was undertaken therefore, to evaluate the effects of dietary protease on growth performance and size distribution of the species in a 9-week feeding trial at the Can Tho University of Vietnam.

Treatment diets

For this study, four isoproteic (40% CP) and isoenergetic (15 kJ/g) diets were formulated:

Diet 1 - positive control comprised 40% FM (HF)

Diet 2 - diet 1 with the addition of 175 ppm protease (HF+protease)



Diet 3 - negative control comprised 14% FM with a partial fishmeal replacement with soybean and canola meals for equal amount of crude protein (LF)

Diet 4 - diet 3 with the addition of 175 ppm protease (LF+protease)

Table 1. Ingredients and proximate chemical composition of the test diets and their calculated digestible protein values

Ingredient composition (kg/1000 kg)	Diet 1 (HF)	Diet 2 (HF+protease)	Diet 3 (LF)	Diet 4 (LF+protease)
Fish meal, 55% CP	397.6	397.6	142.0	142.0
Soybean meal, 45% CP	193.7	193.7	461.5	461.5
Rice bran	100.0	100.0	200.0	200.0
Cassava flour	231.4	231.4	23.2	23.2
Canola meal, 38% CP	0.0	0.0	100.0	100.0
Soybean oil-Squid oil blend	38.3	38.3	34.2	34.2
Vitamin-mineral premix	20.0	20.0	20.0	20.0
Shrimp solubles	15.0	15.0	15.0	15.0
Binder	4.0	4.0	4.0	4.0
Protease		0.175		0.175
Proximate composition				
Dry matter, %	92.5	92.1	91.2	91.1
Crude protein, %	39.8	40.1	39.7	39.6
Crude lipid, %	6.7	6.9	6.8	6.9
NFE, %	33.7	32.7	37.0	36.9
Ash, %	12.3	12.5	7.7	7.7
Gross energy (kJ/g)	3.6	3.6	3.7	3.7
Digestible nutrients (calculated)				
Digestible protein, %	37.0	37.3	34.9	34.9
Apparent digestibility coefficient (ADC CP, %)	93.0	93.0	88.0	88.0

The protease was obtained from Jefe Nutrition Inc., Quebec, Canada. Ingredients and proximate composition of the experimental diets are given in Table 1.

Feeding trial

At the beginning of the trial, 100 roughly equal size common snakehead (mean weight of 43.7 g) were stocked in each of the 16 hapas (1000 L). There were four replicates for each of the four treatments. Growth performance parameters were: final body weight (FBW, g), feed conversion ratio (FCR), protein efficiency ratio (PER), survival (SR, %), and size distribution at harvest. Size distribution was measured for four size classes (<90g, 90-100 g, 100-110 g, and >110 g).

Effects on growth and size distribution

There were no differences in feed intake and survival among the treatments. During the experiment, the afternoon water temperature, dissolved oxygen, and pH ranged between 29°C and 30°C, 4.5 and 6.8 mg/L, and 6.8 and 7.0, respectively.

The addition of protease positively affected the performance and size distribution of common snakehead ($P<0.05$). Table 2 shows that final body weight, weight gain, FCR, and PER were significantly different among the treatments ($P<0.05$). There were no differences between the performance of the animals fed Diet 1 (40% FM diet) and those fed Diet 4 (14%FM+protease diet).

Among the treatments, significantly higher percentage of larger size class fish at harvest was observed in the dietary treatments supplemented with protease. The percentage of largest size class (>110 g) increased from 22% in the high FM treatment to 82% in the high FM+protease treatment. Whereas, among the low FM treatments, the >110 g fish increased from 0% to 31% when protease was added to the diet (Figure 1).

Table 2. Growth performance of common snakehead fed high fishmeal (40%FM) and low fishmeal (14% FM) with and without the supplementation of a protease.

Treatments	IBW (g)	FBW (g)	Weight gain (g)	Feed intake (g/fish)	FCR	PER	Survival (%)
Diet 1 HF, 40% FM	43.7 ±0.11	105.7ab ±1.4	62.1ab ±1.4	145.4 ±2.3	2.17bc ±0.02	1.17b ±0.01	0.92 ±0.07
Diet 2 HF+ Protease	43.8 ±0.06	117.4a ±2.9	73.7a ±2.9	141.2 ±0.9	1.76c ±0.07	1.42a ±0.06	0.99 ±0.02
Diet 3 LF, 14% FM	43.8 ±0.15	91.4c ±4.7	47.6c ±4.5	142.1 ±1.7	2.74a ±0.23	0.93c ±0.08	0.97 ±0.03
Diet 4 LF + Protease	43.8 ±0.13	104.8b ±6.2	61.0b ±6.1	142.3 ±2.1	2.20b ±0.20	1.15b ±0.11	0.96 ±0.04
	$P>0.05$	$P<0.001$	$P<0.001$	$P>0.05$	$P<0.001$	$P<0.001$	$P>0.05$

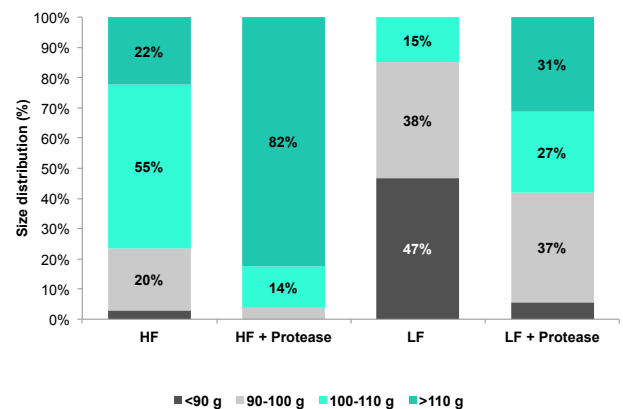


Figure 1. Size distribution of common snakehead in different dietary treatments



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Experimental tanks for digestibility trials at the research facility, Can Tho University

Conclusion

This study shows feeding diets supplemented with a protease can improve the growth performance of common snakehead. Although not significant for the high FM diets, improvement in performance with protease supplementation was evident in fish fed both high and low fishmeal diets. However, protein efficiency ratio was significantly better in both protease-supplemented diets than their respective controls.

Protease allows higher inclusion of poorly digestible low-cost protein sources while replacing or reducing highly digestible proteins bringing significant cost savings without the loss in animal performance. Results of this study indicate that the addition of protease into diets for the snakehead can enhance a low FM diet to achieve better growth performance. In doing so, it could help in significantly reducing the formulation costs.

At the same time, higher percentage of large size fish in both HF+Protease and LF+Protease diets compared to those in HF and LF treatments can provide significant economic gain for the farmers.

References are available on request



Do Thi Thanh Huong



Nicolas Isidori



Herve Lucien-Brun

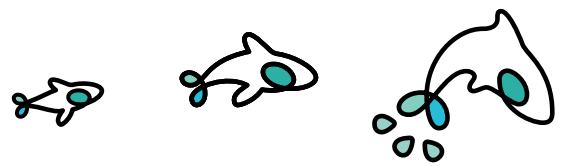


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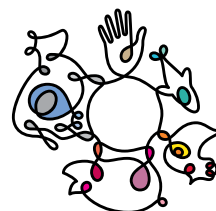
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Zero capture fishmeal in feed for tiger shrimp in Australia

By Sunil Kadri

In response to demand from consumers, retailers and marine conservationists, feed researchers have created the world's first zero capture fishmeal shrimp feed

A new feed developed in Australia represents a new and potentially game changing feed for shrimp farming. It has successfully undergone commercial grow out trials at Australian Prawn Farms in North Queensland, a farm highly regarded as a leader and innovator in Australia's expanding aquaculture industry.

The proof is in the ponds

According to Matt West, general manager of Australian Prawn Farms, their tiger shrimp, *Penaeus monodon* are growing faster and healthier than ever before and have exceptional taste and colour. "Commercial harvests finished in April 2015, with demonstrated growth rates in excess of 1.9 g/week and a farm feed conversion ratio (FCR) of under 1.35," said West, who has been in the industry for over 15 years. West has extensive Australian industry knowledge, and has been an integral part of the Australian Prawn Farm Association (APFA) research and development committee for 5 years. In the last 5 years he was



part of the APFA Executive Board of which he is now president. "The aim of the APFA research committee was to provide input from the industry to help the feed companies develop feeds suitable for both ourselves and our customers: in this case to buffer the rising costs of feed associated with the use of wild-caught fishery resources and to improve feed sustainability."

