

# AQUA CULTURE

A s i a P a c i f i c

**H**ard Talk with shrimp farmers at TARS 2016

**W**hat's new on AHPND and EHP

**P**oor adoption of extruded feeds by groupers

**G**ut health for better productivity of tilapia

**B**enefits of phytase in fish

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**HEADQUARTERS** - Gold Coin Holding Limited Sdn Bhd. Suite 9-6, Level 9, Wisma UOA Damansara II No.6 Jalan Changkat Semantan Damansara Heights 50490, Kuala Lumpur, Malaysia Tel: +603 2092 1999 Fax: +603 2092 1919 email: general@goldcoin-group.com

**MALAYSIA (SELANGOR)** - Gold Coin Specialities Sdn Bhd/Gold Coin Biotechnologies Sdn Bhd, Tel: +603 3102 3070-2 Fax: +603 3102 3090 email: ler.chongmeng@yahoo.com

**INDONESIA (WEST JAVA)** - P.T. Gold Coin Indonesia, Aqua Division, Tel: +62 21 885 3668 Fax: +62 21 884 1947 email: m.bima@goldcoin-id.com

**THAILAND (SONGKHLA)** - Gold Coin Specialities (Thailand) Co Ltd, Tel: +66 74 483 600/5 Fax: +66 74 483 493 email: w.prapipat@goldcoin-th.com

**INDIA (CHENNAI)** - Gold Coin Biotechnologies Sdn. Bhd. India Liaison Office, Tel: +91 44 2486 8433 Fax: +91 44 2486 2091 email: v.ravi@goldcoin-id.com



Ponds at iSharp Farm, Blue Archipelago, Malaysia. Picture by Blue Archipelago, p8

#### Editor/Publisher

Zuridah Merican, PhD  
Tel: +60122053130  
Email: zuridah@aquasiapac.com

#### Editorial Coordination

Corporate Media Services P L  
Tel: +65 6327 8825/6327 8824  
Fax: +65 6223 7314  
Email: irene@corpmediapl.com  
Web: www.corpmediapl.com

#### Design and Layout

Words Worth Media Management Pte Ltd  
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Web: www.wordsworth.com.sg

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Zuridah Merican

# Shrimp Aquaculture: 4 epochs and 2 crises

## Who is evolving faster - pathogens or us?

Robins McIntosh started off TARS 2016 in Phuket with the state of the industry address. He used the catch phrase '4 epochs and 2 crises' to describe our history but his message was that each crisis has resulted in a stronger, subsequent epoch after change. Andy Shinn's calculation of billions lost in Asia's shrimp aquaculture industry pushes us to face the need for change and transformation. Will we remember these as we carry on with our farming business?

The plenary sessions were meant to bring all the participants onto the same page and these also had serious learnings. Many in the industry believed that SPF and SPR were opposing options on broodstock origins for farming models. We are reminded that 'SPF is a health status and SPR is a genetic trait'. While the breeding companies select for the SPR trait for a specific disease, broodstock companies must ensure a pathogen-free status for the animal. The goal is for the shrimp to be SPR and SPF as well. We see this development as Latin America starts cleaning its stock and working toward SPF status. In Asia, we have had the benefit of SPF since vannamei shrimp started more than 15 years ago. Today, we are selecting for more robustness and resistance to specific pathogens.

The roundtable sessions and subsequent panel discussions brought up equally important messages. First and foremost, EMS is still a clear and present danger while EHP is already looming. Both EMS and EHP seem to result in very different outcomes for the industry. The result of an EMS outbreak is likely to be a temporary stop in farming or a disincentive to new investment in shrimp aquaculture. This start/stop phenomenon affects different countries at different times, and so the overall effect would be a drop in shrimp production. However, EHP results in a very different outcome. The shrimp's growth slows significantly and the farmer tends to continue farming to get the shrimp up to a marketable size but the farmer loses money on the crop.

The result is an output of smaller size shrimp and the overall effect may not see a significant drop in output. If anything, the farm segment is lured into a lull of loss - making production. Someone remarked the similarity to boiling a frog by increasing the water temperature by one degree at a time. The frog does not jump out until it is too late and it is cooked.

Asian feed companies find a huge disconnect when compared to their EU counterparts in marketing functional feeds. In the EU, functional feeds comprise up to 60% of production, i.e. there are specialised feeds for specific culture and disease conditions. In Asia, farmers prefer to top dress their standard feeds with functional additives instead of buying ready-made functional feeds. Is there a trust deficit or are Asian feed companies marketing these feeds wrongly? This provoked a serious debate.

In production technology, 3-stage farming with nurseries are starting to be the new normal. It is clear that a transfer from a clean SPF hatchery environment to the 'real world' grow-out pond environment lacks the acclimation period necessary for good PL 10 survival. However, the nursery technology is yet to be standardised. Should a nursery be under climate controlled conditions implementing clear water RAS similar to an extension of a hatchery or should a nursery be a short-stint in a hyper-intensive system in a pond, which functions as a prelude to a grow-out pond? There are also shades of grey in between and the jury is still out.

Ultimately, it is all about evolution. As pathogens evolve to be more virulent and effective in infecting shrimp, the industry has to evolve to be more effective to counteract these pathogens. When will we evolve?

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# State and future of the shrimp aquaculture industry in Asia

Understanding diseases, adapting and changing for the new phase of growth.

**TARS 2016: Shrimp Aquaculture & The New Normal**, the sixth in The Aquaculture Roundtable Series was held in Phuket, Thailand from 17-18 August. The meeting was oversubscribed with 210 participants discussing ways forward for the shrimp farming business beset by diseases. This was a follow-up to TARS 2014, held at the height of the early mortality syndrome in Asia. Some recovery was expected and in 2014, participants suggested options for the 'recovery, revival and renaissance' of the industry. This has not been realised and the industry remains vulnerable to disease outbreaks and disease threats to the industry have multiplied.

The program for TARS 2016 was structured to take the industry to a new normal with the realisation that disease-free farming is passé. Today, it is all about learning to live with diseases, controlling variables, adapting farm practices and nutrition, and better production planning. Managing diseases should not be left to only the farmers but is the responsibility of all stakeholders.



Juadee Pongmaneerat

In her welcome remarks, **Dr Juadee Pongmaneerat**, Deputy Director General, Department of Fisheries, Thailand emphasised on the need to "work around the diseases" and factor in counter measures in production planning. "The reality is that we need to adapt and change so that Asia's shrimp industry can continue to grow.

"In 2015, Thailand produced 250,000 tonnes of shrimp, which was better than in 2014

but still below our production of 540,000 tonnes in 2012. Our best was in 2010 at 640,000 tonnes. Our leaders in the shrimp farming industry are leading the charge and we are optimistic that soon we will recover."

She added that DOF is working very closely with the industry to revive shrimp farming together with The Commission of Driven Shrimp Industry, The Shrimp Task Force Ad Hoc Committee, Thai Shrimp Association, Shrimp Farming Confederation and Shrimp Clubs.

## Four epochs and two crises

As per its tradition, TARS 2016 started with the state of the industry address. Given his vast experiences both in terms of years in the shrimp farming industry and also his global outreach, **Robins McIntosh**, Vice President of Charoen Pokphand Foods, Thailand gave an overview on recent developments and what is required for future sustainability. He titled his presentation on the State of the Shrimp Aquaculture Industry simply as 'Change, Change, and more Change.'

"Historically the industry has had four epochs and two crises," said McIntosh. "The good years in 2010 and 2009 were followed by a 20% decline in production in 2013. These are what I call

catastrophic losses. We have not seen any improvement in shrimp production for 3 years. In 2016, we can expect 11% less shrimp," he continued.

The history of global shrimp production was typified by the trend in Thailand. "Our first crisis was solved with domestication and biosecurity in 2001. The Golden Age of Shrimp started in 2003, with almost 300% increase in world production over a 10-year period. The second crisis came in 2011 with a levelling of production. Just as we had ended the first crisis with change, so again we are looking at change to end this crisis. I believe that



“ Once you find the right change, things get better. ”  
- Robins McIntosh

when we solve this, the industry will go into another Golden Age. Change is hard and shrimp farmers tend to not like change, but sometimes change is necessary. Once you find the right change, things get better."

McIntosh described the current situation in selected countries. "Production in China is still down but may not go as low as before, but they still have not solved the problems with early mortality syndrome/acute hepatopancreatic disease (EMS/AHPND). New production is coming from areas far away from AHPND infected farms, whereas those with AHPND and EHP, production continues to deteriorate. Production in Malaysia could rise in 2016, but this production will be from new areas compensating for crop losses in older areas. Very few of the old areas really have solutions that are consistent. Vietnam declared a recovery in 2014 but this was because farmers were stocking to benefit from high prices due to low global supply. For this, farmers took extra risks. When prices came down they stopped stocking."

## EMS is complicated

"It is not AHPND alone or EHP alone or only WSSV. It could be AHPND with EHP, AHPND and WSSV or AHPND with the bacteria *Shewanella*. All of these pathogens are out there at the same time, and interacting in ways we did not anticipate."



Participants at the breakout roundtable session at TARS 2016 sought ways forward to mitigate disease via genetics, production technology and functional feeds. See pages 8-11 on Hard talk with shrimp farmers and pages 13-21 for part 1 of the report on the plenary presentations.

The bacteria *Shewanella* is also present with the same prevalence as AHPND. Together there is a synergistic effect and there is higher mortality than with *Vibrio parahaemolyticus* (Vp) alone as described by Dr Kallaya Sritunyalucksana (see p18).

“With WSSV-AHPND interaction, when well controlled, there can be no mortality when the Vp count is at  $10^2$  CFU/mL. However, what will the farmer diagnose this as? Usually, this is taken as a WSSV loss. In many countries, we are seeing reports of new WSSV outbreaks, generally not seen 5 years ago.”

### Change is necessary

The common reaction to such disease predicament among shrimp farmers is that the disease will go away. Farms restock again and again with the assumption that it is just an aberration or bad luck. Change may happen after 3 years. “Unfortunately, many looked for silver bullets and there are many companies offering solutions to farmers but often with no evidence on how these work. During this crisis, we had an increase in the use of antibiotics followed by antibiotic rejections for shrimp exports out of India, Vietnam and China.”

### Post larvae efficiency index

A good gauge of recovery, according to McIntosh is the ‘post larvae efficiency index.’ This is the amount of post larvae used to produce 1 tonne of shrimp. In 2010, industry in Thailand used almost 10 tonnes/million post larvae (PL). During the depth of the crisis, this decreased to 3 tonnes/million PL. In 2016, there will be a technical improvement and a signal for recovery with an estimate of 7 tonnes/million PL.

“This year we can produce 320,000 tonnes and by 2017, continue up to 350-360,000 tonnes. I have confidence in this because we understand now that two toxins create AHPND and we know what we are doing now.”

### The model for recovery from AHPND

McIntosh recounted how in 2009, he first saw healthy shrimp which were dead! In 2012, he came up with a model for recovery. “Basically, the bacteria worked with quorum sensing which needs a threshold amount of bacteria. By reducing the amount of bacteria in the pond, farms could reduce the severity of the outbreak. At the same time, I had found that there was a genetic component, a heredity to tolerance. In 2016 in Thailand, we found that if we increase shrimp tolerance, we had better results. Today, as we continue to increase the tolerance of the shrimp to the toxin, we can have production back to the level before AHPND came.”

### New biosecurity rule

“As we now understand the enemy (AHPND), we can create a new biosecurity rule. This is not to exclude the bacteria, but just to reduce the levels through elimination and reduction of the food and the substrates that make those bacteria grow. These include all shrimp feeds, moulds, sludge and organic material in the pond. In 2012, we showed that if the levels were not above  $10^4$  CFU/mL, there was no mortality, provided there is only one factor. Exclusion is not necessary but just limit the levels.”

### Increasing tolerance

After selection from generation to generation, there is a relatively high heritability coefficient for the disease. Advances over five generations showed selection for tolerance to the toxicities. “We have moved up from 35% to 40% in the original families to 60%-65% in challenge tests. At the moment, this just shows that shrimp will need more toxins to kill them today, than at the beginning.”

### Systems are changing

In Thailand, there are fewer culture ponds today. In 2010, one farm had 78% of pond area for shrimp culture but in 2016, it has only 38%. The major increase is with reservoir ponds, from 13% to 46%. With these changes, profits are higher, shrimp sizes are bigger and productivity better. Crop failures from AHPND is less.

### The big debate on definition of SPF/SPR

Specific pathogen free (SPF) stock refers to the health status of a stock and not a genetic characteristic. To qualify as SPF, a shrimp must be free of all known shrimp viruses. Specific pathogen resistant (SPR) refers to a genetic characteristic, that is being resistant to a specific pathogen; a shrimp may be both SPF and SPR.

“There is a lot of misunderstanding on SPF/SPR such that it has created problems in the industry. SPF just means clean shrimp. This is essential for any biosecurity program and to reduce the risks of translocating shrimp diseases. If we had the discipline with surveillance, EHP would not move around as it has. We also want tolerance to a specific disease, but we should have this in a clean body.”

McIntosh also addressed another aspect, that selection for resistance sacrifices growth. “Selection for both characteristics takes a lot more work for families and costs more. However, if I had to choose, I would give up some resistance for growth, because growth is the economical driver here.”

## Young Scientist program beckons to all future innovators

The Alltech Young Scientist (AYS) program, the university-level competition in agri-science, seeks to attract future innovators for its 2017 term. Regional first-place winners will be invited to attend an all-expense-paid Alltech Young Scientist Discovery Week, culminating at ONE: The Alltech Ideas Conference in Lexington, Kentucky, USA. Here, they will compete to obtain a fully funded PhD position (undergraduate) or fully funded post doctorate position (graduate) in addition to cash prizes of USD 5,000 and USD 10,000, respectively.

Dr Aoife Lyons, director of educational initiatives and engagement at Alltech said, "These bright minds have the potential to discover the solutions today to meet the challenges of tomorrow. The AYS program continues to discover emerging research talent, and we want these future innovators to join our global team." Now in its 12th year, AYS attracted approximately 200 student nominees from 144 professors representing the world's top 117 universities from 42 countries last term. Registration is now open for the 2017 competition and will close on October 31, 2016. Students must be nominated by a professor in order to participate and may submit scientific papers on topics such as animal health and nutrition, crop science, agriculture analytical methods, food chain safety and traceability, human health and nutrition, and other sectors related to agri-science. Paper submissions may be completed online through to December 31, 2016. (AlltechYoungScientist.com)

## China tilapia: A slow US market

After falling for several months, prices of tilapia in China seemed to have bottomed out. Sources told *Undercurrent News* of an impending price increase amid supply shortages. However, the US market remains slow. According to Landy Chow at Siam Canada China, raw tilapia prices have fallen this year from a 2016 high of CNY 8.90 (USD 1.34)/kg in

April, to a low of CNY 7.40 in June. Prices now are similar to those in 2006 when the Chinese currency was valued higher against the dollar but labour costs since then have risen by around 350%. So, the price level this June is not sustainable.

Don Kelley, procurement manager at US importer Western Edge Seafood said that prices at this level are too low to be profitable for producers. He added that this has been happening for some months now, raising concern. "Whenever the market does that to the producer it leads to farmers making decisions to grow other species or to just participate at a lower level of growing. That is the worry right now. Despite prolonged low prices, demand among US consumers has remained low. Demand has been especially sluggish on the retail side," Kelley said. Sources pointed out that demand throughout the summer has been slow. The summer season in the US is the lowest sales season of the year, so shipment demands were very low during May to July.

## FDA reports more antibiotic-contaminated shrimp

The US Food and Drug Administration (FDA) has released information regarding imports being refused entry into the United States for the month of July. In total, the agency reported refusing 197 seafood entry lines last month. Of these, 18 (9.1%) were of shrimp entry lines refused for reasons related to banned antibiotics. The total number of entry lines refused has already exceeded the annual total of nine years within the last 15 years. Shrimp shipped from India comprised 75% of the shrimp entry lines refused for reasons related to banned antibiotics (59 of 79). The sheer number of entry line refusals of shrimp from India is unprecedented and is now nearly double the highest annual amount previously reported. In July, the FDA reported refusing shrimp entry lines originating from three different countries (China, India and Vietnam) for banned antibiotics. These entry line refusals are also due to shrimp contaminated with veterinary drug residues. (source: shrimpalliance.com)

*continued from p5.*

## New technologies and the future

These are designer probiotics/prebiotics, designer floc, epigenetics, Rnai, phage therapy, EVE (viral inserts), complete broodstock feed, complete larval feeds, artificial algae and QSI (quorum sensing inhibitors).

"The future is basically more controlled farming using fast growing shrimp. We are getting to be more efficient; we can actually genetically produce shrimp that do very well in all vegetarian fish oil, and fish meal free diets. There are different price points for all producers by marketing their strengths. We need to embrace certification. This is the way consumers have confidence in this industry."

"The new normal" said McIntosh is "changing with science and technology, with transparency, and with pride. A profitable shrimp culture for the industry and affordable shrimp for the everyday consumer."



Dr Chen Ming-Dang, Charoen Pokphand Foods (third from right), Soraphat Panakorn (fourth from right) and Professor Orapint Jintataporn, Kasetsart University (fifth from right), with Thai participants



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# Hard Talk with shrimp farmers on business models and disease mitigation

Three industry leaders from Malaysia, India and Thailand gave thought-provoking views on how they handle their respective shrimp farming business amidst an environment beset with diseases

TARS 2016 focused on Shrimp Aquaculture & The New Normal to get the shrimp farming business back on its feet after more than 6 years succumbing to diseases - from white spot syndrome virus (WSSV), early mortality syndrome/acute hepatopancreatic necrosis disease (EMS/AHPND) and more recently white faeces disease (WFD) and *Enterocytozoon hepatopenaei* (EHP).

A newly introduced segment for this annual gathering of stakeholders was **Hard Talk with Shrimp Farmers**. The three invited farm CEOs not only come from diverse backgrounds but they also manage farming enterprises and business models of diverse sizes. The contrasting style on how each CEO handles disease mitigation in their farming business is also obvious. The only common attribute of the three panellists is that they are all industry leaders in their own country.

As the CEO of Malaysia's Blue Archipelago Berhad (BAB), **Abu Bakar Ibrahim** is responsible for the integrated operations of two farms, a processing plant and hatcheries. A graduate in chemical engineering with an MSc in Management Science, Abu Bakar is also Pro-tem Chairman of the Malaysian Shrimp Aquaculture Alliance. **Dr Manoj M. Sharma**, Director of M/S Mayank Aquaculture Pvt Ltd in Surat, Gujarat, India, armed with a PhD in shrimp aquaculture, began farming large sized monodon shrimp in four ponds in 2009. Now after almost 20 years, he continues to produce large size vannamei shrimp. Dentistry trained **Dr Surapol Pratuangtum** is CEO of Bang Go Farm in Suratthani, Thailand. He has been in the industry for more than 30 years and is President of the Thai Marine Shrimp Farmers Association. He is also one of the co-founders of the Suratthani Shrimp Farmers Club whose members are major producers for shrimp in the southern region.

## The farms

The profiles of these three farms demonstrate the diversity of the shrimp industry in Asia. BAB took over an existing farm of 400 ha on the west coast of Peninsular Malaysia in 2008 and in 2010 developed a new farm from a greenfield site, which allowed it to incorporate features that meet demands for certification and environmental sustainability by NGOs. Currently, the total number of ponds at these two farms is 460 covering 1000 ha. In 2015, the production at the east coast farm, called iSharp, was 3,218 tonnes with 2.6 cycles/year from 260 ponds covering 500ha. It uses a three-phase farming system which includes a 25 to 35-day nursery stage. Average stocking density is 120 post larvae (PL)/m<sup>2</sup> and the farm practises two partial harvests, starting with 10 g shrimp and a full harvest at 16 g. In Malaysia, the farm is unique, featuring fully lined ponds, semi biofloc farming practices and real time remote monitoring of water parameters. It also has sedimentation ponds for effluent water treatment as per the requirements from the Department of Environment.



Similarly, Mayank Aquaculture has a three-phase culture system with a 30-day nursery stage. There are 80 culture ponds and 10 reservoirs as well as an effluent treatment system (ETS) as per the requirement by the Coastal Aquaculture Authority. Production was 500 tonnes in 2015 from 2 cycles. In contrast to the other two farms, the focus is on large vannamei shrimp with average body weight of 33-50 g and one full harvest. Stocking density was 20-30 PL/m<sup>2</sup> which produced average growth rates of 0.3 g/day and high survival rates of 80-85%.

Bang-Go Farm has 12 culture ponds averaging 0.64 ha each, two large reservoir ponds covering 5.2 ha and treatment and settling ponds of 3.5 ha. The ratio of culture ponds to reservoir and treatment ponds is typical of a recent emphasis in Thailand on water quality. Ponds are stocked with PL12 at 65-100 PL/m<sup>2</sup> and production in 2015 was 80 tonnes from 1-2 cycles/year. The harvest sizes range from 10-30 g shrimp, survival rates are 60-80% and there can be one full harvest or two partial harvests.



“ We need to show a sustainable model, particularly to the investment community, before we can attract the right kind of investments into the country. ”  
- Abu Bakar Ibrahim

## Business models and competitive edge

BAB is a subsidiary of Khazanah Nasional, the strategic investment arm of the Malaysian government. Abu Bakar's task is not just confined to its commercial operations but also to spearhead

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20 count shrimp harvested at the Mayank Aquaculture farm.

shrimp farming in Malaysia to attract future investments into this industry.

"I have two hats, the commercial one to make sure that my entity is viable, and a development hat to create a business model which incorporates scale from the beginning. Thus, we did not have the luxury of an organic growth. We need to show a sustainable model, particularly to the investment community, before we can attract the right kind of investments into the country," said Abu Bakar.

"This puts significant pressure on myself and my management team to deliver a set of results that can demonstrate that scale helps to develop the industry. Setting up a farm of this scale has its challenges. A small farmer will be nimble and proactive. But without scale they will not have the support services and structure of organisation. There are pro and cons. In building scale, we have to look at all the components, and we need breadth and depth of knowledge to be sustainable."



**“ I may never have made a lot of money but I have never lost a single crop. I do not produce more than 5-6 tonnes/ha. ”**  
- Manoj M. Sharma

Manoj said, "I decided to go with the natural carrying capacity to produce large size shrimp. I studied this model very carefully and now advocate and educate my fellow farmers to adopt this model. I stock 20-25 PL/m<sup>2</sup> to produce 10-20 count shrimp. I think I have a sustainable model that others can adopt. I may never have made a lot of money but I have never lost a single crop. I do not produce more than 5-6 tonnes/ha.

"Farm gate prices in India is USD 8 for 30 count. This season I produced 17-18 count vannamei shrimp. I made almost USD 7 per kg. If I produce 10-20 tonnes and end up with USD 1 profit, it is still not a sustainable model. I also advise other farmers on this model. Surat has the most sustainable model."

Does this limit his revenue? "I am a businessman and volume is not important. What is important is what the books show on ROI. Big size shrimp is more profitable for me. For the last 18 years, the harvest is booked 2 months before harvest. In India and even in Asia, nobody can supply 10-20 count vannamei shrimp. I think it is a good combination of art and science to grow to this size and requires a lot of discipline. I know aquaculture is a complex and difficult science but it is important that this is made simple especially when you are part of a cluster," added Manoj.

Surapol said that his business model is typical in the Thai shrimp farming industry. "It has been unfortunate that shrimp farming in Thailand is still in 'ICU' in 2015. Although my farm is 35 years old, it is still functioning. We have our ups and downs. I stopped farming for 2 years. However, farmers meet twice a month to brainstorm on how to farm shrimp again. At the moment, we can see that things are improving as we now have good quality post larvae. The bad news is that pathogens are around still."

## Experiences with diseases

BAB's west coast farm was hit badly by EMS/AHPND in 2010, together with other farms in the area. Mitigation steps included lining ponds and trying different solutions. "For 4-5 years we went through a difficult process especially when we had no idea with what we were dealing with. We tried bioflocs, probiotics, zero water exchange and multiple water exchanges. We also had outbreaks of WSSV but this happened when we had a hiccup with our gas chlorination system," said Abu Bakar.

"We did not have the flexibility of closing temporarily as we needed to sustain jobs. Fortunately, production continued at the new farm which is in an isolated location and has good water quality. At the end of 2014, we sat down and analysed. We brought in specific pathogen resistant (SPR) shrimp from Latin America and stocked them in the west coast farm. The shrimp were found to be resistant to WSSV and EMS.

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“ In Suratthani farms, WSSV is more serious but it does not mean that we have eradicated EMS. We have learnt that we cannot allow EMS or any disease to infect ponds.”  
 - Surapol Pratuangtum

“But just at the time we were back to the normal 70-80% survival, shrimp stopped growing due to EHP. EHP still is a serious issue at this farm. In fact, EHP affects both our farms but the impact has been different because of geographical locations. In our east coast farm, we are able to plan production around EHP,” added Abu Bakar.

Manoj recognised that diseases are bound to come but by managing the stress factor, Mayank Farm manages to keep diseases away. “As a group in Surat, we signed a protocol, whereby once the monsoon starts, we stop farming from February to March. We harvest before June/July. In this way, we save our ponds and the entire area. This has worked and we are 90% successful. My own pond management style is keeping the ponds in a high state of health.

“Khun Surapol can go off crops but most shrimp farmers will not be able to do this. At the farm level, most of the infrastructure is based on monodon shrimp farming. Most of us sticking to the basics of farming are doing well. Gujarat’s success is now being copied in Odisha.

“In Suratthani farms, WSSV is more serious but it does not mean that we have eradicated EMS. We have learnt that we cannot allow EMS or any disease to infect ponds. How do we control diseases? We now have the 3Cs program- first C is clean post larvae. We now have clean post larvae free from EHP and EMS. The second and third Cs are clean ponds and clean and clear water. The first C is the responsibility of the post larvae supplier and the second and third C is my responsibility. I strongly believe that the transfer of infection is through the post larvae,” highlighted Surapol.

## When costs are rising

Since 2012, survival rates have dropped tremendously but production costs have gone up. The panellists were then asked on what have been their strategies to maintain margins.

“While costs have gone up, thankfully prices have gone up and margins have been good. Moving forward, our concern is



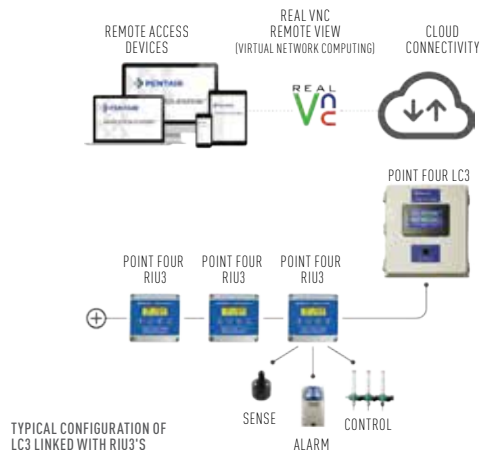
Ponds at Bang Go Farm

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*Vannamee shrimp harvest from lined ponds at the iSharp farm, Blue Archipelago.*

to bring down costs across four areas: post larvae, feed, energy and labour. We know that labour in the Malaysian context is not coming down. Productivity needs to be tackled. Our subsidy for electricity might disappear soon. We can automate some of our processes. Fundamentally, our need is to get the best value post larvae and tackle cost of feeding the shrimp. We need to bring feed conversion ratio (FCR) to 1.1 to 1.3, which is the top of any farmer's agenda. We need to work with the feed industry to keep costs down," said Abu Bakar.

"India is unique in that it exports almost all of the shrimp it produces. Domestic consumption may be between 5-10%. When the world shrimp basket becomes bigger with more shrimp from producing countries, India will be in trouble. It needs to develop a domestic market of at least 30-40% to take up the production of small size shrimp," said Manoj.

"Growing 50-60 size count is already not economical. I believe, if you do not get 40-50% profit margins, it is not worth farming shrimp. Some 50-60% of cost is feed which has increased to IND 87/kg and the calculated FCR is more than 2, based on feed sales. The biggest cost saving is to increase feeding efficiency. The farmer needs to device his own science to reduce costs. Fortunately, post larvae prices have remained the same."

Surapol believes that in Thailand, shrimp farming can remain profitable provided farms can control diseases. He reiterated that the critical factor is good quality post larvae together with good management practises. In intensive systems, survivals have improved to 70-80%. Concurring with Abu Bakar, Surapol said that control should be with costs for energy and labour.

As BAB has the social function of providing employment, the balancing of this responsibility and efficiency must be achieved. Abu Bakar is not worried with the potential loss of jobs with automation. "We believe the industry can grow. We can grow the quality of our workforce to handle the value added jobs and leave the standard activities to be automated. Malaysia is also behind our neighbours with a shortage of aquaculture experts."

"Thailand can recover but not to the high annual production of 600,000 tonnes as before. In 2016, we better keep this at 400,000 to 450,000 tonnes, at most," said Surapol.



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## TARS 2016: Shrimp Aquaculture & The New Normal

### Part 1: Industry challenges and living with disease

The plenary at TARs 2016 had four sessions covering impact of diseases along the supply chain: state of industry and challenges, weak links in the supply chain, living with diseases and finally, building a sustainable shrimp business. During the interactive roundtable breakout session, participants deliberated on disease mitigation via genetics, production technology and functional feeds.

TARS 2016 was organised by Aqua Culture Asia Pacific and Corporate Media Services, Singapore. Participation was from 24 countries. Industry sponsors were Inve Aquaculture, Biomim, BioMar, Aquativ, Nutriad, Jefe and DSM.

### Industry challenges in Indonesia, India and Latin America

In his presentation on "Indonesian Shrimp Farming, Lessons learnt from IMNV," **Anwar Hasan**, Regional Technical Manager - Aquaculture, Biomim said that when dealing with infectious myonecrosis virus (IMNV), the focus was on maintaining a sustainable carrying capacity, improving culture conditions and reducing stocking density to mitigate the disease. While these continued post IMNV and are positive actions, he added that following successful interventions, farmers then gambled by increasing stocking density.

In Indonesia, Anwar said that the original species cultured was the monodon shrimp until the industry was devastated by white spot syndrome virus (WSSV). The alternative was the vannamei shrimp officially introduced into Indonesia in 2001. It was assumed that illegal importation of broodstock from Brazil, poor disease monitoring and biosecurity introduced IMNV into Indonesia. The first report of IMNV was in 2006.

"With the vannamei shrimp, we changed our culture density, from low density to high and super intensive systems. The IMNV outbreak affected our shrimp farming from 2008-2012 with shrimp mortality ranging from 20% to 80%. There was no doubt that all farms were affected, even though a farmer might say that he did not experience IMNV in his farm. Disease surveillance reports show that outbreaks occurred during all culture months. In the initial years, the effect was necrosis of the skeletal muscle



From left, Dr Alexandros Samartzis, Evonik (SEA), Singapore, Dhanunjaya Goud, Lallemand, India, K Venkata Raju Avanti Feeds, India and Kumuda Chandra Patra, Biomim, India.



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“ Unfortunately, farms tend to go back to increasing stocking density and now we have IMNV together with white faeces disease (WFD) outbreaks. ”  
- Anwar Hasan



The Production Technology group, from right, Manoj Sharma, Mayank Aquaculture, India, Robby Mort and Rodney Missen RADAQUA, Australia. Robby presented on controlled production of monodon shrimp using MRAS in China.

at 90 days of culture (DOC 90) but gradually, the impact of the disease was 40% mortality with initial symptoms appearing at DOC 40.

There was also the multiplier effect. Indonesia's shrimp feed industry recorded reduced sales by 18% in 2009 and 42% in 2011. The total loss was USD 750 million.

## Lessons learnt from IMNV

Industry in Indonesia attributed the severity of IMNV to carrying capacity and began to work on adjusting culture practices to match pond biomass. In addition, attention was given to reducing water exchange and improving water quality within the pond with probiotics. Biosecurity measures and partial harvesting were introduced. Sludge removal, already a common practice in the early years of shrimp farming in Indonesia, intensified using newer models to increase efficiency and automation. Anwar gave some examples of changes at the farm level.

“In 2007, the stocking density at one farm was 120-150 PL/m<sup>2</sup>. Although, IMNV caused some mortality, levels were low. In 2008, as mortality increased, the farm reduced stocking density to 60-80 PL/m<sup>2</sup>. As mortality continued, stocking density was further reduced to 40 PL/m<sup>2</sup> in some farms. Shrimp survived with no IMNV. The farm increased stocking density to 50 PL/m<sup>2</sup> but still IMNV outbreaks did not occur.

“Although IMNV is no longer a threat today, Indonesian shrimp farmers continue with these ‘living with IMNV’ farm practices. In hatcheries, the emphasis is on IMNV prevention using disease free broodstock and post larvae as well as better quality post larvae. At the farm level, treatment of incoming water and holding

water in reservoir ponds are carried out. Aeration increased with one HP paddlewheel for every 200-400 kg of biomass in the ponds instead of the previous practice of one HP/500-700 kg of biomass,” said Anwar.

“According to the experiences of a successful farmer, when at DOC 38, IMNV was confirmed in a pond, he minimised stress to shrimp by not changing water and by using multi-strain probiotics. One major move was to reduce stocking density. In another farm, the harvest in 2011 increased to 22 tonnes/ha with a higher survival of 90% and stocking density was only 85 PL/m<sup>2</sup>. The farmer managed to continue the crop to 130 days. This was compared to 70% survival at a stocking density of 121 PL/m<sup>2</sup> and at DOC 103 the harvest was only 13.5 tonnes/ha in 2009.”

The government together with the Shrimp Club Indonesia conducted seminars which foster exchange on information on good practices and began to encourage farm certification such as BAP and GAP. Later as neighbouring countries began to report AHPND in farms, Indonesia was quick to restrict imports of shrimp, in particular live shrimp, Artemia and probiotics from AHPND infected countries. The Ministry of Marine Affairs and Fisheries will also dispatch a team quickly to any suspected farm with shrimp dying and conduct PCR tests.

“Since 2012, Indonesia's shrimp production has been increasing, fueled by high prices. Unfortunately, farms tend to go back to increasing stocking density and now we have IMNV together with white faeces disease (WFD) outbreaks,” added Anwar.

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“ Our future growth depends on how we overcome weak links in the value chain, ”  
-Ravi Kumar Yellanki



Abujasin Sutanto, PT. Windu Mantap Mandiri, Indonesia (right) with Dr Wee Kok Leong Gold Coin Specialties, Indonesia (centre) and Ramakanta Nayak, Trouw Nutrition Asia Pacific, Thailand.

## Challenges to its future growth in India

**Ravi Kumar Yellanki**, Managing Director, Vaisakhi Bio-Resources, called the phenomenal growth in India's shrimp farming industry from 2010 onwards as a tsunami. In his presentation covering challenges to its future growth, he indicated while India's shrimp production grew to 400,000 tonnes within 5 years, production in 2015 dropped 10% to 363,450 tonnes.

“We expect a recovery in 2016 at 400,000 tonnes. This does not mean that we are successful as the increase in production is from new ponds and farms moving to more intensive farming of the vannamei shrimp. In fact, we have more farming areas but productivity has not increased. Our future growth depends on how we address weak links in the supply chain,” said Ravi.