A close collaboration with industry

This new shrimp feed is the culmination of 8 years of research by Dr Richard Smullen and Dr Matthew Briggs, research scientists

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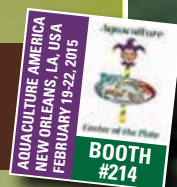
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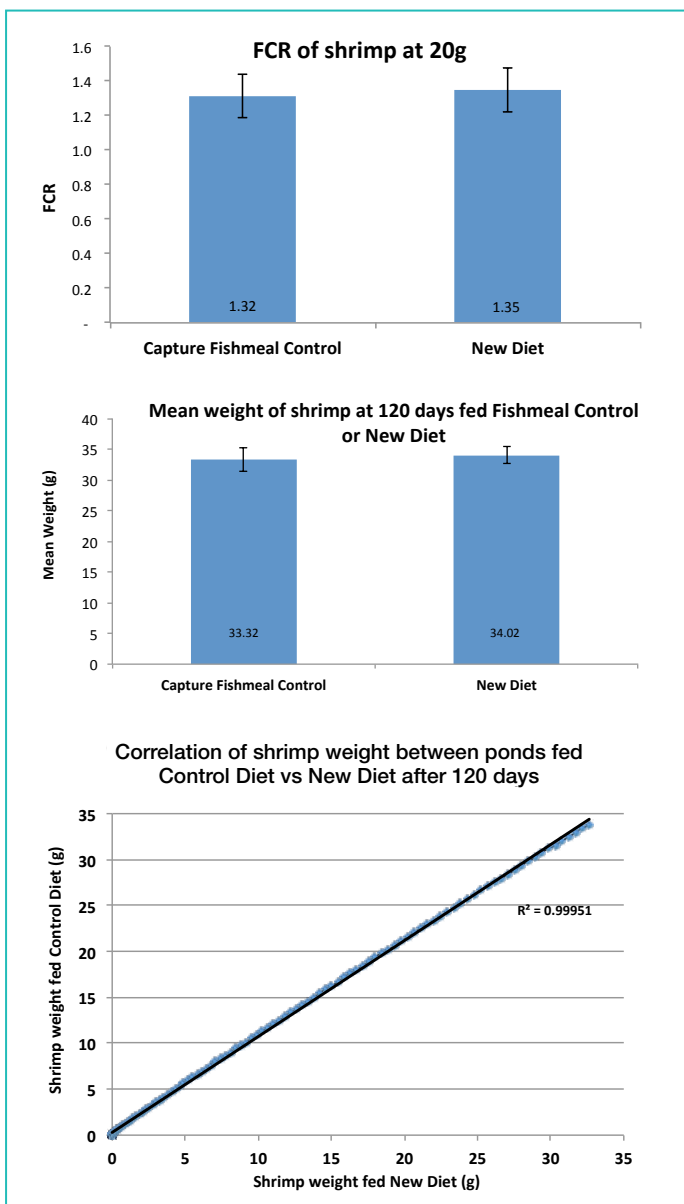
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Matt West

Matthew Briggs

From wild capture fish meal to co-products of high quality fish

This was achieved in part by using co-products from high quality fish, processed primarily for human consumption. These products were sourced from a canned fish supplier as well as the local Sydney Fish Market. Future production could involve using products sourced from Australia's salmon and barramundi processing industries.

"These co-products of human food production have not been used to best advantage to date by the aquaculture industry and this was viewed as a terrible waste of valuable raw materials," said Smullen. "Our aim is to use this excellent raw material source, together with other sustainable raw materials to make a super food for the future of shrimp farming globally".

The majority of the world's fish meal traditionally used in aquaculture feeds is made from sustainably managed, wild caught whole fish, which are trawled from the oceans. However, this raw material is proving very costly for shrimp farmers. Fishmeal has more than doubled in price in the past year, which is a function of its limited supply and increasing demand.

Shrimp and fish buyers and consumers are increasingly aware of dwindling fish stocks and overfishing in many territories and, as such, shrimp and fish farmers have encountered criticism and great pressure to find a more sustainable feed solution. This is particularly true in Australia which is widely regarded as having one of the world's best sustainability practices. This new diet will negate shrimp buyer and consumer sustainability concerns as farmers will no longer have to rely on fishmeal produced from whole wild caught fish.

"This is a win-win for all. Not only does the new diet use zero wild capture fishmeal, it has established a world's best benchmark for growth and food conversion ratio for farmed shrimp of this size. Queensland tiger shrimp fed with 1 kg of Ridley's new

working at Ridley AgriProducts Pty. Ltd., Australia's leading provider of high performance animal nutrition. Smullen is group technical and research and development manager with 17 years of industry experience. Briggs has worked in the shrimp farming industry for 30 years, with commercial, development and research experience from Asia, Latin America and Africa. He is currently project manager for the development of the new microbial biomass product Novacq™.

"Close collaboration with shrimp farms has been essential for the ongoing development of this new feed. Just 4 years ago, we conducted trials on West's farm and revolutionised shrimp feed as a result, creating a diet capable of producing 30g tiger shrimp after only 120 days at FCRs at less than 1.3. This led to the launch of the MR range of shrimp feeds, which has since been adopted by the majority of Australian shrimp farms. However, farmers and the larger Australian shrimp industry community, were not satisfied with this best ever growth performance alone. They set a new goal and challenge for the product development team," said Smullen.

"Our challenge was to take MR, an already sustainable shrimp feed, and totally eliminate dependence on traditional fishmeal made from wild caught fish, thereby obtaining a 'Fish In: Fish Out' (FIFO) ratio of as close to zero as possible, without reducing the growth performance of the feed," said Smullen.



Richard Smullen

“ After extensive research, development and further trials, specific additives were utilised to counter this decrease in performance, ”
- Dr Richard Smullen

diet, containing no whole fish, together with improved farm management, have gained almost a kilogram in weight. The pioneering days of just a decade or so ago when it took nearly 3 kg of whole fish to produce just 1 kg of Australian shrimp are now long gone," said Smullen.

"Achieving this success was not easy though; initial trials proved that simple replacement of regular fishmeal with meal produced from co-products, resulted in greatly reduced growth and an increase in FCR. It was simply not an economical solution for shrimp farms. After extensive research, development and further trials, specific additives were utilised to counter this decrease in performance. The new diet now produces world class growth, FCR and survival."

The new product is the latest in the line of innovative shrimp feeds developed, and the first of Ridley's all new PerformPlus NoCatch range, which will eventually be available for all major species the company manufactures feed for. According to Smullen and Briggs, over the last decade, advances have enabled a 30% increase in growth rates accompanied by increased feeding efficiency and healthier shrimp.

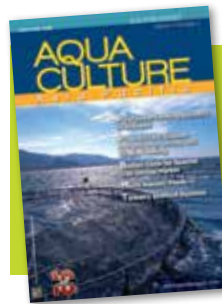
Whilst these feeds are not designed to be the cheapest on the market, they certainly represent the best return on investment to farmers, with production gains and proven healthier stock in the ponds, leading to increased farm profits. Shrimp farmers are very happy with these.

Asia is again trying to catch up and compete head to head with Australian-developed and high performance shrimp feeds. "However", said Briggs, "we are 10 years ahead of their scientists and researchers. Asia is still stuck with a heavy reliance on fishmeal-based feeds with all its attendant problems, such as the use of trash fish."

Ridley's PerformPlus NoCatch for Shrimp will be officially launched at the Australian Prawn and Barramundi Symposium at the Sea World Resort, Gold Coast on 30-31 July (<http://apfa.com.au/events/>).



Dr Sunil Kadri is head of Sales and Business Development at Ridley AgriProducts Pty. Ltd. Email: sunil.kadri@ridley.com.au



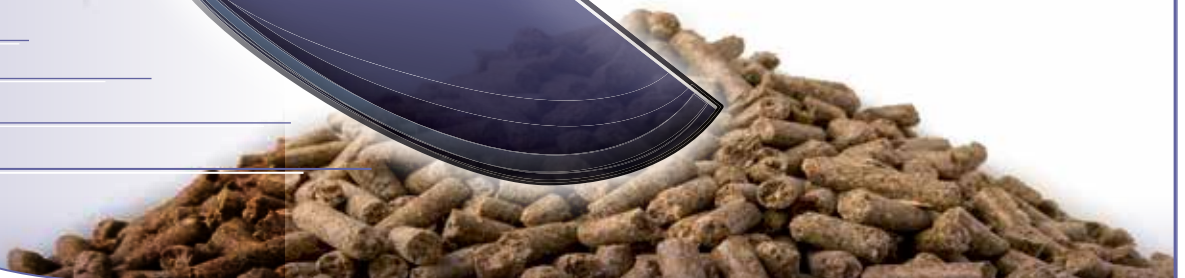
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Aquaculture climate risk and insurance

By Katherine Hawes

The culture stock is the most important insurance interest for farms but the main insurance market fails to adequately provide for their biological risks, particularly when it comes to cover for climate change.

Aquaculture is a relatively new industry that is undergoing rapid growth. Not only does it produce aquatic animals and plants as food for human consumption but there are an additional diverse range of businesses and products which also fall under the heading of aquaculture, including jewellery and crafts, cosmetics, tropical aquarium, baitfish and medical research.