### Restructuring the value chain

With an expectation of an annual 700,000 to 800,000 tonnes of shrimp production, India's shrimp industry has an installed capacity exceeding demand for shrimp feed and shrimp processing. “Upstream we have the central quarantine system, screening every batch of broodstock for OIE listed diseases and we have a broodstock multiplication centre (BMC). Small farms (<2 ha) dominate making it difficult for adequate biosecurity measures, although these are easier to operate. In addition, they produce small shrimp which are sold at low prices in wet markets through 3-4 intermediaries. How can we reshape and restructure the value chain for better production and for better business?”

### BMC (Broodstock Multiplication Centre)

Adequate imported broodstock is critical for the whole production process. This is also to prevent the use of pond raised broodstock. India, similar to other countries, import broodstock from suppliers in the US for maturation in hatcheries or post larvae for the BMC. “Our peak demand for broodstock (December/January) coincides with that of other countries. The situation is different in India. Aside from the administrative processes to apply for import permits, we also book space at the quarantine centre. Any delays in delivery, means waiting for available space.

On arrival, the mortality rate of broodstock can be up to 60%. These and custom duties increase operation costs of hatcheries.

To overcome these problems and meet demand in India and other parts of Asia, Ravi said, “The authorities will set up an additional broodstock quarantine facility north of Chennai and will build three BMCs. There is an opportunity for a breeding company to set facilities in the secluded Andamans,” said Ravi.

### Changing protocols

Recently, hatcheries have changed their disinfection and feeding protocols. Most of the hatcheries use pasteurised feeds to produce clean and disease free post larvae. Larger farms have added a nursery phase in their production cycle but this remains a constraint for small farms.

“It is important that hatcheries cooperate with small farms to supply larger post larvae and also post larvae acclimated to low saline pond culture. Three phase farming allows for staggered harvesting. In turn, this will put less pressure on processors,” said Ravi.

### Diseases and tolerant shrimp

WSSV, *Enterocytozoon hepatopenaei* (EHP), white faeces disease (WFD) and running mortality syndrome (RMS) are the major disease threats. High and unprecedented losses are from WSSV because of poor biosecurity in small farms. The threat level of WFD is higher than that for EHP, where the prevalence can be 3 out of 20 ponds in a farm. Partial harvesting in infected farms reduce losses. RMS is often reported in Indian shrimp farms. According to Ravi, this is rampant during the hot summer months when temperatures exceed 32°C. Shrimp consume more feeds and with poor assimilation, build up the organic load in ponds. Poor shrimp survivals in low saline ponds are due to mineral imbalances. Ravi suggested that shrimp breeding companies explore development of shrimp tolerant to high temperatures and low salinity.



Dr Victoria Alday-Sanz, National Aquaculture Group, Saudi Arabia (right) with Elizabeth Lee, AqualInfo (left) and Sera Kim, MyungSun, Korea. Victoria presented on SPF, SPR and SPT as part of a biosecurity strategy.



At a Genetics breakout roundtable, Dan Fegan, Shaun Moss, Oceanic Institute, Hawaii, Vidya Arumugam, Kemin Industries South Asia, India, Prensak Wanuchsoontorn, Charoen Pokphand Foods, Erin Tan, Syndel, Malaysia and Celia R Lavilla-Pitogo.



“ We need to formulate for a potential performance and not based on composition of feed ingredients and nutrients.”  
- Camilo Pohlenz



Vincent Percier, SPF-Diana Aquativ, France



Philippe Sourd, Aquativ, France (left) and Jesper H Clausen, INVE Aquaculture Thailand. Jesper presented on Shrimp Nurseries and Philippe co-presented with Vincent Percier on Supply Chain and Ingredient Excellence.

## Cold chain network for domestic markets

The final stage in the value chain is marketing shrimp. “When we produce more, where are we going to sell? We need to look for more markets. Our processors need to consider moving into the value added segment. Currently, our shrimp are sold to Thailand, Indonesia and Vietnam for value addition. India lacks a domestic market for its shrimp and the reason for this is the absence of a good cold chain network. In terms of demographics, with 1.2 billion population India has a potential domestic market. We should work towards this,” added Ravi.

## Disease is a game changer in Latin America

FAO reported an overall 95% rise in shrimp production in the past ten years in Latin America. There was only a small 5% decline in 2012 to 2013. The current strategy is to move toward a lower dependence on wild caught shrimp and the new normal is to increase farmed shrimp production, said **Dr Camilo Pohlenz**, Manager, Feed Trial Unit and Product Developer, BioMar Americas, Costa Rica. Major producers are Ecuador, Mexico, Brazil and Honduras.

“In 2015, Ecuador led with an industry estimate of 330,000 tonnes. In Mexico, the preliminary estimate by the Ministry of Agriculture was 130,000 tonnes for 2015. For Mexico, this was a significant improvement over the 87,000 tonnes produced in 2014. Overall, a 5% increase in production is expected in 2017, said Camilo. “In general, culture systems have remained extensive to semi-intensive in large earthen ponds, some as large as 100 ha. Stocking density range from 6-10 PL/m<sup>2</sup> for extensive to 15-30 PL/m<sup>2</sup> for semi-intensive culture. Our largest shrimp are 25 g and smallest are 12-16 g. Contrary to the demand in Asia for fast growth, in Latin America, the genetic pool has been driven towards disease resistance rather than growth.

“In the drive for a sustainable industry in Latin America, stakeholders realise that they need a back-up plan when the world wide industry recovers and perhaps also consider a genetic mix of disease resistance and growth together with bio secure, controlled shrimp farming models,” added Camilo.

While disease is a threat to an industry, which does not understand change, Camilo also sees it as an opportunity for the industry to grow and introduce new technologies, production systems and performance driven feeds. This is the game changer.

“In the years around 1989, we had the sea gull syndrome which made us aware of biosecurity and then came Taura syndrome, which led to genetic selection and legislative framework. WSSV came in 2002 and we learnt our lesson by lowering stocking density, strengthening sanitary surveillances and changing types of feed. We also became interested in more controlled production systems. In Mexico, before we could solve WSSV, we

had outbreaks presumed as early mortality syndrome. Industry implemented alternative farming systems such as easier to manage smaller (1.5 -2 ha) ponds, feeding trays, super intensive culture at 100-150 PL/m<sup>2</sup> and in Ecuador, recirculation systems. Ecuador picked up production while Mexico lagged behind. With health issues in Mexico in 2013, some farms changed to include three phase controlled production, obtaining very promising results,” said Camilo.

## Performance driven feeds

According to Camilo, Latin American shrimp farmers still demand fish meal in shrimp feeds as well as familiar raw materials. The feed producer has to see how this fits into the future need for sustainable feeds. At the same time, he sees disease as an opportunity for performance driven feeds. “Feed should not limit performance of shrimp and we need to formulate for a potential performance and not based on composition of feed ingredients and fixed nutrients. Aside from the usual requirements on FCR, reliability and efficiency, industry needs to accept the need to expand the raw material base. It is time we stop talking on crude protein and focus on available protein.”

In his presentation, he showed data on nutrient and essential amino acid availability in marine and vegetable meals. He also showed some trials on biorhythmic feeding of shrimp and made growth comparisons with crude versus available protein in diets. “Still there are important ‘unknowns’ in shrimp nutrition and different players may dictate the ‘degree’ of a given nutrient requirement based on size of shrimp, water conditions, density and special conditions such as the disease state. This will remove the reliance on ‘historic’ feed ingredients. Special attention must be put under ‘high pathogenic pressure’ and use of specific additives could aid to ameliorate the negative effects of diseases.”



N S Allada, Synergy Biotechnologies, India



Min Zhang, Roquette, China



“ With EHP, the growth ended at 12 g and only around 9 tonnes/ha. The value was only USD 3.5/kg but at that point the production costs were around USD 4/kg. ”  
 - Andy Shinn

## Putting a value on losses from diseases

Any loss from shrimp diseases is not only a catastrophe at the farm level but for the national industry. In the past two years, Andy Shinn, senior scientist, Fish Vet Group Asia Ltd, Thailand has been working on putting numbers to the losses from shrimp diseases. In his presentation on “The lost billions in Asia’s shrimp aquaculture industry” Andy described ways to calculate losses. In Thailand, a simple way is using the average price of shrimp; the loss was USD 5 billion since 2011 which may be attributed to AHPND.

“You can see the drop in containers passing through the Mahachai market. Using average prices/kg/day, we have USD 7.4 billion being lost. We cannot attribute all losses to one pathogen as we know that there are co-infections. When we translate these into real shrimp terms, we have an astonishing 3.5 trillion shrimp. In Thailand we see that productivity fell from 10.6 tonnes/ha in 2010 to only around 4.13 tonnes/ha in 2013 with AHPND outbreaks.”

In Vietnam’s Mekong Delta, to estimate losses, he used production areas with some assumptions on culture system intensity, area and stocking density. “In the case of AHPND, the assumption was 50% mortality of shrimp within 20 days of culture. Calculated losses from AHPND outbreaks reached USD 1.8 million for the monodon shrimp assuming 38% of production was from semi intensive and 63% extensive culture. In the case of the vannamei shrimp, it was USD 8 million as more ponds (52%) are semi-intensive. In the case of WSSV, we used 2% loss per day over a 110-day post stocking period. The disease caused losses of USD 2.3 million/year for the monodon shrimp and USD 5.6 million/year for the vannamei shrimp.”

Andy added that calculating losses from EHP outbreaks are more complicated as a high spore infection in the hepatopancreas affects the digestive capacity of the shrimp. “So we looked at a pond with a typical production of 110 days cycle harvesting 12 tonnes/ha of 18 g shrimp. With EHP, the growth ended at 12 g



Dan Fegan, SyAqua Thailand and Dustin Moss, Oceanic Institute of Hawaii Pacific University, USA at the Genetics group panel discussion

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“ There is a range of bacterial VP isolates of variable virulence. Some produce PirA/B-like toxins but vary in virulence that needs to be explained. Some produce no PirA/B-like toxins nor cause AHPND pathology but still cause significant mortality. ”  
 - Kallaya Sritunyalucksana



Catherine Lee, Blue Archipelago, Malaysia (left) with Celia R Lavilla-Pitogo, iAqua, Malaysia, who presented on managing EHP and production planning.



Jimmy Wang, Jade & Gold Agriculture Products, Taiwan (left) and Dr Le Thanh Hung, Nong Lam University, Vietnam.

and production was reduced to around 9 tonnes/ha. The value was only USD 3.5/kg but at that point the production costs were around USD 4/kg. The loss was calculated at USD 32,000/ha. When we apply these figures in Thailand where a recent survey suggested that 49% of ponds are infected, the economic loss is USD 76.4 million/year”.

The message was: “Collectively, all these diseases are having an impact on shaping aquaculture growth and production in Asia. There are two different investment models, the first being low intensity production with low biosecurity meaning there are high probabilities of disease outbreaks but losses are generally low when they occur. In contrast, high intensity production with high biosecurity means lower probability of outbreaks, but when outbreaks do occur, the losses are very high.”

## What's new on AHPND and EHP

Industry faces a high threat from the bacteria causing acute hepatopancreatic necrosis disease (AHPND) and more recently, a new microsporidian, EHP. In her presentation, **Dr Kallaya Sritunyalucksana**, Principal Researcher, National Center for Genetic Engineering & Biotechnology (BIOTEC), Thailand focused on the latest findings on the relationship between EMS and AHPND and what is known on EHP.

### AHPND

Work at BIOTEC showed that the virulence mechanism of AHPND-inducing *Vibrio parahaemolyticus* (VP<sub>AHPND</sub>) and that AHPND pathology in shrimp is caused by binary toxins called AHPND-ToxA (12.7 kDa) and -ToxB (50.1kDa) released from the bacteria colonising the shrimp stomach. The AP4 PCR detection method designed based on toxin information with highest sensitivity and specificity is now recommended to be used to ensure that post larvae and live feed are free of VP<sub>AHPND</sub> and to monitor shrimp during the culture period.

Next is the cohort epidemiological study of 200 pre-selected ponds from EMS/AHPND areas conducted with Dr. Varin Tanasomwang, Senior Expert at the Department of Fisheries. Ponds with early mortality (<35 days) were sampled immediately and sent for multiple analysis. All other ponds that showed no mortality before 35 days were sampled during 35-40 days and sent for the same multiple analysis. Only 30 ponds had EMS and in these only 40% was confirmed by PCR and 25% by histology that the cause of mortality was AHPND. These results suggest that AHPND is only part of EMS, i.e. AHPND does not equal to EMS. In addition, we also found that a low level of toxin or low concentration of VP<sub>AHPND</sub> did not cause cell sloughing, but collapsed epithelial of hepatopancreatic cells. The results from this study lead us to consider in redefining the case definition of AHPND.

“Recently, we found one VP isolate harbouring plasmid from Vietnam and one from Thailand that can kill shrimp, but not with AHPND. The take home message is that there is a different mechanism killing shrimp and is not through PirA/B-like toxin.”

Kallaya also described the synergistic effects of the bacteria *Shewanella*, which has been co-isolated with VP<sub>AHPND</sub> from the AHPND shrimp. Immersion with single bacteria of *Shewanella* at 10<sup>4</sup> CFU/mL or 10<sup>5</sup> CFU/mL VP<sub>AHPND</sub> can cause mortality at 45% and 20%, respectively. Combination of both bacteria with the dose indicated can cause 100% mortality suggested the synergistic effect of both bacteria.

“We conclude that there is a range of bacterial VP isolates of variable virulence. Some produce PirA/B-like toxins but vary in virulence that needs to be explained. Some produce no PirA/B-like toxins nor cause AHPND pathology but still cause significant mortality. We have more questions. Is virulence based on plasmid genes only? What about the prevalence of AHPND partners.”

### EHP

The transmission of EHP directly from shrimp to shrimp by cannibalism and cohabitation, makes its control difficult. In the Thai cohort study, there is a high incidence of EHP in shrimp ponds and higher prevalence in the pond that reported no shrimp mortality before 35 days.

Kallaya shared results from a CP study which showed infections of EHP was not correlated with survival, but with weight, average daily weight gain (ADG) and size variation (% CV).

“On the link between EHP and white faeces syndrome (WFS), our laboratory trial showed that shrimp fed with EHP infected hepatopancreatic tissue and became EHP-infected did not exhibit symptoms of WFS even after 30 days. We conclude that EHP is not the direct cause of WFS. Our co-habitation studies confirmed horizontal transmission of EHP.

“On detection of EHP, the recommendation is to use the SPW-PCR method rather than a 16s rRNA-PCR method. This is because we have found the possibility of cross-reactions of 16s rRNA primers to other microsporidian in other aquatic species, not in shrimp. We have also developed the simple spore staining method with 2% aqueous Phloxine B to be used in the field. Lately, we have developed the method to activate the polar tube extrusion from an EHP spore, which is a way to infect the host cell. An on-going study is to try the inhibit this process. ”

Going forward, Kallaya said, “With the genome sequence of EHP in cooperation with Exeter University and Cefas, UK, we can understand better the virulence mechanism of EHP. We are now working on the control of EHP based on the virulence genes we found from the EHP genome information.”

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“ The danger is that sooner or later, other compatible **Vibrio** species will also become weaponized by simple conjugation via Type 3 secretion systems (T3SS). ” - Ung Eng Huan



Poh Yong Thong, Gold Coin Aquaculture Group, Malaysia



Soraphat Panakorn, Novozymes Biologicals, Thailand presented on proactive management in today's shrimp farms

## Molecular mechanisms of AHPND

In Malaysia, **Ung Eng Huan**, Chief Technology Officer, Biovalence Sdn Bhd has been actively seeking some answers on three aspects on AHPND. The first is the cause of blebbing cell sloughing and collapsed tubules and the second, the differences in virulence of the AHPND causing bacteria, pir A/B PCR+ strains of *Vibrio parahaemolyticus* (Vp) and their association while the third is about how easy other *Vibrio* species could acquire the toxin carrying genes.

“In the early days of AHPND, we found that with more severity of the disease, there would be more sloughing of the hepatopancreatic cells. We decided to look at the molecular mechanism of blebs. Blebs can only be seen through transmission

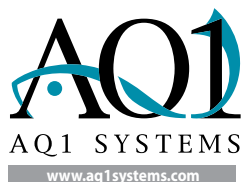
electron microscopy (TEM) and during a small window of 45 minutes. The presence of zonal occludens toxin (ZOT) explains why cell sloughing of intact hepatopancreatic tubular cells occurs into the lumen during the early onset of the disease. ZOT acts by attacking the tight intercellular junctions.

“We also know that Vp bacterial strains are different from each other and that virulence may vary. We wanted to understand the level of virulence. Prophage elements linked toxic genes in strains of Vp are capable of producing histologically confirmed signs of the disease linked to toxic genes. These virulence/toxin genes were conferred by a lysogenic phage. ZOT on prophage 3 showed higher virulence than ZOT on prophage 2 but together, the virulence multiplies,” added Ung.