However, despite this diversity, the insurance industry fails to treat the aquaculture industry differently to any other sector. There is also very little choice of policies available with a limited number of insurance companies offering aquaculture underwriting services.

The term **aquaculture insurance** describes fast running insurable interest that would be normally used to protect an aquaculture business operation. For a large aquaculture company this would include insurance protection for buildings and equipment, employees, culture stock, vessels and other insurable interests.

One of the key concepts in insurance law is the idea of an insurable interest. In recent cases, insurable interest has been particularly important in relation to livestock and more specifically aquatic animals and plants under culture. Although within the aquaculture industry this is the most important insurance interest, it does present a few problems when it comes to insurance.

Aquaculture is a new and unconventional industry that fits awkwardly into national legislative frameworks. Too often, its operating framework is designed for agriculture or fisheries. For example, the law in some countries does not actually uphold rights of ownership of fish in fish farms. In these cases, if the ownership of the stock cannot be legally upheld, then it is extremely difficult to insure them! As a result, the lack of legislation in place for aquaculture can also present considerable difficulties for insurers.

Whatever the insurance policy, they usually address the following issues:

- What is insured
- Where it is insured
- What risks it is insured against
- How it is valued

- What the policy-holder should do if a claim occurs
- What general conditions apply

However, the key perils that the owners of aquaculture production operations generally want to insure against are as follows:

- Disease
- Infestations of parasites, predation
- Temperature fluctuations
- Plankton blooms
- Hazards such as drought, storm, flood, earthquake
- Equipment and system failure
- Vandalism
- Manmade pollution

Insurance in the Asia Pacific

Within the Asia Pacific region, the new challenge facing the aquaculture industry is global warming and in particular climate change. Over the past few years, a number of serious disasters and losses in the Asia-Pacific region have caused a real threat on the industry, particularly for small-scale farmers.

Climate change has the potential to create real problems in the future. For example, as global warming takes effect, extreme weather conditions are likely to lead to changes in plankton profiles. There are already indications that this is happening, and many aqua farmers are trying to offset this risk by opening up to new areas to farm including offshore and underwater.

Climate change is now accepted as a real risk and even Lloyd's of London recently issued a call for insurers to begin adding the impacts of climate change and sea level rises into their insurance risk calculations.

Unfortunately, aquaculture is possibly more exposed to the uncertain overall effects of global warming than any other farming sector. There is evidence that weather patterns are changing and some weather phenomena are becoming more extreme. This could lead to increases in sea level and ambient temperatures eliminating some growing areas, while obviously creating opportunities to grow new ones.

“ Management of these risks can be difficult and expensive and minimising climate change risk through insurance does require a specialist underwriting approach. ”



NEXT ISSUE

September/October 2015

Issue focus: Health Monitoring & Disease Management

Industry review: Marine Fish

Feed Safety & Hygiene/Genetics in Fish/Shrimp

Show & distribution: Aquaculture Europe, October 20-23, Rotterdam, Netherlands

China Fisheries and Seafood Expo, November 4-6, Qingdao, China

Deadlines: Articles - July 27, Adverts - August 3

Email: zuridah@aquasiapac.com ; enquiries@aquasiapac.com for details



Within the Asia Pacific region, the new challenge facing the aquaculture industry is global warming and in particular climate change.

Climate change factors may also include the acidification of water, which in turn will alter our oceans ecosystems. This would increase the mortality for shellfish and in some areas, could also lead to a decrease in current fish stocks.

Freshwater aquaculture operations in low-lying coastal areas in the tropics are particularly at risk. These include a river basin flooding from increased rainfall, storm surges, and inundation of seawater from rising sea levels. Fish raised in freshwater aquaculture could be at risk from disease as a result of increased temperatures, low oxygen levels and rising sea levels.

Management of these risks can be difficult and expensive and minimising climate change risk through insurance does require a specialist underwriting approach. The main insurance market can easily manage risks when it comes to offshore aquaculture

equipment etc., but does not adequately provide for biological risks of culture stock, particularly when it comes to cover for climate change.

Moving offshore and underwater may help to mitigate some of the hazards of surface operation from climate change, but undoubtedly it will generate new issues and problems. For example, it may be harder to monitor stock and deal with disease issues underwater; and clearing mortalities may also be more difficult. Going underwater will also generate a significant increase in diving activity, the insurance of which is expensive.

Therefore, it remains to be seen whether any overall reduction of risk will be achieved by moving offshore and underwater. However, on the basis of the industry's evolutionary experience to date, there are bound to be some unpleasant surprises!

In conclusion, the insurance industry still regards aquaculture as a high risk industry and as yet, is unable to insure against climate change.



Katherine Hawes is known as "The Fish Lawyer" for her specialisation in aquaculture, marine and fisheries law. Hawes is the principal of Aquarius Lawyers and on the board of the World Aquaculture Society. With over 20 years' legal and business experience, Katherine's expertise lies in advising and representing organizations and businesses on issues pertaining to the marine environment. Email: khawes@aquariuslawyers.com.au

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2015 Taiwan Fisheries and Seafood Show

In November, Taiwan will have its first trade show on aquaculture, fisheries and seafood, showcasing not only the big boys but ancillary players, to create business opportunities for all stakeholders

The 2015 Taiwan Fisheries and Seafood Show will be held from 19-21 November at the newly completed Kaohsiung Exhibition Centre (KEC) on the waterfront. Kaohsiung is Taiwan's second largest city and is close to the heart of most aquaculture activities along Taiwan's southwest coast and around Pingtung province. The trade will focus on four main areas: fisheries equipment and technology, aquaculture, seafood, and processing equipment, seafood traceability and cold chain logistic systems. The exhibition area will occupy 3,600m² with more than 200 local and international exhibitors expected. Besides unveiling the Taiwanese fishery's complete industry chain, the show provides an excellent platform for opening up business opportunities and market expansion as 12,000 domestic and foreign professional buyers are expected to visit the show.

A complete industry chain

Taiwan's complete industry chain is from fishing and aquaculture, seafood processing and peripheral products to technology and services. The aquatic produce and related products not only satisfy domestic demand but enjoy a high proportion for export with international competitiveness, leading to a solid foundation in the international fishery and aquaculture supply chains.

In May, the organisers, Taiwan External Trade Development Council (TAITRA) and WES Worldwide Expo Services (Wesexpo) arranged for the media to visit selected companies around Kaohsiung. In this issue, AAP reports on the companies involved in seafood processing, aquaculture and biotechnology. The next issue will continue with companies supporting aquaculture with feed, equipment and cages.

Seafood demand

Taiwan's seafood consumers are very discerning, showing preference for high quality seafood and paying increased attention to food safety. Shao Guang-zhao, research fellow at the Biodiversity Research Center of the Academia Sinica, cited a 2010 report conducted by the National Geographic Magazine, pointing out that Taiwan consumes about 790,000 tonnes of aquatic products a year and takes the 12th place in the world. This volume, divided by the national population, gives an average seafood intake per person in Taiwan of 34 kg, which is 1.9 times the global average.

Within Taiwan, aquatic production is gradually decreasing due to high labour costs, climate change and several other factors. Imports have been increasing. According to the Fisheries Agency Council of Agriculture, the total value of imported seafood by Taiwan was USD1.185 billion in 2012 and is still increasing at 7-8% annually. Japan, Thailand, China, USA, Indonesia and Hong Kong lead in exporting mostly high-price items to Taiwan.

**More information: TFSS Secretariat,
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Kaohsiung Exhibition Centre

Seafood and cold chain logistics

Supporting tuna and deep sea fishing

In 1990, Wen-Jiao Chen, CEO, established the **Wen Chi Seafood Company Ltd** to support the Taiwanese fishing fleet, in particular those involved in tuna fishing in the Pacific, Indian and Atlantic oceans and the seas around Taiwan. The fleet, comprising mainly long line fishing vessels, allows the company to focus on high quality products. According to Chen, "We insist on doing business with honesty and integrity in the spirit of sustainability."

As such, aside from implementing a traceability system from raw material to finished product, the company is HACCP certified and also with EU and USFDA. "We preserve the freshness and tastiness of fish at -60°C to prevent bacteria and histamine build-up. The new facilities at Wen Chi, set up in 2013, have top of the line facilities and equipment and the biggest freezer in Taiwan. We are the first in Taiwan to install stainless steel gutters and treatments for discharge water. There is also the anion fatty acids infrared machines, which will allow us to thaw 10 tonnes of fish rapidly without rupturing cells.

"The raw material for processing is from deep sea vessels and fish caught by long line vessels are frozen immediately to conform to international protocols. The fish ranges from tuna, Bluefin tuna, marlin, swordfish, sailfish, sharks, mahi mahi, oil fish etc. On landing, Wen Chi transports them in refrigerated trucks to the plant and processes them at 12°C into various products



At Wen Chi Seafood, Wen-Jiao Chen (third, right) with his team.