# AQ1 SOUND FEEDING

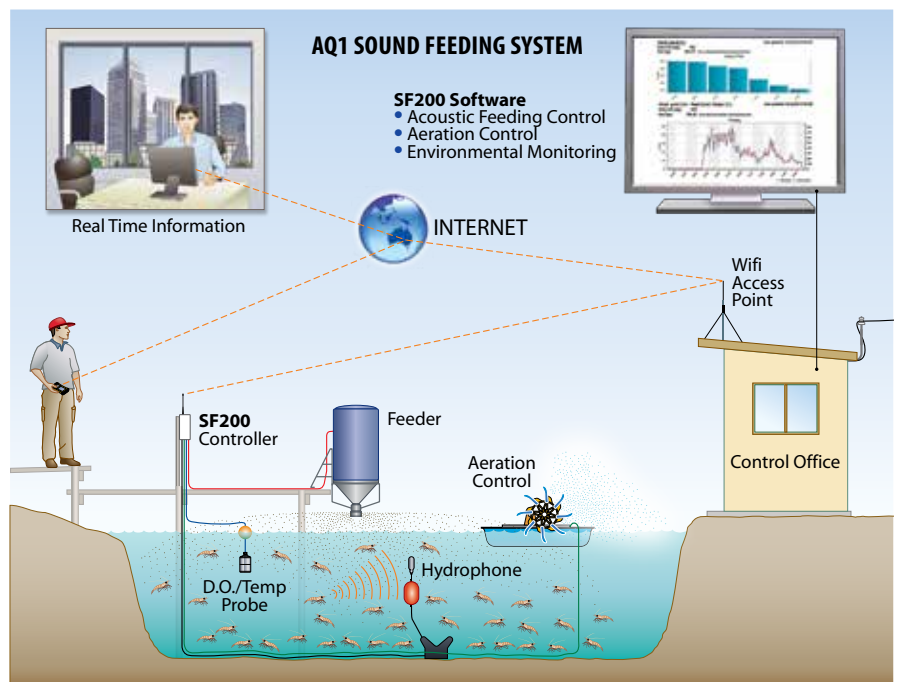
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“ We never speak that 100% an outbreak will not happen. When we are not ready, this will happen. ” - Maria Mercè Isern i Subich



Dr Kabir Chowdhury, Jefe Nutrition, Canada (left) reviewed nutritional solutions in dealing with diseases and Dr Daranee Sookying, DSM Nutritional Products, Thailand, who gave perspectives from the feed industry on disease mitigation via nutrition.

Bioinformatic evidence first presented during DAA9 in Ho Chi Minh City also showed that ZOT may have originally come from a species of *Shewanella* and that the presence of prophage elements is evidence of how bacteriophages were historically involved in the transduction.

“We have also carried out co-incubation experiments to show that a strain of pir A/B+ *V. parahaemolyticus* was able to quickly and easily transmit pirA/B to a strain of non-pirA/B *V. alginolyticus*, which explains recent reports of other *Vibrio* found with these genes. The danger is that sooner or later, other compatible *Vibrio* species may also become weaponized by simple conjugation via Type 3 secretion systems (T3SS). This may offer the potential for other compatible species that have other toxins to act in synergy with pirA/B or ZOT and give rise to an even more virulent pathogen. There are now also reports of pirA/B-containing strains that do not show cell sloughing despite mortalities being observed. We suggest investigating if ZOT is also present in these strains because these might be caused by just pirA/B toxicosis acting independently.

Although there were some negative statements on farmers seeking for ‘silver bullets’ to overcome disease, Ung said that as a biotech company, their role is to bioprospect potential bacteria showing inhibition of the pathogenic Vp and find the proverbial silver bullet. Biovalence has a candidate bacteria called B11 which when encapsulated and fed to shrimp showed survival up to 92% after day 18 in a typical Loc Tran challenge. However, the next challenge is post pellet addition onto feeds as the bacteria is negatively affected by high pelleting temperatures.

## Prevention with a health management program

Many of the emerging diseases in shrimp are not fully understood. Often there is little that can be done at the therapeutic level when there is an outbreak. Industry should consider preventive or prophylactic measures to secure their business. With an extensive background in running a fish health management program at a Mediterranean fish farm, **Dr Maria Mercè Isern i Subich**, Business Development Manager Aquaculture Health, Nutriad International NV, Belgium gave her take on the needs for similar approaches in Asia’s shrimp farming business.

According to Maria Mercè, in the European Union more legal restrictions on the use of antibiotics and chemical treatments in fish farming are being imposed. “These result in rigid controls of residues implemented to protect the end users in all major shrimp markets. Consumers are asking for higher standards to ensure food safety, making it even more complicated to control of some disease. Certification programs are strict with a higher frequency of audits.”

Similarly, health management, aimed at disease prevention and avoiding the costs of disease and corrective measures

is becoming a must for the shrimp industry to maintain its sustainable and profitable growth,” added Maria Mercè. “The set-up of proper strategies needs to involve administrations, governments, academics and researchers, suppliers and then industry and farmers.

There is a need to establish the status of the epidemiological unit for each specific disease of interest comprising historical data and surveillance. “We never speak that 100% an outbreak will not happen. When we are not ready, this will happen. We are balancing risks of doing or not doing, having or not having a program. This is the hidden part of biosecurity.

In aquaculture, few are able to work in closed environments. We may think that we are isolated but are actually not. The farmer should ask how will production affect the environment and how will the environment impact the farm. A good example is control of sea lice in Norway. This shows organization at the farm, zone, area, region and country level. Here the farms in 550 sites with 8 cages/site submit data on prevalence of sea lice in salmon and 10 fish from four cages at each site are counted each week for sea lice. With the years, strategies were developed into biological, mechanical plans to remove the sea lice menace from farms favouring biological treatments and working to reduce optimized medical treatments as the latest solution.

How does this apply to shrimp farming? Maria Mercè said that this starts with control and optimization conditions of the shrimp (SPF/SPR, age and husbandry, feeding and optimal nutrition) and control the environment. “Something to learn is how the fish industry is very concerned with fallowing, not because they want to do this but because there is a need. Disease surveillances and monitoring includes all mechanisms to know the health situation of the farm. For example, disease monitoring and checking for lipid droplets in the hepatopancreas as signs of a healthy animal and early detection of pathological changes.

“We cannot manage what we do not know we have and we will not find it if we do not look for it. Surveillances and monitoring will allow to implement tailor made procedures and strategies for the farm to avoid the consequences of disease,” concluded Maria Mercè.

**TARS 2017 will focus on Finfish Aquaculture. Updates will be available at [www.tarsaquaculture.com](http://www.tarsaquaculture.com)**

**Next issue: Part 2 of this TARS 2016 report will cover presentations on weak links in the supply chain, disease mitigation and building a sustainable shrimp industry.**

## Mitigating the high risks of WSSV and AHPND outbreaks

By Leobert D. de la Peña, Westly R. Rosario, Rodolfo V. Zamora, Jr., Mary Ann C. Solis and Cary P. Andigan

In the Philippines, training on sustainable aquaculture practices at the Shrimps School is nurturing a new generation of shrimp technicians.

The aim of the Shrimps School is to employ modern techniques in the culture of white shrimp. It was established by Dr Westly R. Rosario, chief of BFAR-NIFTDC. The school is located at the Bureau of Fisheries and Aquatic Resources-National Integrated Fisheries Technology Development Center (BFAR-NIFTDC) complex, Bonuan-Binloc, Dagupan City, Philippines. BFAR-NIFTDC partnered Biosolutions International Corporation to implement the program. On the part of Biosolutions, the project which began in 2014 is part of their corporate social responsibility program.

This is the first and only Shrimps School in the Philippines for hands-on and field training for fisheries students of colleges and universities, local government units (LGUs) as well as potential shrimp investors. The site is at the tip of San Fabian River and has four 0.13 ha ponds comprising a reservoir/treatment pond, *Molobicus* tilapia greenwater pond and two grow-out ponds. Each pond is HDPE-lined and 2 m in depth.

The major problem the farm has encountered with vannamee shrimp during previous harvests was very low productivity due to recurring disease outbreaks. A previous white spot syndrome (WSSV) outbreak caused 100% mortality in the grow-out ponds. Another threat is acute hepatopancreatic necrosis disease (AHPND) which also causes mass mortalities in shrimp farms and is caused by the toxin-producing strain of *Vibrio parahaemolyticus*.

To alleviate this problem, Shrimps School is adapting the Biosolutions International Corporation's aquaculture technology which embraces the concept of a semi-closed system and uses INVE (Belgium) aquaculture products. The water is disinfected with INVE Aquaculture's organic disinfectant and virucide to prevent the entry of WSSV, AHPND and other pathogens in the culture system. Advanced probiotics for water and feeds, vitamins and immunostimulants were also applied. Application of trace elements is done from the pre-culture phase to improve the mineral content and the growth of phytoplankton in the water during the culture period. Rigid biosecurity measures are also implemented in the farm.

### Key factors for the success and sustainable operation

The following are some of the factors attributing to successful crops at the Shrimps School.

#### Strict fry quality screening and proper handling

High health fry from specific pathogen free (SPF) broodstock are used. At post larvae (PL7) and PL10, laboratory analysts monitor the accredited hatchery stock until harvest. Samples are submitted to the laboratories of Negros Prawn Producers Cooperative (NPPC), BFAR, and Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC/AQD).

Microscopic and bacterial analyses include total plate count (TPC), total *Vibrio* count (TVC) and total luminous bacteria count (TLC). PCR analyses for the major diseases WSSV, infectious hypodermal and haematopoietic necrosis virus (IHHNV) and AHPND are carried out to ensure that the stock is free from bacterial and viral pathogens. Proper transport and acclimation techniques during stocking are also observed.

#### Pond liners

High-density polyethylene (HDPE) liners are installed in each pond to prevent crossover contamination of various pathogens and reduction of water level due to seepage.

#### Pond preparation

Disinfection of all pond paraphernalia, installation of fences, filter bags and aerosol barriers, and positioning of paddle wheels and AirO<sub>2</sub> are done prior to stocking. Water from the shallow well is tested for bacterial load especially for *V. parahaemolyticus*, which is responsible for AHPND.

#### Greenwater culture system and probiotics

Green water culture system using appropriate *Molobicus* tilapia biomass (2-3 tonnes/ha; average body weight (ABW 60-100 g) is employed to minimise the growth of pathogenic *Vibrio*. Water from treatment ponds filtered in 5-10 µm filter bag is used. The use of probiotics in rearing water and daily monitoring of physico-chemical parameters are also implemented to maintain good water quality.

#### Rearing water

Water from *Molobicus* tilapia greenwater pond with a minimum depth of 1 m, is used. There are applications of probiotics and trace elements in the rearing for 7-10 days with minimum aeration (2 units of 1 HP paddle wheels in 1,300 m<sup>2</sup> pond area).

#### Stocking of fry

Fry are transported at the density of 2,000 fry per bag with 2.5 L of water. Upon arrival in the farm, fry bags are treated with organic disinfectant and virucide and rinsed with water before acclimation for at least 1 h in canvas box within the ponds with minimum aeration.

#### Feed supplementation

A proper feeding schedule includes blind feeding for 30 days of culture (DOC) with post-larval feeds for 15 days. Feed was supplemented with probiotics, vitamins and immunostimulants from DOC 2 onwards to meet the dietary requirements of the stock.

#### Water management

An in-house laboratory monitors physico-chemical parameters, phytoplankton count and bacterial loads in the farm. Every 15 days, organic disinfectant and virucide is applied periodically to lower bacterial and viral loads, as well as trace elements at 5-10 kg/ha to stabilise algal bloom and probiotics to sustain good water quality.

#### Biosecurity

Preventive measures such as one-entrance-one exit policy for water intake and discharge, prohibition of crustacean food, restriction of vehicles and personnel movement, foot and tyre

bath, handwashing, aerosol barrier and bird scare are being implemented to prevent the entry of pathogens into the farming system.

### Shrimp health management

Monitoring especially for AHPND as well as WSSV is done every 7 and 15 days, respectively. If there is heavy infection of WSSV in the stock, the culture is aborted but if the infection is low, the culture is continued but the ponds are quarantined and screened every 5-7 days instead of 15 days. During this period, interventions such as water treatment with organic disinfectant and virucide to reduce viral and bacterial loads, supplementations of probiotics, vitamins and immunostimulants in double dosages in feeds and addition of probiotics in rearing water are implemented. In addition, there is also an in-house laboratory for monitoring physico-chemical parameters. Bacterial analysis of both shrimp and rearing water are carried out once and twice a week, respectively.

### Challenges

Some of the significant challenges encountered were ammonia and *Vibrio* build up. Trace elements and probiotics were applied daily to lower the ammonia level. To lower the *Vibrio* levels, organic disinfectant and virucide was applied to the rearing water followed by the application of probiotics. Phytoplankton die off was also one of the major problems which was solved by the daily application of trace elements and probiotics accompanied by water change of at least 10 cm. There were significantly lower ammonia and *Vibrio* levels during periods when these products were applied (Figure 1).

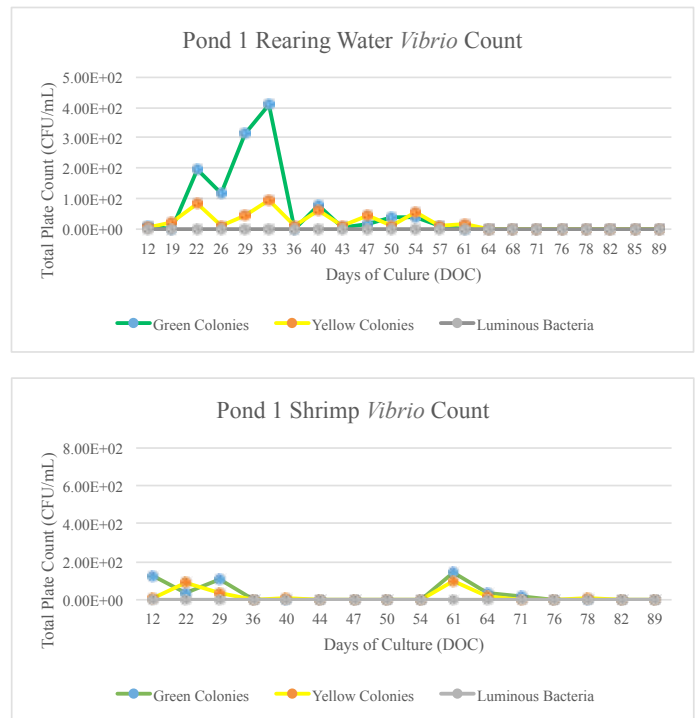


Figure 1. Total *Vibrio* count of water and animal samples during the first cropping



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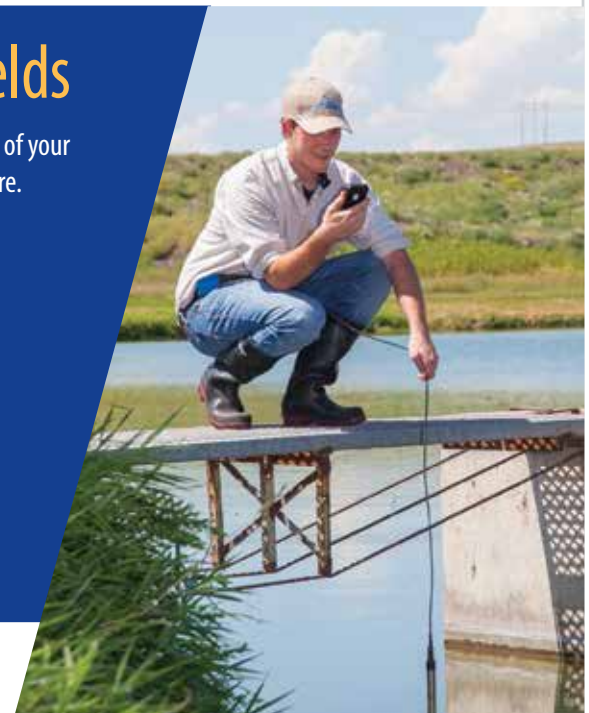
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## Shrimps School and farm output

Since it started, 103 students from 13 state colleges and universities have benefited from the Shrimps School - 43 from Region I (Ilocos Region), 14 from Region 3 (Central Luzon), 20 from Region IV-A (CALABARZON), 14 from Region IV-B (MIMAROPA), 8 from Region IX (Zamboanga Peninsula) and 4 from Region XIII (CAR). These students formed a technical human resource pool that can be employed anytime in shrimp farms.

Moreover, very good survival rate of almost 72-100%, FCR of 1.08-1.31 and biomass of 1.04-2.10 tonnes per pond (1300m<sup>2</sup>) with ABW 14.00-16.66 g were achieved after 90-94 DOC of vannamei shrimp in two grow-out ponds initially stocked at 92-166 PL/m<sup>2</sup> (Table 1).

Biosolutions International Corporation's aquaculture technology has been successful in mitigating the high risks of WSSV and AHPND outbreaks. Good production in the farm was also achieved with the use of its effective products and working aquaculture technology.

Table 1. Production data of the three crops

	1 <sup>st</sup> Crop (May-Aug 2015)		2 <sup>nd</sup> Crop (Oct-Dec 2015)		3 <sup>rd</sup> Crop (Feb-May 2016)	
	Pond 1	Pond 2	Pond 1	Pond 2	Pond 1	Pond 2
Biomass/ pond (tonnes)	1.98	1.90	1.04	1.15	2.10	2.04
Biomass/ ha	16.50	14.60	8.60	8.80	17.53	15.71
FCR	1.10	1.08	1.31	1.13	1.17	1.16
ABW (g)	16.66	14.00	16.35	15.50	14.08	12.26
DOC	90	90	90	90	94	94
Survival (%)	100.00	100.00	72.00	78.00	81.60	90.60
Stocking density (PL/m <sup>2</sup> )	100	108	92	86	166	165



The stock was hit by WSSV during the second crop but with prompt mitigation intervention with the use of appropriate products, the crop was able to make it until harvest (Table 2). The stock was also infected with IHNV at the start of the third crop, which also encountered very high temperature and salinity throughout the cycle due to the El Niño phenomenon. Despite these adverse conditions and high stocking density of 160 PL/m<sup>2</sup>, a biomass of 16 tonnes/ha with feed conversion ratio (FCR) of 1.16 were achieved at harvest.