Tuna belly from Wen Chi Seafood served at the media lunch.

depending on the species such as cubes, loins for the yellowfin tuna. Export markets include Russia, Europe, Australia and the US," added Chen.

Similar to most processing plants, the laboratory is equipped for the detection of bacterial pathogens such as *E.coli*, *Listeria*, and *Staphylococcus* etc. It outsources tests for heavy metals whilst the metallic detectors in processing follow guidelines set by the major importers. The Department of Hygiene Taiwan conducts checks every 3 months as well as conducts training for staff on analytical methods.

Chen started trading in fish in 1985 at the Donggang Fish market. "I was not happy with the level of hygiene at the markets. I knew that Taiwanese practices have to change if Taiwan wants to compete internationally. In 1990, I began the processing for marlin in the market."

Wen Chi's main markets for its tuna are Japan and USA. On challenges, Chen said, "With the tuna market our challenge is the fluctuations in prices for raw materials. We require 15,000 tonnes of raw material. Japan consumes 80% of tuna from the Pacific and we only send a small volume to China. For us, this market will only develop if the consumption of sashimi increases."

Expanding markets for fish floss

This is quality fish floss from the **Wei-i Foodstuff Co Ltd**, with raw material comprising tuna and marlin from long line caught and salmon from capture fisheries in Alaska. The fishing vessels have EU certification and passed Taiwan's food safety standards.

Fish floss is a traditional food for the young and old in Taiwan. The floss is added to baby porridge and is supplied to schools as part of the country's nutrition program.

"Fish floss is now available in other countries. To expand markets, we attend about 2-3 trade shows outside of Taiwan annually. In Malaysia, we are the OEM for Amway. Outside of Asia, fish floss is gaining popularity such as in Australia where children like it. During the last SIAL exposition in Paris, I received an order from UK, and customers in France and the Netherlands have expressed interest, although they are puzzled why we need to produce fish floss," said Wei-i's chairman Chin-Yin Hsieh.

The recipe for production is simple, with salt, sugar and soya sauce added. Wei-i has two production lines for fish floss, besides one for pork floss and another for vegetarian floss. This is a state-of-the-art facility with controlled temperature and humidity. The factory is HACCP certified with inspected bacterial level of 0-2 CFU/15 min. The quality control process checks for mercury, lead, cadmium, histamine and VBN, following EU regulations. The stainless steel worktops, machinery and drainage at Wei-i were supplied by Kinn Shang Ironworks, operated by Bill Hsieh,



Chin Yin Hsieh, chairman of Wei-i Foodstuff

brother of C-Y Hsieh, who started Wei-i eight years ago in Pingtung Industrial Park.

"Gradually more customers know the product. We had 40% growth in sales in 2014, with more growth in the overseas markets as overseas customers are more serious on quality and willing to pay the higher price. Wei-i's fish floss is sold at NTD 280/300g in comparison to a competitor's NTD 130/300g. More of the younger generation are buying the product," added Hsieh.

Cold chain logistics from farm to market

The **Industrial Technology Research Institute (ITRI)** is a non-profit R&D institute founded in 1973. Its role is to lead in the development of emerging hi-tech industries to enhance the global competitiveness of Taiwan's exports. ITRI has played a vital role in Taiwan's economic growth as it shifts from its focus from labour-intensive to a value-added, technology-driven one.

Dr Yun-Wei Hung at Service Systems Technology Centre explained how ITRI has been working on total cold chain logistics solutions to support industry supply chain development. ITRI is implementing on behalf of the Department of Commerce, Ministry of Economic Affairs in Taiwan the project "Development and Promotion of International Cold Chain Logistics Services". The objective of this project is to improve the service quality of Taiwan's cold chain logistics industry and promote their application globally. This project encompasses aspects on cold chain quality control, hardware and software development. It has a pilot cold chain project with aquaculture farmers in Taiwan to strengthen supply chain management in 2014.



Dr Yun-Wei Hung, ITRI

"The target is to move from current practices where aquaculture harvests are delivered by brokers to wet markets, so as to control temperature immediately after harvesting and enable direct sales by the farmers. The farmer has worked hard to achieve good quality harvests in the ponds and our role is to develop good technology to maintain freshness and market perfect quality fish/shrimp for the consumer. As it takes 8 hours to deliver fresh fish/shrimp over 200km, cold chain logistics is essential to sustain freshness," said Hung.

Aquaculture and biotechnology

Branding Taiwan grouper and cobia

A recent trend in Taiwan is fish farming in an eco-friendly way and packaging fish for a new generation of customers. This trend is among the objectives motivating a couple of teams of young entrepreneurs.

One such team is **Lijia Green Energy Biotechnology Co Ltd** which has a hatchery and ponds to farm the grouper. Harvests are sold as live, fresh and vacuum packed whole gutted fish.

This packaging is a new development according to brand manager Alice Chen. "The Taiwanese grouper is sought after for its taste and texture. We transport fish live to the processing plant, descale, remove gills and viscera and use the most advanced low-temperature preservation technology to rapidly freeze at -70°C . This rapid freezing and vacuum-packed can protect against oxidation. Each fish has an ID card with a QR code giving the origin of the farm. Consumers need to only defrost under running water and cook."

The team has a long way to go as presently consumer preference is still for live or fresh whole grouper, said Chen. "Only 20% of production is frozen of which 50% is sent to China. The balance is live fish and we export 90% of this to China and Hong Kong. The most popular size is 600g."

The company produces three species of grouper: orange spotted *Epinephelus coioides*, giant grouper *E. lanceolatus* and the giant and tiger grouper *E. fuscoguttatus* hybrid. In Taiwan, the market size of orange spotted grouper is 2kg and ex-farm price is NTD300/kg. The giant grouper takes three years to reach the market size of 20kg. Market size for the hybrid grouper is 4-5kg. The ex-farm price for both giant and hybrid groupers was NTD350/kg in May.

Everspring Marine Aquaculture Co Ltd farms cobia *Rachycentron canadum* in offshore cages off Pingtung district. Other farming areas for the cobia are off Siao Liouciou island and Penghu islands. The farming cycle includes land based hatchery production of fry and fingerlings and cage culture in an area of 20ha. The area is ideal with a current speed of 2 knots.



Alice Chen (right) and Leo Huang (second right) and colleagues with vacuum packed products such as vacuum packed groupers with the QR code and grouper prepared for shabu-shabu, sold at NTD350/100g.



Jeffrey Liu (left) with Stone Chen, editor and publisher of the Taiwanese aquaculture magazine *Fish World*

"We have developed a few kinds of reusable insulated containers which can carry more than 60 litres of fish/shrimp. Cooling is with eutectic plates which can go down to -15°C and last 12 to 24 hours. This benefits the farmer as he can carry the produce in boxes to the markets. In the case of a shrimp farmer, he can sell his shrimp direct to consumers at NTD 300/600g (USD 16.6/kg), instead of through distributors."

From micro feeds production to food safety

Jeffrey Liu is now taking **Hai Yu Enterprises** downstream into the marketing of quality seafood. In May, Liu said that Hai Yu is now "All About Aquaculture (A.A.A)."

Hai Yu's entry into aquaculture 40 years ago was with micro particulate feeds for the marine shrimp. This has now changed and Hai Yu has shifted focus to market these hatchery feeds to the region's marine shrimp producers such as Vietnam and Indonesia. In 1988, Hai Yu developed the black granule GUDA for the king or giant grouper *Epinephelus lanceolatus*, a leading high value marine fish in Taiwan. Today, it also has feeds for the abalone and crab. These are manufactured in Pingtung province.

According to Liu, "Our breakthrough in 2011 was the development of micro feeds from as small as 950 nm using trans-micron technology. The average sizes are 2μ to 8μ . The open mouth stage for the king grouper is only 8μ to 10μ . These feeds are used after the yolk sac stage which lasts for 72 hours. I know that in the industry, the smallest feed size is 20μ , available from a Belgium company and the rest is around 30μ . In 2012, we then developed a whole range of feeds for this grouper."

Hai Yu's second business is the manufacture of equipment for aquaculture such as the NINS system (negative ion nozzle system) for aeration in hatcheries and ponds, as well as in live transport in tanks to generate a high level of oxygenation. It also markets geo-membrance portable and durable options for tanks.

"Our third business is the marketing of supreme quality seafood, 'Trusty and Tasty' (TT™). This came about because here in Taiwan, we have been facing serious food safety issues. Hai Yu's contribution is to provide safe seafood by working with the farmer to follow our method, the '5N' in fish production. These have no antibiotics, toxicants, chemicals, pesticides and radioactive contaminants. Our consumers of high value fish appreciate this. Lastly in 2014, we began to work more on B to C marketing."

Aside from all these, Hai Yu as part of the Fish Breeding Association, is also participating in projects in Kuwait, Bahrain and Oman. One is to develop a pilot indoor recirculation system for the production of the green or orange spotted grouper *E. coioides*. The project is a 100% Taiwanese venture.



Vacuum packed whole gutted grouper

The fingerlings are held in nursery ponds of 1-1.5m deep and are transferred to cages at 200-300g. It takes 1-1.5 years to produce 5-6 kg fish.

“There are 30 cages of 12m, 16m, 20m and 30m in diameter sizes to produce 700 tonnes of the cobia. In the future, we expect to add a further 10 cages. Because of its fast growth rate, the cobia has a large potential. We also farm the pompano *Trachinotus blochii*. We sell the fish live, frozen and fresh in supermarkets and local fish markets. The demand is for cobia more than 6kg and is sold from USD10/kg,” said Leo Huang, assistant manager, Marketing at Everspring. (see cover picture)

“We used the sell cobia to Japan but stopped because of the increase in volumes of the kampachi (greater amberjack) and unfavourable rates of exchange. We hope to resume sales to Japan. The Japanese usually prefer fish of 5-6kg. We market frozen cobia to China by working with Lijia. Although China produces its own cobia, there is a value for the Taiwanese cobia because of concerns on food safety and use of antibiotics in China marine fish production.”

At the Taiwan Seafood show, the focus of the team will be to find new markets for their value added and vacuum packed ready-to-cook fish.

Probiotics from recycled waste

Fortune Life Enterprises Co Ltd is introducing its BUIK probiotics systems at the 2015 Taiwan Fisheries and Seafood Expo. The company was established in 1979, marketing sashimi grade tilapia, yellowfin tuna and grouper. Owner Frank CH Tsai sees the company's future prospects in biotechnology, producing probiotics to revive aquaculture and agriculture.

The BUIK system recycles organic wastes such as vegetable and fish wastes through a fermentation process into probiotic feed or fertilisers, branded as FSE. The machinery for this process is fully automatic. The ingredients are added, followed by a selection of 50 bacteria for the fermentation process of 6 hours at 70°C to 75°C. After sieving out bones etc, the stable product, in the case of aquaculture, can be used in fish feeds. It is high in nutrients such as amino acids and oils. The agricultural applications are as fertilizers in the production of basil with larger leaves and in livestock, resulting in better quality chicken meat and higher survival rates, and low cholesterol eggs.

“In aquaculture, FSE stabilises water quality in terms of pH, nitrites, ammonia and dissolved oxygen in ponds. We can increase the survival rate and improve flesh quality of Taiwan tilapia. In the case of the giant grouper, it increases growth performance and reduces the accumulation of fat. In a comparison of feeds with



Frank C.H Tsai (left) with his two sons (right) Terry, in charge of trading and Jerry (centre), Sales manager, with the range of feed supplemented with FSE probiotics.

FSE and control (commercial feeds), we showed that weight gain was significantly higher at 222.31% as compared to 219.57% in the control. In the giant grouper, we also saw improvement in intestinal health via increases in villi length,” said Tsai.

The feed additive is added at 3%, depending on the type of feed. The bacterial selection comprising gram positive and negative bacteria originated from Japan and Fortune Life has the rights to use this in Taiwan. Taiwan is the second country to use this system. Currently, Fortune Life is working with two feed millers in Taiwan to produce feeds supplemented with the probiotics.

“The Japanese group will be expanding this system to Vietnam where they intend to work on a government to government basis. This means that we will send the machine, which we have the licence to manufacture, to Vietnam.”

At the same time, Tsai sees all these development as beneficial for his seafood processing business. Tsai is chairman of the Taiwan Tilapia Alliance. He also has a vannamei shrimp farm in Thailand.

“We co-operate with tilapia farmers to use feed with the probiotics and then buy the fish. This helps with the supplies of raw materials for my seafood processing business. With the decline in capture fisheries, this is a good solution to obtaining quality fish. We tested the feed three years ago and started farming with this feed two years ago. In Taiwan, farmers in Pingtung have reported problems with yellow flesh with giant groupers fed on commercial feeds. This feed is a solution.”



Cobia steaks from Everspring



The BULK system includes a fermentation process of 6 hours at 70-75°C, drying and extruder for pellets with 10% moisture.



The SynbioTech team, from left, Jin-Seng Lin and Tien-Ken Hsu with Lisa Chen, Marketing specialist, Wen-Shiaw Lan, Overseas Affairs manager and Chuan-Hsien Yang, RD/Technical specialist.

Better probiotics, better business

Taiwan's **SYNBIO Tech Inc** has been active at regional and international trade shows to demonstrate its presence in the probiotics business. In 2014, it was nominated the Aquafeed.com award at VICTAM Asia. This is an achievement for this newly established biotechnology company. Since its set up in 2000, the company has made fast inroads into the probiotics business in aquaculture aside from that for animal production and for human health. Associated centres are in China; Synbiotech Biotechnology in Nanjing involved in the yogurt business and SYNLAB Biotechnology Beijing, formed in 2003, which distributes and markets probiotics for the aquaculture and livestock business. The headquarters is in the Kaohsiung Science Park. The company tag line is "Better probiotics, better life".

Tien-Ken Hsu, general manager of SynbioTech, said that its most valuable asset is the lactic acid bacteria culture bank with over 2,000 strains, the basis for product development for pre- and probiotics. "Core to our success is the R&D by our young team of researchers and microbiologists, established analytical platforms for cell culture and strain identification, and state of the art laboratory equipment and production technology. We are ISO22000, HACCP, FGMP and Halal certified."

The aqua probiotics under the SYNLAB range is based on *Pediococcus pentosaceus* (PP4012) and various *Lactobacillus sp* and *Bacillus subtilis*. Jin-Seng Lin, director of Culture Collection and Research Institute, explained the origin of these bacteria.

"We worked with Dr Hung-Hsi Hu, National Penghu University of Science and Technology and Dr Shau-Chi Chi, National Taiwan University. With intensive aqua systems, and increasing threats of environmental pollution and diseases, they needed solutions to improve on immune systems of fish and balance micro flora in the gut. Dr Hu isolated the bacteria from 343 bacterial isolates from adult 3-day fasted cobia *Rachycentron canadum*. This unique strain was selected to inhibit the growth of *Photobacterium damsela*, the causative agent of photobacteriosis in cobia. It also enhances the immunity, growth rate and survival rate."

The research to determine the efficacy of this probiotic product was conducted with cobia in a two week feeding trial. Results showed that this duration was sufficient to elevate fish growth by 12% and a body weight increase of 14%. Survival rate improved in a challenge test. The supplementation of the probiotic with commercial feed was shown to compensate for antibiotics in disease control and its application with or without vaccination would be beneficial in protecting the cobia against

photobacteriosis in large-scale cobia farming (C-F Xing et al, 2013).

The bacterial count in the probiotic product is 10^8 CFU/g and one kg is added per tonne of feed. According to Lin, the company has carried trials to determine its efficacy in sea bass, grouper and white shrimp. Some results indicated 10% increase in body weight for shrimp leading to a shorter growth cycle. Feed efficiency was 10% higher in the sea bass.

On whether the product can inhibit the *Vibrio parahaemolyticus* strain causing EMS, Lin said, "Our in-vitro research with Vp showed that this is possible but as we are in Taiwan, we do not have the strain causing EMS. We have tested against EMS in Vietnam in the field but at this moment, we can only show some improvement in the immune system."

The other product for aquaculture is pond probiotics called AquaClean. This comprises *Pediococcus pentosaceus*, *Lactobacillus fermentum*, *L. rhamnosus*, *L. paracasei* and *B. subtilis*. The total bacterial count is 10^{10} CFU/g and one kg is added to 10,000m³ of water (0.1 ppm). Trials indicated a reduction in the concentration of ammonia nitrogen and nitrite in milkfish ponds.

"We see aquaculture as a potential industry for our probiotics and especially in South East Asia. We have been working on product development for aquaculture since 2013. We have already reached full capacity of 40 tonnes per year and will need to expand capacity in 2015. Also in 2015, we will expand into markets in Indonesia and Thailand," said Hsu.

Next issue: Supporting industries: from feeds to cages



Fermenters at Synbio Tech.

Push for international collaboration in aquaculture

At its annual Seafood Expo news conference in Brussels on April 23, GLOBALG.A.P. presented updates on a number of initiatives in international collaboration in aquaculture, including efforts to reduce duplication in audits, Version 5 aquaculture standards, as well as new certification awards.

Within the framework of the MoU with the Aquaculture Stewardship Council (ASC) and Best Aquaculture Practices (BAP), the two other leading aquaculture certification programs, GlobalGAP has supported the collaboration on drafting and agreeing combined checklists for farms that seek more than one certification.

Pilot to streamline joint audits

Kristian Moeller, CEO said, "The three leading aquaculture certification programs, ASC, BAP and GlobalGAP are following up on a commitment made two years ago on reducing costs of adopting standards and avoiding duplication where necessary. We have now drafted and agreed on combined checklists for farms that seek more than one certification. This fits well into the increasing demand by retailers such as those in Germany which require ASC besides GlobalGAP certifications."