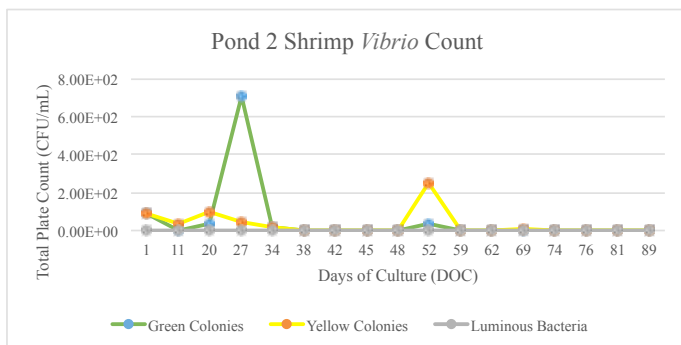
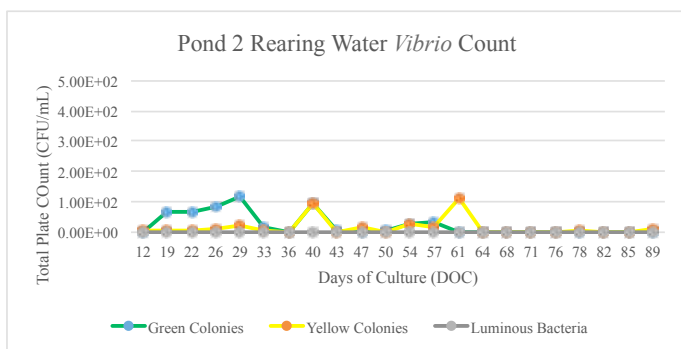


Figure 2. Total *Vibrio* count of water and animal samples during the second cropping



*Leobert  
D. de la Peña*



*Westly R.  
Rosario*



*Rodolfo V.  
Zamora, Jr*



*Mary Ann C.  
Solis*



*Cary P.  
Andigan*

**Dr Leobert D. de la Peña** is Shrimp Health and Biosecurity Consultant. Email: leobertdelapena@yahoo.com

**Dr Westly R. Rosario** is Center Chief, BFAR-NIFTDC.

**Rodolfo V. Zamora, Jr** is General Manager and **Mary Ann C. Solis** is Sales and Marketing Manager at Biosolutions International Corporation, Philippines.

**Cary P. Andigan** is an Aquaculture Consultant.

# Compound feeds for grouper aquaculture – why has adoption been so poor?

By Michael A. Rimmer, Wajan Sudja, Denny D. Indradjaja, Nyoman Adiasmara Giri and Asda Laining

Perspectives from grouper farmers, researchers and commercial feed companies at a workshop in Bali.


Groupers (Family *Serranidae*, Subfamily *Epinephelinae*) are farmed in many countries in the Asia-Pacific region. Global production in 2014 was 140,000 tonnes valued at USD 655 million (FAO data 2016). The three largest producer countries are China, Taiwan and Indonesia; production from these three countries combined makes up around 91% of the total global grouper aquaculture production (FAO data 2016).

With aquaculture generally under siege on issues relating to environmental sustainability, a major concern with grouper aquaculture is its continuing reliance on the use of 'trash' fish as a feed source. 'Trash' fish is defined as 'fish that have a low commercial value by virtue of their low quality, small size or low consumer preference' (FAO, 2011). Compound feeds (usually extruded pellets) are available in most countries in the region, although many of these are generic 'marine finfish' feeds rather than dedicated species-specific feeds. Despite this availability, the adoption of compound (pellet) diets for groupers in the


Asia-Pacific region has been relatively poor and most grouper production throughout the region is still heavily reliant on the use of 'trash' fish (Kongkeo et al., 2010).

'Trash' fish may be collected locally. In southern Thailand, some small fish farms have a lift net adjacent to the cages to supply 'trash' fish feed. Trash fish may be provided from capture fisheries either locally or some distance away from the farm. In northern Bali much of the 'trash' fish is imported from East Java. Depending on the size of the 'trash' fish and the size of the cultured fish the 'trash' fish may be chopped into small pieces before being used as feed. The prepared 'trash' fish are scooped up and thrown into the cages. Feeding is usually done to satiation, i.e. the cultured fish are fed until their feeding activity decreases substantially.


To examine the issue of adoption of pellet diets in more detail, and to suggest new approaches to improve adoption, we arranged a workshop for grouper farmers, nutrition researchers and commercial feed companies in Bali in September 2014. The workshop was supported by the Australian Centre for International Agricultural Research (ACIAR), which has invested in research to develop compounded feeds for grouper since 1999 (Rimmer et al., 2004).




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The workshop was attended by researchers, representatives of Indonesian aquafeed companies, and grouper farmers

## Pellet feed for groupers

There has been substantial research into the nutritional requirements of groupers, and these are now well established (Luo et al., 2005; Williams, 2009). At the workshop, Professor N.A. Giri from the Institute for Mariculture Research and Development (IMRAD) at Gondol, Bali, provided detailed examples of the various nutrition experiments that have been done by IMRAD Gondol, including: crude protein and crude lipid requirements, n-3 highly-unsaturated fatty acids (HUFA) requirements, amino acids (methionine, lysine, arginine), and Vitamin C requirements. Based on these research findings, a formulation for grouper feed should have:

- Protein: 47 – 48 %
- Lipid: 9 – 12 %
- Protein/energy ratio: 26 g/MJ
- n-3 HUFA: > 1.5%
- Vitamin A: > 4000 IU/kg (retinol = 1200 mg/kg)
- Vitamin C: > 50 mg/kg (stable form, e.g. APM)
- Vitamin E: > 100 mg/kg (as DL- $\alpha$  tocopherol acetate)
- Vitamin B1: > 1.2 mg/kg

Giri pointed out that marine finfish such as groupers, which are generally cultured in floating net cages in the sea, have specific dietary requirements. This means that compounded feeds have to meet all these requirements to support good growth and health of the fish; in other words a 'complete feed' is required. This is in contrast to feeds for some freshwater species that do not need to be complete because many freshwater fish can obtain some nutrition from food sources in the pond.

## Constraints to adoption of pellet feeds

The workshop discussed the reasons why grouper farmers are reluctant to adopt pellet feeds. Foremost amongst these reasons are the relatively high price of pellet feeds (compared with 'trash' fish) and the growth performance of grouper fed pellet feeds only is usually inferior to those fed 'trash' fish.

## Cost

Pellet diets are usually more expensive than 'trash' fish, not only on a per-weight basis, but also after taking into account feed conversion ratio (FCR) values. Dr Denny Indradjaja, representing the Indonesian Feedmills Association (GPMT) noted that about 85% of the cost of aquafeed comes from the cost of the raw ingredients, and ingredient costs are generally increasing due to the following reasons:

- the cost of imported raw ingredients is increasing due to supply shortages and exchange rate fluctuations;
- the cost of local (Indonesian) raw ingredients is increasing because of competing export demand (e.g. rice bran, dried cassava);

- the higher protein content of marine finfish feeds (compared with freshwater fish feeds) results in a higher priced product.

An earlier study by Sih-Yang Sim (Sim, 2006) evaluating the economics of grouper aquaculture in Thailand, Vietnam and Indonesia indicated that a break-even FCR for 'trash' fish was around 13:1. In other words, using 'trash' fish as the feed for grouper was more cost effective at (wet weight: wet weight) despite FCRs up to 13:1. At higher FCR values, pellet feed is more cost effective. However, in our experience FCRs for grouper culture using 'trash' fish as feeds are much lower than 13:1 (generally between 5:1 and 8:1) indicating that 'trash' fish is a more cost-effective feed for grouper aquaculture. FCR values are very much influenced by the quality or freshness of the 'trash' fish used.

## Performance

Giri noted that trials comparing commercial grouper or marine fish pellet diets with research pellet diets formulated to the same specification had demonstrated similar growth performance. However, when comparing pellet diets with 'trash' fish, growth performance is better with 'trash' fish. Giri provided examples of growth trials comparing the use of pellet feed with 'trash' fish in humpback grouper (*Cromileptes altivelis*), coral trout (*Plectropomus leopardus*) (Fig. 1) and sand grouper (*Epinephelus corallicola*). In all cases growth on the 'trash' fish diet was superior to that of fish fed the pellet diets.

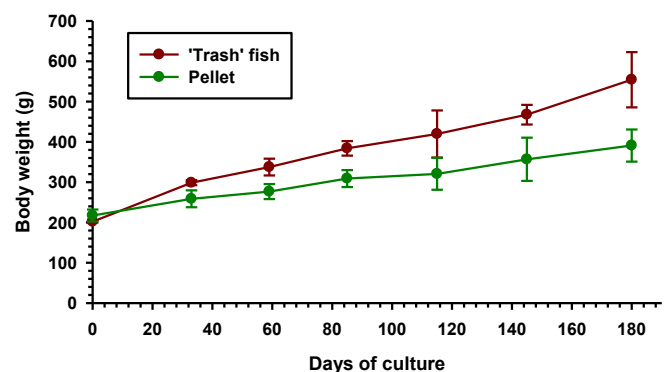


Figure 1. Comparative growth of common coral trout (*Plectropomus leopardus*) fed a custom-made pellet diet and 'trash' fish over a six-month period. Data points are average body weight 3 standard deviation.

“ A key issue in acceptance of pellet feed by groupers is weaning the groupers at an early age (1–2 months) to pellets; they will more readily accept pellets than fish weaned at a later stage. ”



Small goatfishes (Family Mullidae) called 'biji nangka' are the preferred feed for grouper farmed in northern Bali

### Availability

Pellet feeds, particularly in remote locations may not be available. Most grouper aquaculture is carried out in remote areas. Distribution networks are not well developed in many parts of Indonesia. Consequently, pellets are frequently transported long distances by truck, exposing the feed to hot, humid or wet conditions. This can lead to rapid degradation of some feed components, particularly vitamins, or even feed spoilage. Transport

over long distances and multiple transfers cause breakage of the pellets, resulting in a high proportion of 'dust' which cannot be used and contributes to feed waste. In addition, in Indonesia transport costs are rather high and add considerably to the cost of the pellets.

### Acceptance to fish

Grouper acceptance of pellet diets is generally poorer than their acceptance of 'trash' fish, which after all is their diet in the wild. A key issue in acceptance of pellet feed by groupers is weaning the groupers at an early age (1-2 months) to pellets; they will more readily accept pellets than fish weaned at a later stage. To get the best acceptance of pellet feeds they must be used consistently from early weaning in the hatchery throughout the nursery and grow-out phases.

### Acceptance by farmers

It was noted that many farmers have no experience with using pellet feeds and are often reluctant to change to a new approach, being more comfortable with using 'trash' fish. Most farmers are also price oriented, preferring to use feeds that are cheaper and provide good results, as opposed to focusing on cost reduction through good feed and feeding management to reduce wastage (Sim, 2006).

### The feedmill perspective

From the feed mill perspective the market for grouper, or even for 'marine finfish' feed in Indonesia is small compared with the markets for freshwater fish and shrimp feed, and demand for pellet feed for marine finfish fluctuates. Farmers request a 'slow-sinking' pellet which is more difficult to produce than a floating or sinking pellet.

The reason for this small demand is that marine finfish aquaculture in Indonesia is a relatively small sub-sector compared with other commodities. In 2014, Indonesia produced an estimated 12,430 tonnes of farmed grouper and around 4,440 tonnes of farmed barramundi or Asian seabass (*Lates calcarifer*). Compared to shrimp production which was estimated at 600,000 tonnes in 2014 or tilapia production at around 900,000 tonnes (KKP, 2014), the market for feed for marine finfish is relatively small. From an economic perspective, feedmills prefer to invest in feeds for commodities for which the market is much larger, such as shrimp or freshwater fish.

### How can pellet feed adoption be improved?

The workshop recognised that adoption of pellet diets by farmers has been very slow, for the reasons listed above. For farmers to adopt pellet diets, the diets need to show an advantage over

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In contrast to groupers, barramundi or Asian seabass (*Lates calcarifer*) are usually fed a pellet diet, which they devour actively

'trash' fish. It is now clear that for groupers there is no growth performance advantage provided by using pellets. In addition, research has been unable to show improved survival associated with feeding pellets compared with 'trash' fish (Bunlipatanon et al., 2014). Some recent research has indicated that parasite transmission may be reduced by feeding pellets instead of 'trash' fish (Rückert et al., 2009), but it is not clear whether this provides an economic advantage to the farmer.

One alternative is the use of a 'moist' pellet, which mixes 'trash' fish with other ingredients. A formulation suitable for groupers, and with instructions for preparation, is provided in Sim et al. (2005). Using this formulation, the quantity of 'trash' fish used in the diet is reduced by about 40%. However, it is difficult to reduce this much further because of the complexities of incorporating different feed ingredients in fish diets. Moist pellets can be made locally, using some local ingredients, but, unlike dry pellets, cannot be stored. While the use of moist pellets has been proposed since the last decade, there has been little adoption by marine finfish farmers.

The workshop noted that there was increasing interest in the region in large-scale culture of marine finfish species such as barramundi and pompano (*Trachinotus* spp.). Compound feeds marketed as extruded pellets are available for these species. Both barramundi and pompano perform well when fed 100% on such feeds. Importantly, extruded feeds are well suited to the culture systems in use for barramundi and pompano, which are generally categorised as 'large-scale' farms. The use and improvement of pellet diets may be more effectively focussed on these farms, rather than the smaller grouper farms.

The meeting noted that the Indonesian government has a target of 12,000 tonnes of marine finfish production and that this target cannot be met using 'trash' fish. If the government wants to meet this target, they need to provide technical support and incentives to improve the adoption of pellet diets. Forms of government support could include:

- training of farmers in the storage and use of pellet diets;
- improvement of transport and storage infrastructure;
- development of certified local fishmeal sources;
- scale-up of research results.

The workshop also agreed that ongoing collaboration between researchers, farmers and feedmills would be advantageous in improving the quality of grouper feeds, and supporting better adoption amongst farmers.

We hope that the outcomes of this workshop will provide a policy basis for enhanced sustainability of grouper aquaculture in Indonesia.

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References are available on request



Mike Rimmer



Wajan Sudja



Denny D.  
Indradjaja



Nyoman  
Adiasmara Giri



Asda Laining

**Mike Rimmer** is a Senior Research Fellow with the University of Sydney in Australia. Email: mike.rimmer.ind@gmail.com

**Wajan Sudja** is the Secretary-General of the Indonesian Mariculture Association (Asosiasi Budidaya Ikan Laut Indonesia - ABILINDO).

**Denny D. Indradjaja** is Chairman of the Indonesian Feedmills Association (Gabungan Perusahaan Makanan Ternak - GPMT).

**Nyoman Adiasmara Giri** is a senior research scientist with the Indonesian Agency for Marine Affairs and Fisheries Research and Development (AMAFRAD), Ministry of Marine Affairs and Fisheries (MMAF), based at the Institute for Mariculture Research and Development, Gondol, Bali.

**Asda Laining** is a senior research scientist with AMAFRAD, MMAF, based at the Research Institute for Coastal Aquaculture, Maros, South Sulawesi.

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## Commitment to farms in Vietnam and India

By Zuridah Merican

In this sixth year of operations in Vietnam, Sheng Long moves to support tilapia farming in Vietnam and develop the new shrimp feed business in India.

Vietnam's aqua feed market has been rather challenging for its feed producers. In the largest feed market for the pangasius, almost all of the large integrators have their own feed production units. Consequently, most of the foreign owned fish feed producers are instead focusing only on the starter feed segment for the pangasius, but on the starter and grow-out feeds for marine fish and other freshwater fish. Today, there is a potential feed market for the tilapia which the government plans to increase production to 300,000 tonnes by 2020 (VASEP, 2016).

Tilapia will be the next focus for Sheng Long Bio-Tech International Co Ltd or Thang Long as it is known in Vietnamese. This subsidiary of China's Guangdong Haid group up scaled its feed production in 2013 with three feed mills in Long An, Binh Duong and Khanh Hoa provinces. These have a total production capacity of 250,000 tonnes per year (tpy) of both shrimp and fish feeds. Its 2015 expansion with new feed lines, allowed Sheng Long to further increase production of shrimp feeds as well as begin the production of fish feeds. In 2015, it sold 20,000 tonnes of fish feeds.

"In our early days, growth was a 100% and now after 5 years, we expect to continue growing our feed markets in Vietnam but at a lower rate of 40% in 2016," said Jeff Jie Cheng Chuang, General Manager.

### Shrimp feed business

In the past 6 years, Sheng Long has shown success in the shrimp feed business in Vietnam. In 2015, it was among the top four leading producers of shrimp feeds in Vietnam, producing 16% of the 700,000 tonnes shrimp feed market. This is an increase of 20% over the volume in 2014. It sells to both small-scale shrimp farms as well as large ones such as the BIM group. Chuang attributes this success to its distributors and 150 biologists providing services and technical support throughout Vietnam.

To support the shrimp aquaculture industry with quality post larvae, Sheng Long has one hatchery complete with a brood stock maturation centre which produces 600 to 700 million post larvae in Ninh Thuan. It also has nursery facilities in Tien Giang and Hue which supply larger post larvae as well as post larvae acclimated to salinity of farmers' ponds. They are also located close to farming areas to reduce distances to transport post larvae.

Sheng Long has the support of the R&D team at Guangdong Haid. At the experimental farm in Vietnam, both are looking at shrimp farming models to prevent or at least minimise the spread of the early mortality syndrome, which is adversely affecting the industry in Vietnam. These models include the polyculture of shrimp and tilapia, biofloc technology and a new stocking model called 'babycare' to improve the survival of post larvae or juveniles in ponds. Ultimately, the aim is to use science to develop a 'Sheng Long ecological farming model'.