He added that the farmer will decide on the sets of criteria. This minimises duplication of audit points between schemes and will comprise all the audit points of one standard, supplemented by specific add-on clauses for the other standard(s). If a farm proves to be compliant with the schemes' standards it may be able to gain two certificates (or later even three) through this process.

"The pilot on combined audits for ASC and GlobalGAP covering shrimp, salmon and pangasius, and for ASC and GAA covering pangasius, started in May and if successful they can lead to farms obtaining multiple certificates. Other species are likely to be considered after the pilots have been evaluated. The three organisations will continue to retain their independence while striving to offer further synergies wherever possible."

Revision Version 5 aquaculture standard

Valeska Weymann, senior expert and GlobalGAP's technical key account manager for aquaculture said that the second round of public consultations for the Version 5 aquaculture standard has been completed. This new version enhances aspects on animal welfare and social responsibility. It also includes a voluntary add-on for compound feed manufacturers for responsible operations, which defines criteria for the identification of actions to be taken on key sustainability risks including labour, environment and sourcing of raw materials.

Partnership with Friend of the Sea

GlobalGAP entered into a partnership with Friend of the Sea (FOS) with the aim to reduce duplication, push innovation and drive down audit costs for farms. Paolo Bray, director and founder of FOS announced that, the Croatian aquaculture leader,

Cromaris, a specialist in the farming and processing of sea bass, sea bream and shellfish, is the first company authorised to use the FOS logo in combination with the GlobalGAP number. The assessment audit, run by DNV GL, found Cromaris compliant with the GlobalGAP Aquaculture Version 4 and the four criteria defined in the FOS add-on. These criteria cover the impact on water body sediment, the effect on the local community regarding access to drinking water and fishing areas, and social criteria required by GRASP (GlobalGAP Risk Assessment on Social Practice).

New certifications

Moeller announced that the National Aquaculture Group (NAQUA) is the first company in Saudi Arabia to achieve GlobalGAP aquaculture (shrimp & fish) and compound feed manufacturing certifications for its barramundi and white shrimp *Litopenaeus vannamei* production.

NAQUA is one of the largest integrated desert coastal companies in global marine aquaculture systems, with over 2,500 employees in the group and an expected production capacity of 35,000 tonnes of shrimp and 100,000 tonnes of fish.

Open Blue Sea Farms which farms cobia in submerged cages 12 miles off the Panama coast also received GlobalGAP certification. Chris Perry, CFO stressed that in the future he would like to see cobia on the list of species. "Our platform and innovation concepts are in-line with a focus on sustainability and ecological impact. We are very focused on social responsibility and provide funding for local communities and scholarships to start an educational cycle in aquaculture."

On 18 August 2015, GlobalGAP aquaculture certified producers will share their experiences of the certification process and how its aquaculture certification has benefited their production processes and their overall businesses at TOUR 2015 in Puerto Varas, Chile, organised by DNV GL and focusing on aquaculture. More information can be accessed through the link: www.globalgap.org



Kristian Moeller, (right) with from left to right, Ivan Gligora, processing manager and Renato Barić, head of research and development, Cromaris, Ketil Djonne, vice president, European affairs, group communications, DNV GL, Goran Markulin, CEO, Cromaris, Emanuele Callipo, lead auditor, DNV GL, and Paolo Bray, director, Friend of the Sea.

Technical booklet on Feed Ingredients in Aquaculture



The ARRAINA partners have announced the publication of the first of three technical booklets proposed to illustrate the project benefits and facilitate user access to research. This important resource is titled “Feed Ingredients in Aquaculture” and contains a database of

aquaculture feed ingredients covering the nutrient composition, functional properties and their effects on feed processing conditions and the physical quality of extruded pellets.

This booklet is within the framework of the EU FP7 project ARRAINA (Advanced Research Initiatives for Nutrition and Aquaculture). The aim is to make these booklets widely available to both targeted stakeholders and society in general, in order to raise awareness on the science based knowledge supporting the development of high-quality, safe and environmentally sustainable aquaculture feeds.

This booklet is specifically aimed at aquaculture feed producers, but also targets other industrial segments (e.g. fish farmers, feed additives companies, retailers) and individuals interested in gaining further knowledge on the raw materials that are currently used in the feeds of farmed fish. It is composed of a database of key ingredients used in aquaculture feeds and focuses on their nutrient composition, functional properties and their effects on feed processing conditions and physical quality of extruded pellets.

The inspiration behind the development of this booklet was to provide a user friendly resource for aquaculture feed producers which would allow them to understand at a glance the different properties of specific feed ingredients for aquaculture. The information provided in this booklet could serve as common ground for more clear and transparent communication across the aquaculture production chain (farmer, feed producer/retail) and address some unfounded fears and barriers.

The booklet can be downloaded from the ARRAINA website, www.rraina.eu

For more information, project coordinator, Sadasivam Kaushik (kaushik@st-pee.inra.fr) or the project manager, Heloise Simonson (Heloise.Simonson@paris.inra.fr).

Tech Center celebrates 50th anniversary



2015 marks the 50th anniversary for the Wenger Technical Center, and a recent accreditation from the International Accreditation Service (IAS) for Testing Laboratories brings even more to the celebration. According to accreditation documents, the Wenger Tech Center has met the requirements for a number of

American Association of Cereal Chemists (AACC) and American Society of Agricultural and Biological Engineers (ASABE) standards, including accredited tests for moisture measurement, starch gelatinization analysis, phase transition analysis, and rapid viscosity analysis.

“This is just further verification of our ability to test and analyse anything from breakfast cereal and pet food to aquatic feed and textured vegetable protein products,” said Rhonni Mitchell, Tech Center Laboratory technician. “We have a wide range of testing equipment to aid us in analysing raw materials and finished products, as well as nearly two dozen test procedures we can run within the lab.”

Founded in 1965 as a research plant in which Wenger could demonstrate its equipment and develop new processes, the Wenger Technical Center has grown into a world-class facility for research and development. In 1985, the Wenger Technical Center

was acclaimed as the most complete and largest extrusion research lab in the food and grain processing industries. Equipped with the latest in research and production scale extrusion and drying equipment, the center can assist with a wide range of services, including demonstrations, product planning and development, process evaluation and testing and lab analysis.

“Through the Technical Center, we have been able to share what we have learnt as a company over the last 80 years and to help our customers develop new products and processes,” said Lafe Bailey, Co-CEO and president of Sales and Business Development at Wenger. “However, it is not just about hardware and test facilities. We are able to help customers weave their way through the process much faster than they could do it alone. In addition, our technicians assist with the interpretation of results, help track product quality and even help set up the process, transferring technology to the customer’s facility.”

Wenger Manufacturing, Inc., headquartered in Sabetha, Kansas USA, is a global leader in extrusion processing equipment. In addition to 14 sizes of extruders, single and twin screw, the company offers top performing horizontal dryers and toasting ovens, enrobing equipment, and automated control packages. Sales and service personnel operate from offices in Sabetha, Kansas; Kansas City, Missouri; Taiwan; Brasil; Belgium; China; and India. Wenger extension research sites are available at a number of universities and research centers around the world. More information: info@wenger.com/www.wenger.com.

Launch of fast and efficient paddle mixer



Fast, clean, and easy to maintain: the new OptiMix paddle mixer from Andritz Feed Technologies.

International technology Group ANDRITZ has launched a new paddle mixer for feed compounds. It was presented at Victam International trade show in June in Cologne, Germany. The main

benefit of the innovative Andritz OptiMix mixer is the high speed, mixing up to 30 batches per hour, which is three times faster than the previous generation of mixers.

Further advantages are the unique design features, making the mixer as clean and easy to maintain as possible. The OptiMix paddle mixer has a special self-cleaning feature. The rotor changes direction between each batch, ensuring that all surfaces are kept clean by the material being mixed. Furthermore, placing the nozzles directly in the inlet ensures that they are wiped clean as well while each batch is loaded. The paddle mixer was tested and verified by TI (Technological Institute) and MTSE (Micro Tracer Services Europe) and achieved the highest scores possible for mixing quality (mixing probability of > 25% within 75 seconds, equivalent to a coefficient of variation of < 5%).

Andritz is a globally leading supplier of plants, equipment, and services for hydropower stations, the pulp and paper industry, the metalworking and steel industries, and for solid/liquid separation in the municipal and industrial sectors. The publicly listed technology Group is headquartered in Graz, Austria, and has a staff of almost 25,000 employees. It operates over 250 sites worldwide. Andritz Feed Technologies is one of the leading suppliers of systems, equipment, and services for the industrial production of animal feed pellets (pet food, fish, and shrimp feed). More information: www.andritz.com

High yield tilapia coming to the fillet market

GenoMar, the world's premier tilapia breeding company has announced a partnership with Xelect Ltd., a global leader in marker assisted selection to bring higher yielding tilapia to the market.

This worldwide and exclusive partnership confirms the commitment of GenoMar to continuously develop the GenoMar Supreme Tilapia™ (GST) strain to supply tilapia markets with highly differentiated products. By licensing Xelect's unique intellectual property GenoMar will be able to further improve the fillet yield of broodstock and fry supplied to producers serving the fast growing fillet market. Today around 700,000 tonnes of live tilapia is processed into fillets mostly for the North American and European markets, accounting for 15% of global tilapia production. The market for value added tilapia products is expected to increase substantially in the future.

GenoMar's line of Xelect High Yield tilapia will provide producers with an anticipated 3.1% additional fillet per tonne body mass over the already market leading yield of the regular GenoMar Supreme Tilapia™ (GST) strain. The additional value of fillet production derived from each individual parent breeder is estimated at 97 kg worth some USD776 at current prices. The company is conducting extensive field trials of the high yield line at its Philippines facilities with the aim of delivering the first fully tested product on the market later in 2016.

Dr Alejandro Tola, CTO at GenoMar commented "We are always searching for innovations that can create value for our customers

of genetic material. There is a lot pressure for efficiency in the tilapia industry and we immediately saw a great potential to improve profitability through the application of Xelect's proprietary markers for fillet yield."

"The Xelect High Yield markers are the fruition of several decades of academic work on the genetic basis of muscle development and growth in fish. We have developed genetic assays to identify fish with natural variations in gene sequences leading to a higher meat yield," said Professor Ian Johnston FRSE, CEO Xelect.

Dr Tom Ashton, executive director Xelect, added, "Xelect is pleased to partner with GenoMar, the leading tilapia breeding company, to bring our high yield technology to the market. The tilapia high yield markers supplement those already licenced to SalmoBreed and under trial licence to Landcatch Natural Selection and Marine Harvest, for Atlantic salmon."

GenoMar Genetics was founded in 1996 in Oslo, Norway. Its primary activity is the development and commercialisation of tilapia genetic products under the brand GenoMar Supreme Tilapia (GST). The company has been actively supporting the development of the global tilapia industry for the past 15 years. In addition, it provides breeding services to other aquaculture species and operates grow-out and processing facilities in Malaysia and Philippines which play an important role in the documentation of performance of the genetic products and in the development of downstream farming know-how. More information: www.genomar.com

A crucial step towards achieving the perfect pellet



This is the new Bühler Coolex™ pellet cooler presented for the very first time at VICTAM 2015 in Cologne, Germany. This sets new standards in the feed manufacturing industry.

According to Bühler, optimal pellets cannot be produced using single machines or systems alone, but only on the basis of a seamlessly matched process chain - from cleaning and grinding to mixing, conditioning, pelleting, and cooling. Proper pellet cooling is one of the crucial process steps in the production of high-quality end products that up to now has not been optimised. Integral pelleting processes require individual system components that can be fully integrated in the overall production process.

With its new cooler, Bühler offers feed producers not only efficient cooling and optimal hygiene, but also sets new standards in this area. Stefan Hoh, product manager feed, Bühler, said, "Efficient cooling of the still hot pellets is a process step that should not be neglected if high-quality end products are to be obtained. Proper cooling of feed pellets in the pelleting process

chain means more than just to reduce the pellet temperature. With our new perfectly integration-enabled Coolex™ cooling component, we support our customers in their efforts to increase their product quality and hygiene while at the same time cutting their costs."

Its innovative design based on the counter current principle and its conical product layer and octagonal geometry enable many important process steps to be optimised, ensuring a consistently high product quality of the pellets. With its specific air volume of merely 10 to 16m³/min/tonne, Coolex™ has a higher energy efficiency than many conventional coolers.

"But energy efficiency is only one aspect of our new cooler that has a positive impact on feed producers' margins," explained Hoh. "Thanks to the reliable reproducibility of the product quality, feed manufacturers can stretch the moisture content of their end product to the legally allowed limits and reduce their raw material consumption. This uniform cooling action enables the moisture content variance to be reduced to about half the value of conventional coolers, allowing margins to be perceptibly increased yet again."

Another unbeatable benefit that Bühler indicated for its new Coolex™ is the adjustability of the continuous product discharge rate, which ensures optimal throughputs and retention times. This is the first pellet cooler to be provided with several service doors and up to four integrated inspection windows. This makes cleaning of the cooler very much easier and significantly reduces product deposits, greatly diminishing the contamination risk and the risk of costly and image impairing recall campaigns. The smart design of this cooler offers even more benefits, for it needs much smaller fans. This cuts energy consumption in comparison to other counter current cooler designs by as much as 10%. More information: Email: stefan.hoh@buhlergroup.com/ web: www.buhlergroup.com

New website

ENTOFOOD, a biotechnology startup founded by Frenchmen Frederic Viala and Franck Ducharne, announced the official launch of its new website in May 2015. This is <http://entofood.com>

Through its R&D program, Entofood is involved in the mass bioconversion of under-valorized nutrients through detritivorous insects (Black Soldier Fly) to generate alternatives and highly sustainable proteins used for animal nutrition and aquaculture. Awarded with the Bionexus status for its proven expertise in bioconversion, Entofood brings an innovative alternative to fishmeal with its unique business model enabling production of high quality and competitive insect-based proteins without jeopardizing natural resources. The new website provides a direct access point to the company. More information: Anne Deguerry (a.deguerry@me.com)



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- Thailand Convention & Exhibition Bureau



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For more information please visit our websites:

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Targets for sustainability

The BioMar Group has published a global report on sustainability. The report outlines BioMar's ambitious targets for sustainability, but also shows the strong commitment the BioMar Group has over the years had to developing sustainable and responsible solutions throughout its activities.

"It is the first time we publish a global report on sustainability. With this we commit to increased public transparency in our activities via annual disclosures in accordance with the GRI G4 framework", said Carlos Diaz, CEO of the BioMar Group at the launch of the new report.

BioMar has for many years worked very actively with sustainability both in terms of product development, but also through an active collaboration with customers, suppliers, NGOs and other stakeholders in the value chain. This includes involvement in the elaboration of the ASC standards for salmon and trout and in the development of the IFFO RS standard.

"An essential part of our commitment to increased sustainability is to minimise sustainability risks and support initiatives towards increased sustainability

throughout the aquaculture value chain. We recognise that what we do in our operations, the performance of our products, and how we source our raw materials affect our customers' options to improve sustainability of their operations. The GRI report has to be seen in this light as it creates transparency with our actions, both for our customers and other stakeholders", explained Diaz. At the same time, he invited customers to enter into a closer dialogue on how to improve sustainability in aquaculture.

"Aquaculture will be one of the most important elements in establishing sufficient food production and we have a great responsibility to ensure it happens in a sustainable way. Aquaculture must become a pioneering model for sustainable food production," underlined Diaz. "More complex diets used in aquaculture both allow the industry to grow and contribute to an improved sustainability profile, but they also open new challenges as the new ingredients in the diets all must be evaluated in terms of sustainability. It does not help if we replace scarce marine resources with ingredients which lead to deforestation. We need to make choices

which do not just change the problem," added Diaz.

In order to make the right choices BioMar has within the BioSustain program developed a unique Eco-Efficiency tool, which can be used to evaluate not just the sustainability profile of diets, but which can also help fish producers to optimise their production towards increased sustainability.

"We have ourselves set some ambitious targets e.g. a reduction of CO₂-emission from our production by 20% per tonne of feed produced. However, the largest environmental impact from fish feed production comes from the production of the feed ingredients e.g. through the consumption of water or the utilisation of scarce resources. Therefore we want to allow our customers to make informed choices when it comes selecting fish feed, and our own goal is to make eco-efficiency an essential criterion in everything we do."