Jeff Jie Cheng Chuang (right) with Maple Hung

### New focus on fish feeds

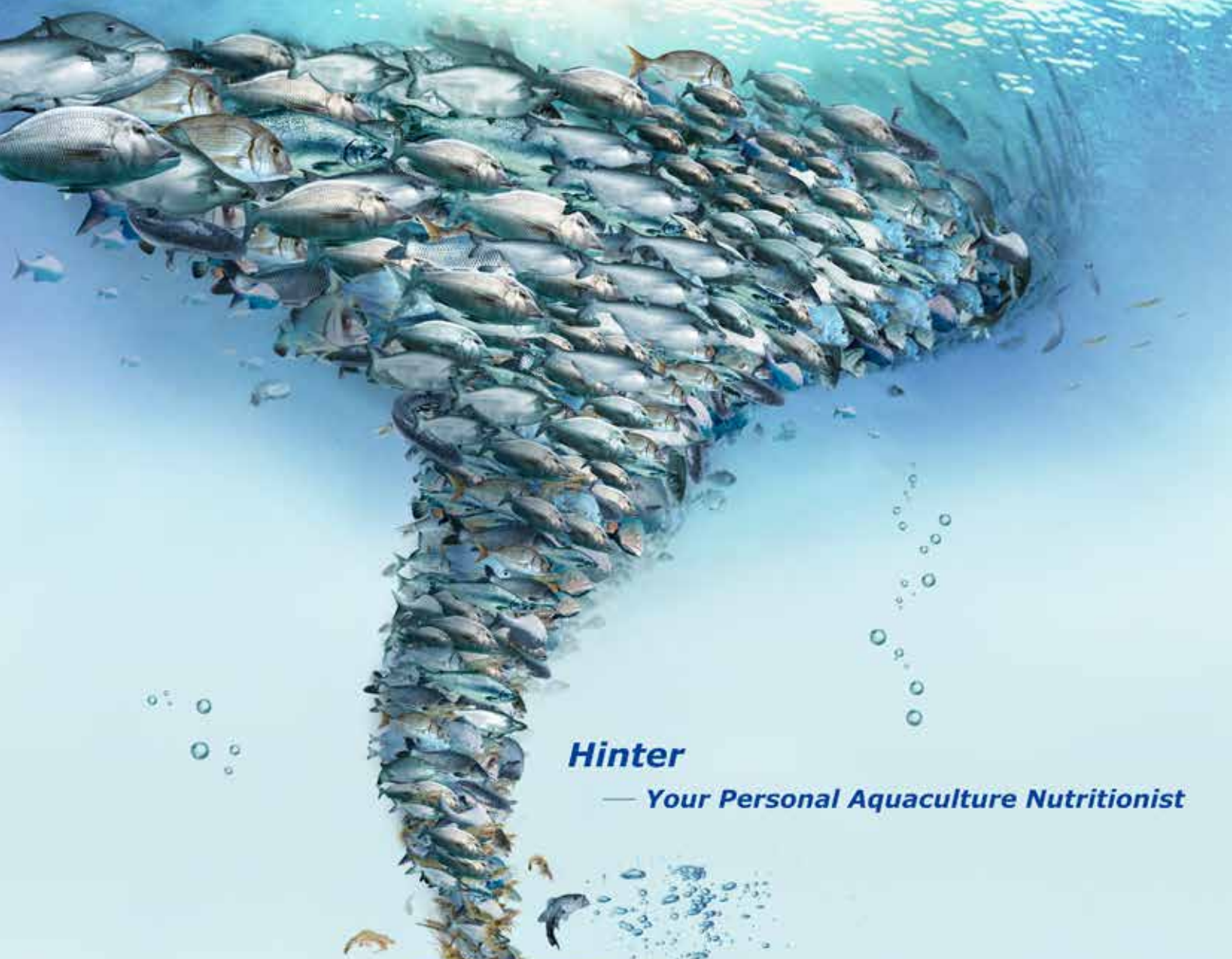
"We have very positive outlooks on the aqua feed market in Vietnam and the total aquaculture production for the country. Our new focus will be on the tilapia feed market. Today our market share for tilapia feeds is very small but we are getting ready for an expansion in feed production and the construction of a hatchery," said Chuang.

Sheng Long plans to further increase its fish feed production from 2016 onwards. The estimated 80,000 tonnes of fish feed in 2016 will increase with the addition of another feed line. It also plans to build another factory in Long An Province in 2017 with two lines each for shrimp and fish feed production. This will have a production capacity of 120,000 tpy of fish feeds and 60,000 tpy of shrimp feeds.

"We are now the leading supplier of feeds for the snakehead fish in Vietnam. This happened because we successfully adapted the feed formulation for the snakehead species in China into one suitable for the local species here in Vietnam. Because of the popularity of our snakehead feeds, most of our feed lines are being used to produce snakehead feeds. Additional new lines will allow us to increase and explore the production of more feeds for other species. We can see that the future demand will be for tilapia feeds. We are ready to develop tilapia feeds but first, we need to invest to support the tilapia hatchery and farming segment.

Chuang added that, "Alongside this, we also need to expand production of feeds for marine fish. We export most of our small production of marine fish feeds to Malaysia for the farming of groupers and seabass. For the market in Vietnam, we will work on feeds for the pompano, a popular species in the region and China."

**“ We cannot compete with China, the market leader in the global market for whole frozen fish. We may need to study the frozen fillet market, which means that we need to encourage farmers to grow fish to 1.2 to 1.5 kg sizes. It follows that we should develop a model to farm larger fish, ” - Chuang**



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On 20 August 2016, Chuang (centre right) and Hung (centre left) participated in the inauguration of the aquatic service centre in Sirkali, Tamil Nadu. Third on the right is Kumaresan, Director-Marketing, Sheng Long Bio-Tech India Pvt Ltd.

## Support for tilapia farming

According to Chuang, there are constraints in tilapia aquaculture in Vietnam where tilapia is farmed in cages and earthen ponds. Firstly, there is a lack of hatcheries to supply good quality fry and fingerlings. Initially, Sheng Long will import broodstock from the broodstock development program at the parent company in China. These will form the founder stocks for its breeding program in Vietnam. It will set up a hatchery to supply fry and fingerlings to farms. Secondly, it will demonstrate tilapia farming models to Vietnamese farmers. One example will be to farm tilapia in shrimp ponds where water salinity is only 5-6% and the tilapia: shrimp ratio is 50:50, or to farm shrimp using outflow water from tilapia ponds.

“We are collaborating with Vinh Hoan, a leading processor in Vietnam which also has many farms. Currently, the harvest sizes are 600 g to 1 kg fish and the preference is the red tilapia for local markets. However, with this harvest size, we can only export whole frozen fish. We cannot compete with China, the market leader in the global market for whole frozen fish. We may need to study the frozen fillet market, which means that we need to encourage farmers to grow fish to 1.2 to 1.5 kg sizes. It follows that we should develop a model to farm larger fish,” said Chuang.

## Progress with the shrimp feed business in India

Sheng Long entered the Indian shrimp feed market in 2013 and by 2015, feed imports from Vietnam grew to 13,000 tonnes. In 2016, this is expected to rise to 20,000 tonnes. Some 50% of this volume is sold to farms in the north eastern and western territories (Odisha, West Bengal and Gujarat states).

“We saw the potential for a shrimp feed business in India several years ago. Currently, the stocking density for vannamei shrimp is 25-40 post larvae/m<sup>2</sup> and many farms are adopting more intensive culture systems,” said Chuang.

The setting up of a feed mill in India, north of Chennai in Tamil Nadu, was decided in 2014 and construction begun in early 2016. In 2015, it also began construction of a 2 billion per year post larvae hatchery. Both feed mill and hatchery are now expected to begin operations in July 2017.

“As the volumes of imports grow, it is more practical to set up a plant in India. India has a 30% tariff on imports. Although our 11 distributors are helping us expand our market, our feed brand is relatively weak. It is a question of supply availability; since the feed mill is not ready, customers are hesitant to buy our shrimp feed,” said Maple Hung, Sheng Long’s Vice President-Exports.

“We see India as an interesting market where shrimp farming will be expanding. The large players, Avanti and CP India, each have three and four plants, respectively. Together, they have 70% of the market share. Our feed production target in India is 100,000 tpy and we will focus on supplying farms in Tamil Nadu, Orissa, West Bengal as well as Andhra Pradesh. As feed demand increases, we may decide to have another plant closer to farms in Andhra Pradesh.”

Similar to its strategy in Vietnam where it has 15 service centres, Sheng Long is establishing ‘aquatic service centres’ in India to support small farmers in the country. There are now two centres in Tamil Nadu and one in Orissa. These are equipped with PCR for disease diagnosis. These service centres also provide free services on health management and water analysis prior to stocking and during the culture period. The inauguration of the centre in Sirkali, Tamil Nadu was carried out on 20 August 2016.

“Our main objective in investing into all these facilities is to help our farmers in India and Vietnam achieve consistent and high yields. We can only do this if we ensure a continuous improvement of skills in our technical service teams.

## Regional focus

Finally Chuang said, “While we target 200,000 tpy of shrimp feed in 2017 which also includes feed exports to India and Malaysia, our expectation is that by 2018, our shrimp feed production both in Vietnam and India will reach 300,000 tpy. While Vietnam will be the business unit for Southeast Asia, India will be the one covering Sri Lanka, Bangladesh, Myanmar, the Middle East and African markets. Particularly in Vietnam, while we continue to be a major player in the shrimp feed market, which is mainly feeds for the vannamei shrimp, we also wish to enter the feed market for the monodon shrimp.

“We are not stopping here as we hope to move into feed production in Malaysia when the time is right and when shrimp production picks up. Some potential shrimp and marine fish feed markets on our radar are Myanmar, Cambodia, Turkey and for tilapia feeds, Africa.”

“While these are our external goals, internally, we work towards nurturing a generation of professionals whose mission is not only to produce and market high quality feeds but to use their technological advantage to support shrimp and fish farmers and bring them to the next quantum leap,” added Chuang.

# A comparison of wheat and rice bran meal in diets for grass carp

By Yongqing Ye and Xiaoxi Luo

Replacing wheat with 10% rice bran meal will decrease cost of feed without affecting growth performance.

Rice bran meal is the by-product of rice bran after oil extraction. China has rich rice bran resources. Rice bran meal with high nutrition value is used as an ingredient in formulated feed production. Not only can it ease the situation of shortage of feed resources, but can also reduce feed costs. With the rising prices of feed ingredients, animal husbandry industry production costs continue to increase. The development of cheap feed ingredients is one of the effective measures to stamp the rise in feed prices in the Chinese feed industry.

The proximate analysis of wheat, rice bran meal and rice bran are presented in Table 1. There are no major differences in composition in terms of dry matter (DM) and ether extract (EE) between wheat and rice bran meal, but the crude protein (CP) content is the highest in rice bran meal than in wheat and rice bran. Rice bran meal is easier to store and does not oxidise easily.

The price of rice bran meal is lower than wheat (Figure 1), at more than CNY 1,000/tonne. There has been some controversy

Table 1. The proximate nutrient composition of wheat, rice bran meal and rice bran (from Xiong Benhai et al.,2015)

Name	DM (%)	CP (%)	EE (%)	CF(%)	NFE (%)	Ash (%)
Wheat	88.0	13.4	1.7	1.9	69.1	1.9
Rice bran meal	87.0	15.1	2.0	7.5	53.6	8.8
Rice bran	87.0	12.8	16.5	5.7	44.5	7.5

DM, dry matter; CP, crude protein; EE, ether extracts; DE, digestible energy; CF, crude fibre; NFE, nitrogen free extract.

on the effects of rice bran meal in fish feed. Some feed companies still prefer to buy rice bran and wheat despite the higher prices.

In the present study, a comparison of rice bran meal and wheat did not show any significant differences when added into fish feed. The comparison of rice bran meal and wheat was designed to evaluate the effect on grass carp performance which was evaluated through conventional variables such as growth and food conversion ratio.

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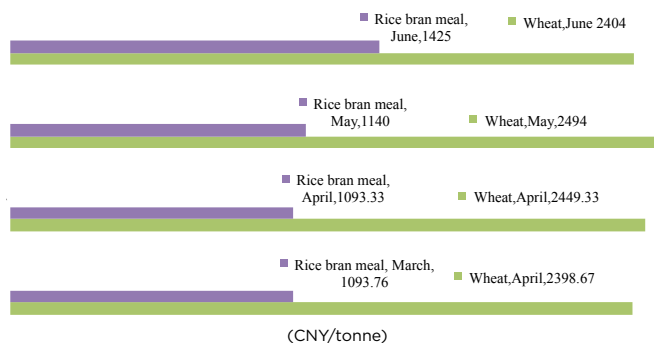


Figure 1. The price of wheat and rice bran meal

## Comparing dietary rice bran and wheat

The study was conducted at the pilot base of Guangdong Daynew Bio-technology Co., Ltd. Two experimental diets were formulated with the following combinations: Diet #26 with 10% wheat and diet #27 with 10% rice bran meal (Table 2).

Table 2. Formulation of the experimental diets.

Ingredients	Experimental diets	
	#26	#27
Rapeseed meal	42	42
Soybean meal	20	20
Soy sauce residues	5	5
Rice bran meal	0	10
Yeast extract	4	4
Monocalcium phosphate	2	2
Mineral premix	1	1
Vitamin premix	0.1	0.1
Choline chloride	0.1	0.1
Mould inhibitor	0.1	0.1
Wheat	26	16
Crude protein	30.22	30.39
Crude lipid	1.91	1.94
Ash	9.75	10



Grass Carp

Grass carp *Ctenopharyngodon idella* were obtained from a local fish farm. Prior to the experiment, all fish were acclimatised for 2 weeks to the environmental condition. A total of 560 fish were randomly assigned to eight cages (1.5m x 1.5m x 1.5m) with 70 fish/cage. The mean initial body weight was 17.55±0.07 kg and the two experimental diets were randomly assigned to cages with four replicates. Fish were fed twice daily at approximately



Rice Bran Meal

08:30 and 15:30, each time for 30 minutes to apparent satiation. The experiment was conducted over a 60-day duration. The total feed used was 26.9 kg. The initial daily feed ration was calculated based on the initial individual mean weight, corresponding to 2.2% of the wet weight of fish, and was adjusted daily depending on the feed consumed by fish. During the experiment, water temperature averaged at 28±2°C.

## Growth performance

This is shown in Table 3. The final body weight, body weight gain (BWG), specific growth rate (SGR) and feed conversion ratio (FCR) in the two groups did not show any significant differences (Table 3).

Table 3. Growth performances of grass carp fed diets for 60 days.

Parameters	Experimental diets	
	#26	#27
Mean initial body weight (kg)	17.58±0.09	17.53±0.05
Mean final body weight (kg)	31.95±0.58	32±0.35
Mean body weight (kg)	14.7±0.32	14.8±0.35
BWG (%)	83.64	84.45
SGR	23.96	24.13
FCR	1.83	1.82

BWG, body weight gain = (final body weight – initial body weight) x 100/initial body weight.  
 SGR, specific growth rate = (Ln W<sub>t</sub> Ln W<sub>0</sub>) x 100/T, where W<sub>0</sub> and W<sub>t</sub> are the initial and final body weight, respectively; T is the culture period.  
 FCR, feed conversion ratio = total diet fed /total wet weight gain.

The results suggest that the 10% rice bran meal replacement of wheat is recommended, because it decreases the cost of fish feed. The price of rice bran meal is over CNY 1,000/tonne lower than the price of wheat. The use of 10% rice bran meal could save about CNY100/tonne feed.

## Conclusions

Feeding small amounts of rice bran meal in grass carp diets does not affect fish growth. The replacement of 10% wheat with 10% rice bran meal is recommended, because it decreases the cost of fish feed.



Yongqing Ye



Xiaoxi Luo

**Yongqing Ye** is Deputy General Manager, Guangdong Daynew Bio-technology Co., Ltd, China. E-mail: yyongqing@126.com.

**Xiaoxi Luo** is R & D Manager, Guangdong Daynew Bio-technology Co., Ltd, China. Email: mohuanxiaoxi@163.com

# Ideal amino acid ratios in vannamei shrimp starter feeds

By Dhanapong Sangsue

A better understanding of protein and amino acid nutrition can potentially improve feed quality and save cost of feeding vannamei shrimp.

In shrimp aquaculture in Southeast Asia, feeds for the vannamei shrimp may contain crude protein levels from 32% to 38%. From the farmers' perspective, one of the major concerns is whether to feed shrimp with high or low protein diets. Some farmers choose to feed high quality protein diets with an expectation of faster growth, albeit costly and probably uneconomical as well. On the other hand, feeding less expensive protein diets can be a false economy as these feeds may have unbalanced nutrients, low palatability and reduced digestibility, often leading to environmental as well as economic setbacks.

The feed of choice farmers opt for their shrimp farm is typically based on the following technical reasons such as size of shrimp,



Vannamei shrimp. Picture copyright, Evonik, SEA.

Table 1. The total farmed shrimp production (tonnes) in 2014 from the major producers globally as reported by FAO (2016)

<b>Total world</b>	<b>China</b>	<b>Indonesia</b>	<b>Vietnam</b>	<b>India</b>	<b>Ecuador</b>
4,580,769	1,863,598	598,275	486,859	377,059	340,000 F
<b>Thailand</b>	<b>Mexico</b>	<b>Bangladesh</b>	<b>Malaysia</b>	<b>The Philippines</b>	<b>Myanmar</b>
282,321	86,973	80,693	61,386	58,447	40,000

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stocking density and pond carrying capacity. In general, the choice also depends among others, on the level of experience of the farmer, price of the feeds and current farm gate prices of shrimps. In most cases, a combination of both technical and general reasons influences decision making on the feed to use.

Similar to other farmed animals, in fish and shrimp farming, nutrition is critical because feed contributes more than 40% of the production costs. Better knowledge of diet formulations in the shrimp farming industry is critical in order to satisfy the growing demand for affordable, safe, and high-quality products. Therefore, the scope of this article is to address two important issues which are efficiency improvement and cost savings for vannamei shrimp feed.

Table 2. A summary of complete feed analysis conducted from January 2014 to December 2015 by Evonik AMINOLab (vannamei starter feed)

Amino acids												
n = 10	CP	Met	Cys	M+C	Lys	Thr	Arg	Ile	Leu	Val	His	Phe
Average	39.01	0.85	0.46	1.31	2.04	1.37	2.23	1.43	2.54	1.68	0.79	1.57
S.D	0.34	0.19	0.04	0.21	0.07	0.05	0.06	0.05	0.06	0.05	0.04	0.05

1. Amino acid values are reported on 88% standardised dry matter basis 2. CP (crude protein) was analysed by Dumas combustion method 3. Amino acids were analysed by chromatographic method (wet chem)

Table 3. Ideal protein ratio for vannamei starter phase recommended by AMINOShrimp®

Amino acids												
	Met	Cys	M+C	Lys	Thr	Trp	Arg	Ile	Leu	Val	His	Phe
Ratios on Lys	44	18	62	100	72	19	121	61	108	71	44	86
Lys 2.11%	0.93	0.38	1.31	2.11	1.52	0.40	2.55	1.29	2.28	1.50	0.93	1.81

1 Amino acid values are reported on a 88% standardised dry matter basis 2. AMINOShrimp® (first released in the year 2016) is an interactive and easy to use software calculating and giving amino acid recommendations for white leg shrimp diets.

Table 4.1. The diets formulated based on Table 2 vs Table 3

Ingredients (% diet)	TABLE 2	TABLE 3	Composition (% diet)	TABLE 2	TABLE 3
SBM 48%	35.96	38.70	Dry matter, %	88.43	88.37
Wheat flour	25.00	28.59	Gross Energy, kcal/kg	4,400	4,400
Fishmeal 61%	17.80	14.13	Crude protein, %	39.01	37.86
Poultry by product 63%	4.62	4.97	Crude fat, %	7.50	6.89
Rice bran	5.17	2.37	Crude fiber, %	3.44	3.36
Squid meal	3.00	2.50	Ash, %	8.00	8.00
Tuna extract 67%	2.00	1.70	Starch, %	16.28	17.66
Soy lecithin	2.00	1.50	Lys, %	2.11	2.11
Fish oil	1.00	1.50	Met, %	1.04	0.93
Premixes	1.00	1.00	Cys, %	0.44	0.45
Choline Chloride 75%	0.25	0.25	M+C, %	1.48	1.38
Monocaph	0.50	0.79	Thr, %	1.42	1.52
CaCO <sub>3</sub>	0.00	0.51	Trp, %	0.40	0.40
Salt	0.69	0.78	Arg, %	2.45	2.41
Binder	0.30	0.30	Ile, %	1.59	1.57
DL-Methionine for Aquaculture®	0.36	0.00	Leu, %	2.73	2.68
AQUAVI® Met-Met	0.00	0.14	Val, %	1.74	1.71
Lysine HCl	0.24	0.00	His, %	0.86	0.84
Vitamin C	0.10	0.10	Phe, %	1.68	1.67
ThreAMINO®	0.02	0.16			
Cost of feed (USD/tonne)	710.02	679.38			

- Prices for March 2016 in most of the ingredients
- DL-Methionine for Aquaculture® (Evonik, Germany) is 99% DL-Met which has the optimized particle size distribution for Aqua feed
- AQUAVI® Met-Met (Evonik, Germany) is a dipeptide of DL-Methionine and has about 200% relative biological efficacy higher than that of DL-Methionine on a product basis.
- ThreAMINO® (Evonik, Germany) is L-Threonine feed grade 98.5% produced in a fermentation process using high-potential microbial strains.
- In the Table 3 diet, DL-Methionine for Aquaculture® was replaced by AQUAVI® Met-Met which resulted in allowing more room for the cost improvement in the formulation

Table 4.2. Amino acid ratios

AAs ratios on Lys	AMINOShrimp®	Table 2	Table 3
Met	44	49	44
Cys	18	21	21
M+C	62	70	65
Thr	72	67	72
Trp	19	19	19
Arg	121	116	114
Ile	61	75	74
Leu	108	129	127
Val	71	82	81
His	44	41	40
Phe	86	80	79



Vannamei shrimp. Picture copyright, Evonik, SEA.

With an approximate feed conversion ratio (FCR) of 1.5, the total shrimp feed requirement could be nearly 5.8 million tonnes or 3 million tonnes if the production from China is excluded. This is the amount required to grow shrimp to a market size of 16.67 g/shrimp in 2014. This would mean that almost 2 million tonnes of crude protein, mainly from both plant and animal sources, were consumed by farmed shrimp in 2014.

## How protein in diets are measured

For many years Kjeldahl (or similar methods) has been the common analytical method for determining nitrogen content (AOAC, 2000). The crude protein content is calculated by multiplying the nitrogen content by a factor of 6.5 based on the commonly accepted assumption that the average nitrogen content in protein is around 16%. This calculation is based on two assumptions: dietary carbohydrates and fats contain no nitrogen and almost all of the nitrogen in the diet is present as amino acids in proteins. However, not all nitrogen in diets is available as proteins some are in the form of non-protein nitrogen (NPN) in which aquatic species has limited ability to utilise. Therefore, amino acids, not protein *per se*, are more precise indicators of growth of the animal.

## Protein and EAAs for starter feeds

Feed surveys frequently conducted by EVONIK revealed the amino acid profiles of some commercial vannamei starter feeds used in Southeast Asia and this is shown in Table 2.

In Table 3, taking the dietary lysine (Lys 2.04±0.07%) in Table 2, we calculated the levels of the other 9 remaining essential amino acids using the ratios on lysine recommended by AMINOShrimp®. The optimum levels of the essential amino acid contents in a diet of vannamei shrimp starter phase are presented in the last row of the same table.

## Ideal amino acid ratios

According to NRC 2011, 'the definition of an ideal protein is the amino acid profile of the diet that meets exactly the requirement of the animal with no excess or deficit where optimum dietary essential amino acid (EAAs) levels are considered as proportions relative to total EAAs rather than the whole diet'. However, in practice, ideal protein, or more precisely ideal amino acid patterns of the diets are usually indicated as the ratio of the nine other EAAs to lysine. This is because lysine is mostly utilised for protein synthesis, is stable and easy to analyse while the other amino acids are not. For example, from Table 4.2, the level of total methionine in the vannamei starter diet is 44% of total lysine which means that at this level methionine should not be in excess or deficit. Efficiency can be improved with the use of digestible values provided that they are obtained from reliable sources and methodologies.

Using AMINOShrimp®, we have fine-tuned the 39.01% CP diet which contains EAAs pattern in Table 2 into a more amino acid-balanced 37.86% CP diet (Table 3) resulting in a cost reduction of 4.31% (Table 4.1 and 4.2). More importantly, this lower crude protein but more amino acid-balanced diet will result in better protein deposition as well as less catabolism of excess amino acids.



**Dhanapong Sangsue** is a Regional Technical Sales Manager-Aquaculture of Evonik Nutrition & Care based in Singapore. Email: [dhanapong.sangsue@evonik.com](mailto:dhanapong.sangsue@evonik.com)



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# Promoting gut health improves productivity and profitability in Nile tilapia farmed in cages in Brazil

By Giovani Sampaio Gonçalves, Manoel Joaquim Peres Ribeiro, Maria Mercè Isern Subich and Peter Coutteau

**A stable and healthy gut microbiota impacts directly on digestive and growth efficiency in fish.**

In tilapia farming, feed comprises the highest cost item, amounting to 60% of the total farming costs. Increasing prices of raw materials, lead nutritionists to search for alternative ingredients to reduce or at least maintain feed costs. Meanwhile, as aquaculture production continues to intensify, disease is putting more pressure on profits.

Best farming practices, including the implementation of biosecurity protocols, good husbandry practices and the use of functional feeds adapted to each specific fish species, are keys for the optimal and profitable development of the industry.

## Why better gut health?

The search for functional feeds to enhance digestive capacities and robustness against diseases are a major goal for the fish feed industry. In this regard, additives capable of promoting a stable and healthy gut microbiota have the potential to directly impact digestive efficiency of fish and result in effective natural growth promotion.

Better gut health forms a natural barrier against pathogenic infections entering via the digestive tract. It follows that this will boost the overall immune status of fish, leading to higher resistance to diseases. Results in marine fish and shrimp feeding trials demonstrated the positive effects of gut health promoters on performance and profitability in field conditions (Chamorro et al., 2011; Tzouramanis et al. 2012; Valle et al., 2015).

In the present study, the gut health promoting additive was evaluated on the production parameters of tilapia reared in cages in Brazil.



The cage trial

This study was conducted with Nile tilapia (*Oreochromis niloticus*, GIFT strain) by the Instituto da Pesca in collaboration with a commercial tilapia integrator in the Sao Paulo Region of Brazil, who provided the fish and logistical support for feed and fish processing.

The study spanned 111 days, starting with fish of 170 g and ending with market size fish of approximately 750 g. The cages were 7 m<sup>3</sup> each, with 840 fish per cage. Experimental fish were counted and weighed prior to random distribution to cages. There were five cages per treatment.

Prior to the start of the trial, the animals were fed with a commercial feed containing 36% crude protein (CP). Parameters were monitored during acclimatization and throughout the trial. Temperature was rather low during the pre-trial period, staying around 23°C. Despite the increasing temperature during the study, from the 23°C to almost 30°C, pH and dissolved oxygen remained within acceptable ranges for tilapia throughout the trial (Figure 1).

The control diet was a commercial floating feed with 32% CP. The treatment diet consisted of the same commercial diet formula but included a natural growth promoter (Sanacore® GM, Nutriad) which was added at an inclusion of 1.5 kg per tonne of feed. This promoter has a double action mode comprising a modulation mode of the microbiota (inhibiting growth of pathogenic bacteria and promoting growth of beneficial bacteria) and a quorum sensing inhibition mode.

The feed was prepared in a commercial extrusion feed line. The additive was added in the mixer with the rest of the ingredients prior to cooking and extrusion. Fish were fed four times/day until they reach 170 g. Once the trial started, fish were fed three times/day.

Uneaten feed was collected from the surface of the cage after every meal and measured. No differences in terms of appetite were detected during the trial due to the feed type. At the end of the trial all the fish were collected, counted and weighed. Five percent of fish from each treatment was gutted for the evaluation of viscero-somatic indexes.

## Better performance and reduced visceral fat deposition

At harvest, the group supplemented with the gut modulator showed significantly improved production parameters compared to the control. This included increases in survival by 4.7%, average final weight by 2.8%, and feed conversion ratio (FCR) by 6.7%. Feed consumption declined by 6.7%. Overall, the harvested biomass was 7.7% higher for the treatment group relative to that of the control group (Table 1; Figure 2).

In addition, fish fed the gut health promoter showed a lower visceral fat deposition (-8.4%) as well as improved viscero and hepato-somatic indices (-6 and -12%, respectively) (Table 2).

## Economics

The use of functional feed additives to promote growth and/or disease resistance has been demonstrated with different aquaculture species in controlled laboratory studies. Nevertheless,

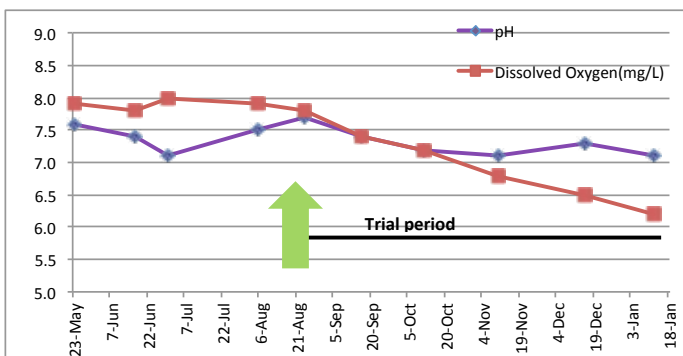
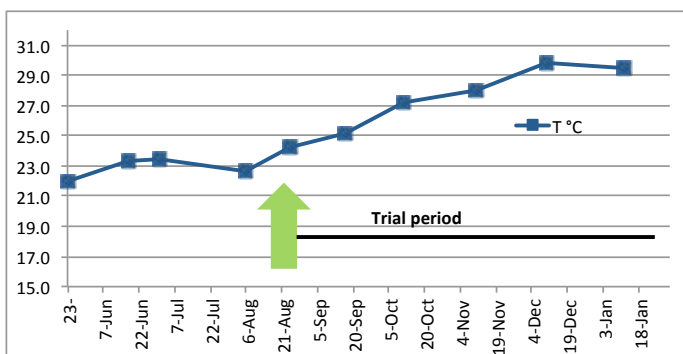


Figure 1. Evolution of temperature and DO/pH during the trial.

Table 1. Effect of a gut health promoter on production parameters of tilapia. P value < 0.05 shows statistically significant results.

	Control	Sanacore GM	% Change	P Value
			vs control	
Survival (%)	92.1	96.4	+4.7%	0.048
FCR	1.72	1.60	-6.7%	0.019
Daily weight gain (g/day)	4.93	5.05	+2.5%	0.165
Average final fish weight (g/fish)	714	734	+2.8%	0.021
Harvested biomass (% of control)	100	107.7	+7.7%	0.004
Feed Intake as % ABW/d	3.09	2.89	-6.7%	0.019

the cost efficiency of these strategies requires field evaluations under the specific challenges encountered in production. During the current field trial, conditions were favourable and there were no disease outbreaks during the grow-out, resulting in excellent survival at harvest (control cages averaged 92% survival). Despite the excellent productivity in the control cages, the gut health promoter yielded a significant improvement in survival, growth and feed conversion ratio, resulting in an overall improvement in productivity of 7.7%. The economic analysis showed that the feed additive resulted in 9.9% increased revenues for the farmer and a return on investment of 2.2.

The current study revealed the potential of functional feed additives as growth promoters in the grow-out of tilapia in the absence of major disease threats. Further research is underway to investigate the impact on survival in production conditions where disease pressure is affecting fish health and farm productivity.



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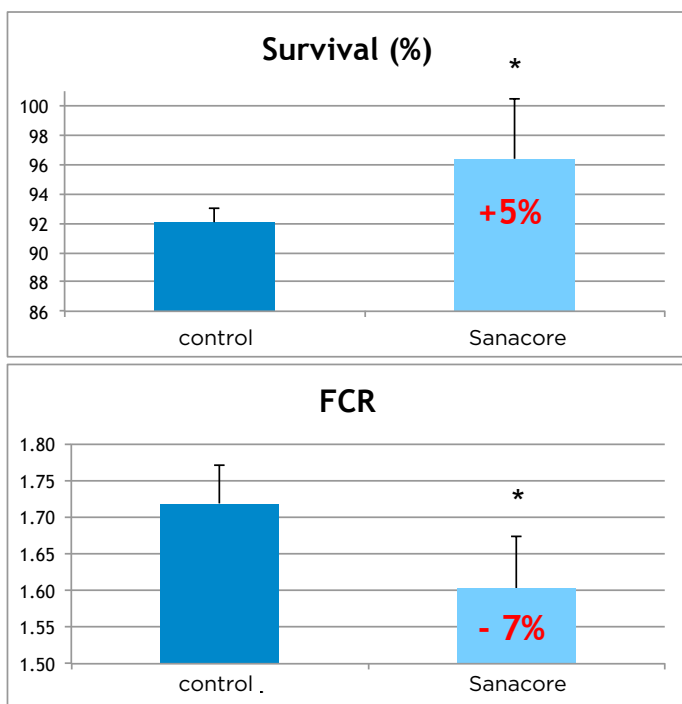


Figure 2. Effect of a gut health promoter on FCR and survival of tilapia. P value < 0.05 shows statistically significant results and are indicated with \*.

Table 2. Effect of a gut health promoter on visceral fat and viscero/hepato-somatic indices.

	Control	Sanacore GM	% Change	P Value
Visceral fat (%)	4.76	4.36	-8.4%	0.048
Viscero-somatic index (VSI. %)	8.84	8.29	-6.2%	0.019
Hepato-somatic index (HSI. %)	1.07	0.94	-12.1%	0.165

Table 3. Effect of a gut health promoter on farm economics in cage farmed tilapia

	Relative improvement of treatment versus control
Fish produced (tonnes)	+7.70%
FCR	-6.70%
Feed price (incl additive) (BRL/tonne)	+3.80%
Additional revenue (BRL)	+9.90%
Feed cost (BRL/kg fish)	-3.50%
Return on investment (ROI)	2.2

BRL- Brazilian Real (one USD= 3.26 BRL on 1 August 2016)






*Giovani Sampaio Gonçalves*     *Manoel Joaquim Peres Ribeiro*     *Maria Mercè Isern Subich*     *Peter Coutteau*

**Giovani Sampaio Gonçalves**, PhD is researcher and **Manoel Joaquim Peres Ribeiro** is a post graduate student at the Instituto de Pesca. São José do Rio Preto. SP. Brazil.

**Maria Mercè Isern Subich**, DVM is Business Development Manager Aqua Health and **Peter Coutteau**, PhD is Business Director Aquaculture at Nutriad International, Belgium. Email: p.coutteau@nutriad.com

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# Phytase acts against the anti-nutritional effects of phytic acid in fish

By Thomas Wilson

The common benefits of phytase include making dietary P in low fish meal feeds more available and reduction in phosphorus loading in pond water. The benefits are discussed alongside improvements in availability of dietary minerals and in fat and protein retention.