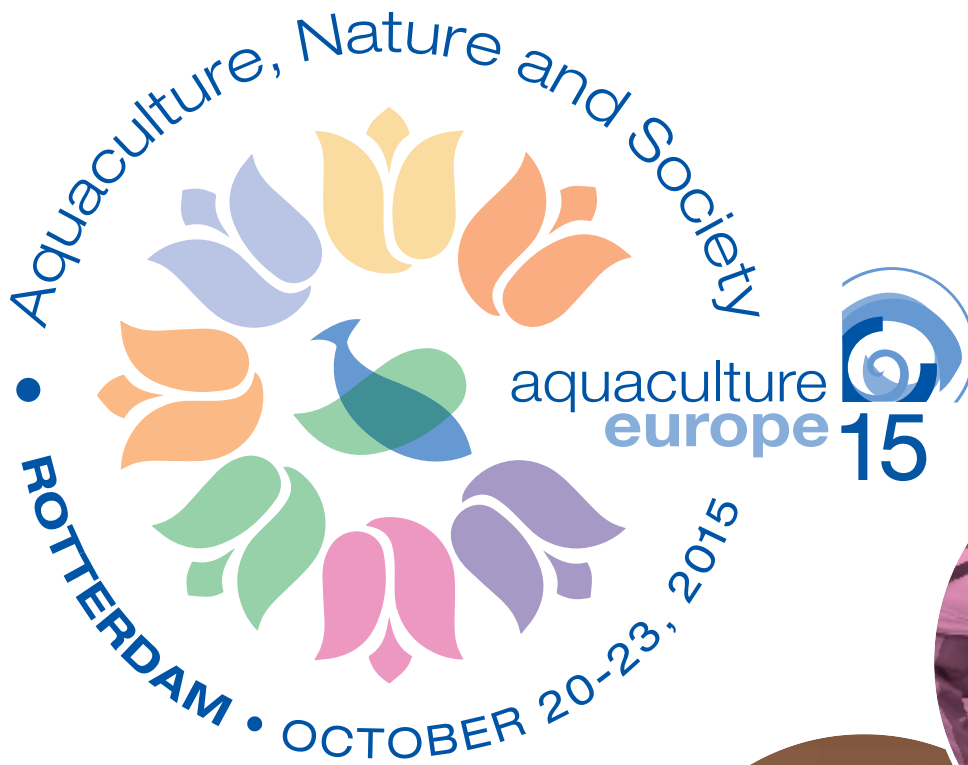
The report can be downloaded from www.biosustain.world.

What to look forward to in Aqua Culture Asia Pacific in 2016

Our editorial calendar for 2016 reflects the new trends and technologies in aquaculture in Asia Pacific. These are most relevant to the industry and will help you reach your target audience.

Volume 12 2016						
Number	1 - January/February	2 - March/April	3 - May/June	4 - July/August	5 - September/October	6 - November/December
Issue focus <i>Recent developments and challenges for the next step</i>	Health & Nutrition	Hatchery & Nursery Technology	R&D & Genetics in Fish/Shrimp	Industrialisation & Automation	Biosecurity & Disease Management	Probiotics
Industry Review <i>Trends and outlook, demand & supply</i>	Marine Shrimp	Tilapia	Aqua Feed Production	Catfish	Marine fish	Freshwater Fish/Prawn
Feeds & Processing Technology <i>Technical contributions from feed industry</i>	Functional Feeds/ Fishmeal & Fish Oil Replacements	Micro Feeds/Lipid and Fatty acids	Additives/ Probiotics	Extrusion & Processing Technology	Feed Safety/Feed Enzymes	Nutrition & Formulation
Production Technology <i>Technical information and ideas</i>	Harvesting & Post Harvest Technologies	Cage Culture	Recirculation Aquaculture Systems	Sustainable & Responsible Aquaculture	Biofloc & Biotechnology	Aeration Technology
Aqua business <i>Feature articles</i>	Experiences from industry and opinion article covering role models, benchmarking, health management, SOPs, social investments, CSR, ancillary services etc					
Markets	Developments in markets (live fish, product development, market access, certifications, branding, food safety etc)					
Company/Product news	News from industry including local and regional trade shows					
Deadlines for Technical articles	November 15, 2015	January 15	March 15	May 15	July 15	September 15
Deadlines Advert bookings	November 22, 2015	January 22	March 22	May 22	July 22	September 22
Show Issue & Distribution at these events as well as local and regional meetings	Aquaindia 2016 February 5-6 Aquaculture 2016 February 22-26 Las Vegas, USA	*Victam Asia 2016 March 29-31 Bangkok, Thailand Asia Pacific Aquaculture 2016 April 26-29 Surabaya, Indonesia		11th Asian Fisheries & Aquaculture Forum August 3-7, Bangkok, Thailand The Aquaculture RoundTable Series, (TARS 2016) August 17-18, TBA Vietfish 2016, (TBA) Ho Chi Minh City, Vietnam	China Seafood & Fisheries Exposition 2016 November China (TBA)	
*Show preview						

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22nd Annual Practical Short Course on Aquaculture Feed Extrusion, Nutrition and Feed Management

September 20 - 25, 2015, Texas A&M University, USA

This one-week practical short course on aquaculture feed extrusion, nutrition and feed management will be held at Texas A&M University by staff, industry representatives and consultants. This program will cover information on designing new feed mills and selecting conveying, drying, grinding, conditioning and feed mixing equipment.

Current practices for preparing full-fat soy meal processing; recycling fisheries by-products, raw animal products, and

secondary resources; raw material, extrusion of floating, sinking, and high fat feeds; spraying and coating fats, digests and preservatives; use of encapsulated ingredients and preparation of premixes, nutritional requirements of warm water fish and shrimp, feed managements and least cost formulation will be reviewed.

The course will include practical demonstrations of sinking, floating, and high fat aqua feed on four major types of extruders - dry, interrupted flights, single

and twin screw, using various shaping dies. Other demonstrations include: vacuum coating and lab analysis of the raw material for extrusion.

Reservations are accepted on a first-come basis. For more information, programs and application forms, contact: Dr. Mian N. Riaz, 2476 TAMU; Food Protein R&D Center, Texas A&M University; College Station, TX 77843-2476. Email: mnriaz@tamu.edu; Website: <http://foodprotein.tamu.edu/extrusion>

2015 - 2016

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@aquasiapac.com

July 20-22

International Conference on Aquaculture & Fisheries Brisbane, Australia

Email: aquaculture@conferenceseries.net
Web: www.aquaculture-fisheries.conferenceseries.com

August 19-20

The Aquaculture RoundTable Series (TARS 2015) Hanoi, Vietnam

Email: conference@tarsaquaculture.com
Web: www.tarsaquaculture.com



August 24-26

Vietfish 2015 Ho Chi Minh City, Vietnam

Email: quochanh@vasep.com.vn/
tienloc@vasep.com.vn
Web: www.vietfish.com.vn

August 25-27

2nd Annual International Conference on Fisheries and Aquaculture. Colombo, Sri Lanka

Email: isanka@tiikm.com
Web: <http://aquaconference.com/2015/>

September 20 - 25

22nd Annual Practical Short Course on Aquaculture Feed Extrusion, Nutrition and Feed Management, Texas A&M, USA

Email: mnriaz@tamu.edu;
Web: <http://foodprotein.tamu.edu/extrusion>

October 6-8

International Conference of Aquaculture Indonesia (ICAI) 2015 Jakarta, Indonesia

Email: icai.aquaculture@gmail.com
Web: icai.aquaculture-mai.org

October 8-9

Inaugural Institution of Aquaculture Singapore (IAS) Conference 2015 Singapore

Email: secretariat@aquaculturesg.org
Web: <http://iasaqua2015.wix.com/aquaconference2015>

October 14-16

Aqua Fisheries Myanmar 2015 Yangon, Myanmar

Web: www.myanmar-aquafisheries.com

October 20-23

Aquaculture Europe Rotterdam, Netherlands

Web: www.easonline.org

October 22-26

10th Symposium of World's Chinese Scientists on Nutrition and Feeding of Finfish and Shellfish, Wuhan, China

Email: SWCSNFFS2015@ihb.ac.cn

October 22-24

The 7th Regional Aquafeed Forum Can Tho University, Vietnam

Email: Dr.Hua.Thai.Nhan@ctu.edu.vn
Dr.Tran.Minh.Phu@ctu.edu.vn
Web: http://conference.ctu.edu.vn/introduction.php?conf_id=AF

November 4-6

China Fisheries and Seafood Show 2015 Qingdao

Email: info@seafarechina.com/
jennie8888@seafare.com
Web: chinaseafoodexpo.com

November 5-7

Expo Pesca & AcuiPeru Fisheries, Aquaculture, Refrigeration & Processing Lima, Peru

Email: thais@amauta.rcp.net.pe
Web: www.thaiscorp.com

November 11-13

10th National Philippines Shrimp Congress

General Santos City, Mindanao
Email: r.usero@yahoo.com
(Roselyn Usero)

November 16-19

South American and Caribbean Aquaculture 2015

Fortaleza, Brazil
Email: worldaqua@aol.com
Web: www.was.org

November 19-21

Taiwan International Fisheries and Seafood Show

Email: sonya_chaw@myexhibition.com.tw
Web: www.taiwanfishery.com

December 7-9

International Symposium on Aquatic Product Processing: Cleaner Production Chain for Healthier Food

Can Tho City, Vietnam
Email: Dr.Le.Thi.Minh.Thuy@ctu.edu.vn
(ltmthuy@ctu.edu.vn)
Web: http://conference.ctu.edu.vn/introduction.php?conf_id=APP

2016

February 5-6

AquaIndia 2016

India

Email: contact@aquaprofessional.org
Web: <http://www.aquaprofessional.org>

February 22-26

Aquaculture 2016

Las Vegas, USA

Email: worldaqua@aol.com
Web: www.was.org

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Director
Wild Oceans Pty. Ltd.

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