Aquafeed formulators are increasingly using plant ingredients to replace fish meal so as to reduce costs. Unfortunately, many of the common plant ingredients contain anti-nutritional factors such as phytic acid, high fibre, saponins and tannins that negatively affect feed performance. Phytic acid, the storage form of phosphorus (P) in plant constitutes between 1% and 3%, by weight, in many cereals, legumes and oilseeds used in animal feeds. Phytic acid is not digestible by aquatic animals, so P bound in phytic acid is not nutritionally available. In many common plant ingredients, more than 60% of total P is bound in phytic acid (Table 1).

It is important to understand that there is significant variability (see Table 1 and 2) in phytic acid content in plant ingredients, depending on country, region, climate, plant cultivars, soil quality and fertilisation, irrigation conditions and processing method. Phytic acid in feed has wide-ranging negative effects, which include reducing availability of phosphorus and trace minerals, and affecting protein and lipid uptake (Sugiura, 2004), and inhibiting digestive enzyme function (Khan and Ghosh, 2013). A failure to consider the variability of phytic acid content in plant ingredients in low fish meal high plant ingredient feeds may lead to inadequate dietary available P, causing unexplained drops in feed performance.

## Effect of phytic acid on calcium, phosphorus and trace mineral nutrition

Phytic acid binds with trace elements, interfere with absorption and bioavailability. The solubility and stability of phytic acid-trace element complexes depends on the affinity of phytate for specific cations, intestinal pH, and the concentration of Ca<sup>2+</sup>,

among other factors. Phytic acid has the strongest adverse effect on Zinc (Zn<sup>2+</sup>) absorption, but also has a significant effect on non-haem iron (Fe<sup>2+</sup>, Fe<sup>3+</sup>) uptake. Phytate salts with Ca<sup>2+</sup>, Zn<sup>2+</sup> and Cu<sup>2+</sup> tend to be soluble at pH less than 5, whereas ferric (Fe<sup>3+</sup>) solubility increases above pH 4.

P deficiency has been shown to increase excretion of calcium and magnesium in fish, which impairs bone development and causes skeletal deformities. In Figure 2, the carp and tilapia on top in both pictures have a normal body shape. The carp and tilapia on the bottom have shortened/deformed bodies caused by phosphorus/zinc deficiency due to high phytic acid content and inadequate available P/Zn in their feed.

Table 1. Total phosphorus and phytate phosphorus in common feed ingredients (After Gabaudan, DSM Aquaculture Center AP.)

Ingredient	Total P % (mean ± sd)	Phytate P % (mean ± sd)	% of phytate-P in total-P	Samples (n)
Soya (full fat)	0.51 ± 0.06	0.30 ± 0.02	58.8	2
Soya (Hi Pro)	0.57 ± 0.02	0.31 ± 0.02	54.4	3
Soybean Meal	0.66 ± 0.07	0.39 ± 0.07	59.0	15
Soy Protein Concentrate	0.71 ± 0.04	0.34 ± 0.17	47.9	3
Rapeseed Meal	0.95 ± 0.21	0.66 ± 0.14	69.5	11
Cottonseed Meal	1.29 ± 0.03	0.89 ± 0.02	69.0	2
Sunflower Meal	1.39 ± 0.25	1.06 ± 0.18	76.2	7
Corn (whole)	0.23 ± 0.01	0.17 ± 0.23	73.9	6
DDGS	0.79 ± 0.03	0.27 ± 0.08	69.2	3
Wheat Flour	0.11 ± 0.04	0.04 ± 0.02	36.4	3
Wheat Gluten	0.17 ± 0.03	0.03 ± 0.02	17.6	3
Wheat (whole)	0.27 ± 0.05	0.18 ± 0.05	66.7	12
Wheat Bran	0.69 ± 0.03	0.51 ± 0.03	73.9	2
Wheat Middlings	0.94 ± 0.02	0.71 ± 0.06	75.5	4
Rice (broken)	0.28 ± 0.19	0.17 ± 0.10	60.7	3
Rice Bran	1.61 ± 0.16	1.20 ± 0.07	74.5	8
Lupin	0.35 ± 0.04	0.17 ± 0.05	48.6	4

Table 2. Total phosphorus and phytate P in common feed ingredients from USA and Canada (after Tahir et al. 2012) with coefficient of variation (CV).

Ingredient	Total P % mean (CV*)	Phytate P % mean (CV*)	Samples (n)
Corn (whole)	0.324 (28.7)	0.186 (13.44)	133
Soybean Meal	0.836 (7.18)	0.395 (5.57)	114
Corn DDGS	0.958 (6.47)	0.257 (27.24)	89
Canola Meal	1.350 (5.11)	0.695 (4.75)	21
Wheat (whole)	0.421 (14.96)	0.251 (13.94)	22
Wheat Middlings	1.305 (15.02)	0.799 (6.38)	31

\* CV scores: <5%, excellent; 5-10%, good; 10-15%, poor; >15% very poor

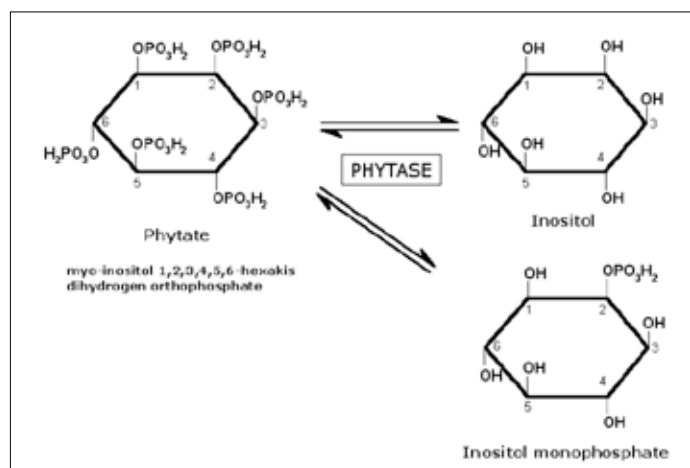


Figure 1. The mode of action of phytase. Baruah et al. (2004)



Figure 2. Deficiencies of dietary P/Zn can lead to body deformation in fish.

McLain and Gatlin (1988) fed blue tilapia fingerlings (*Oreochromis aureus*) a purified research diet supplemented with calcium (0.5 and 2%) and sodium phytate (0 and 1.5%). They then analysed the concentration of Zn accumulated in fish scales and bone. Adding 1.5% phytate reduced deposition of P and Zn in bone and scales by more than 50% (Figure 3).

The Zn requirement for most fresh water fish (catfish, rainbow trout, tilapia, carp), is between 15-40 mg Zn/kg diet. However, when feeds contain soybean meal, Lovell (1989) recommends adding > 100 mg Zn/kg feed to compensate for the Zn-binding property of phytic acid.

## Effect of phytic acid on protein and lipid uptake and metabolism

Extensive research has shown reduced protein utilisation in high phytic acid diets fed to swine and poultry. Fish grown on feeds high in phytic acid often show reduced protein retention. P deficiency impairs cellular energy metabolism, and leads to excess accumulation of body fat (Sugiura et al. 2011), especially visceral fat (Sugiura et al. 2004). Usmani and Jafri reported that mrigal carp fed diets containing 0.5%- 1.5% phytate had significantly poorer feed conversion and protein and fat retention compared to their phytate-free control diet (Table 3).

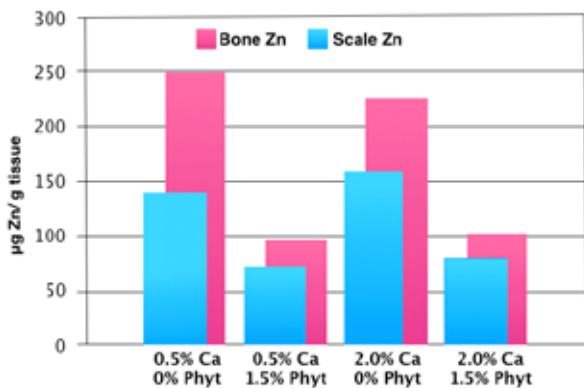


Figure 3. Adding phytate to feed significantly reduces Zn deposition in fish (McLain and Gatlin 1988).

Table 3. Effect of sodium phytate on FCR and PER in mrigal carp (Usmani and Jafri, 2002)

Diet	Feed Conversion Ratio (FCR)	Protein Efficiency Ratio (PER)
Phytate-free Basal diet	1.21± 0.03 <sup>d</sup>	2.02± 0.07 <sup>a</sup>
Basal diet + 0.5% added Na phytate	1.50± 0.09 <sup>c</sup>	1.69± 0.03 <sup>b</sup>
Basal diet + 1.0% added Na phytate	1.54± 0.06 <sup>c</sup>	1.64± 0.11 <sup>b</sup>
Basal diet + 1.5% added Na Phytate	2.52± 0.41 <sup>b</sup>	0.99± 0.09 <sup>c</sup>

Phytase application has been shown to significantly improve availability of dietary P in low fishmeal feeds for various species (tilapia, pangasius, rohu, mrigal, catfish, milkfish).

Table 4. Effect of adding di-calcium phosphate (DCP) and phytase on FCR and PER of sex-reversed red tilapia fed a practical basal diet (main ingredients: fishmeal (FM) 10%, soybean meal (SBM) 45%, rice bran 18%, cassava 20%, fish oil 1.5%, source: Tudkaew et al. 2008)

Diet	Feed Conversion Ratio (FCR)	Protein Efficiency Ratio (PER)
Basal diet	1.66± 0.08	1.97± 0.09
Basal diet + 0.5% added DCP	1.55± 0.10	2.04± 0.13
Basal diet + 750 FYT Ronozyme P	1.44± 0.15	2.31± 0.24
Basal diet + 1.5% added DCP + 750 FYT Ronozyme P	1.54± 0.12	2.13± 0.16

Ronozyme P is a superceded product from DSM, the Netherlands

## Benefits of using phytase in low fish meal feeds

Phosphorus is an important nutrient for fish, but adding supplementary P to feeds, while effective, is not as efficient as improving the digestibility of the phytate P that is already in the feed ingredients. Phytase application has been shown to significantly improve availability of dietary P in low fish meal feeds for various species (tilapia, pangasius, rohu, mrigal, catfish, milkfish).

In an experiment by the DSM Aquaculture Center Asia Pacific, the following results were obtained with a low fishmeal diet (main ingredients: 10% FM, 45% SBM, 20% cassava, 18% rice bran, 1.5% fish oil) fed to tilapia (Figure 4).

Studies with phytase enzymes show that they significantly improve availability of other dietary minerals (calcium, magnesium, zinc, iron, manganese, copper). Tilapia fed with a zero fish meal diet (main ingredients: 67% SBM, 14% rice bran, 10% broken rice, 1% fish oil) with phytase added at 500, 1,000, 2,000 and 4,000 FYT/kg, showed a reduction in faecal Zn and P. This indicated that absorption of dietary P improved when the fish were fed 1,000- 2,000 FYT, and absorption of zinc was the highest when phytase was added at 2,000-4,000 FYT (Figure 5 and 6).

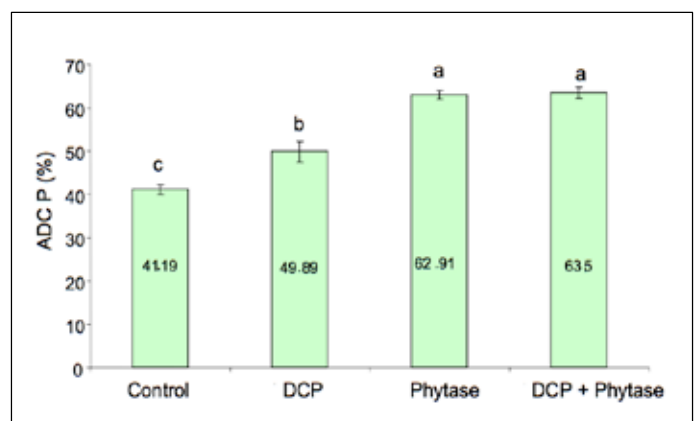


Figure 4. Availability of dietary P in a high SBM diet was improved 1.5 times when phytase was added as compared to the control. After Gabaudan, DSM Aquaculture Center AP.

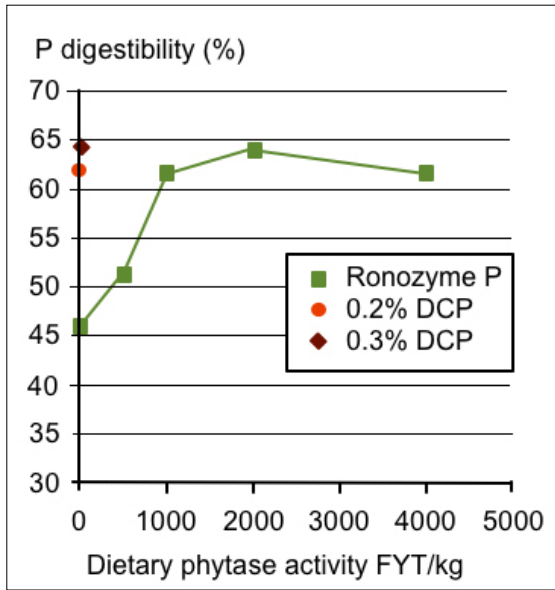


Figure 5. Adding phytase to the feed was as effective as adding 10 kg of mono di-calcium phosphate (MDCP) to the diet. After Gabaudan, DSM Aquaculture Center AP.

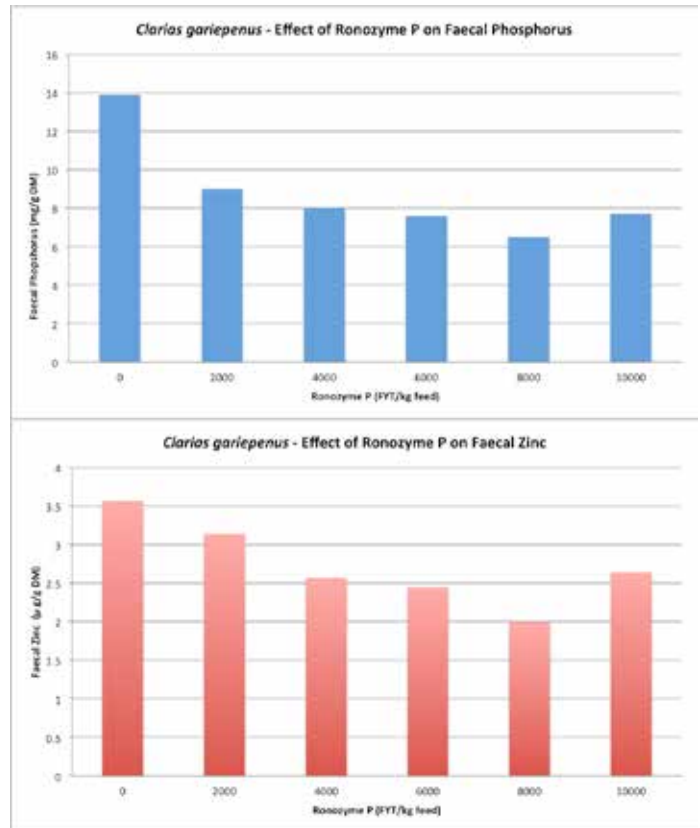


Figure 7. Adding phytase to *Clarias gariepinus* catfish feed reduced excretions of P (top) and Zn (Nwana et al. 2006).

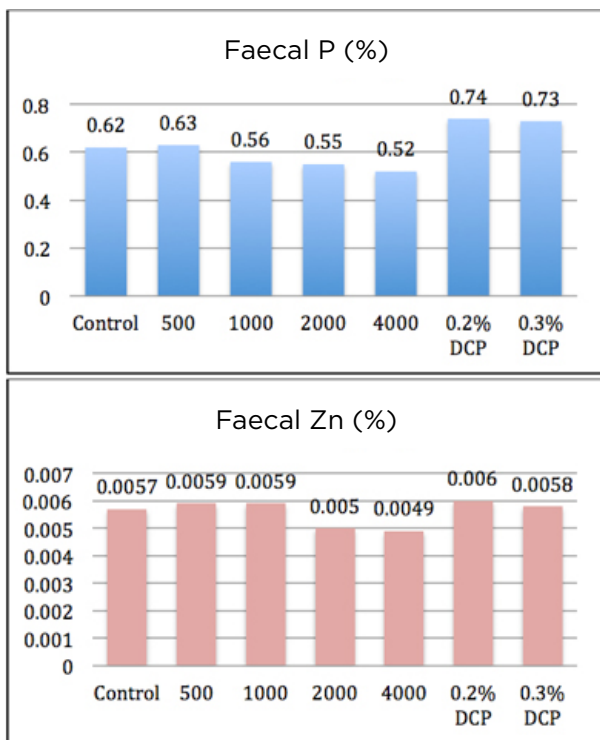


Figure 6. Adding phytase to tilapia feed reduced excretions of P and Zn. (Phromkunthong and Gabaudan, 2006).

In another experiment, Nwana et al. (2006), fed North African catfish (*Clarias gariepinus*) a semi-practical diet (main ingredients: 60% SBM, 20% Danish FM, 10% maize, 6% cod liver oil) with Ronozyme P phytase added at 2,000, 4,000, 6,000, 8,000 and 10,000 FYT/kg. Their results showed a reduction in faecal Zn and P, indicating that absorption of dietary P and Zn was improved when the fish were fed phytase. This shows that the addition of phytase to feeds can benefit the mineral nutrition of fish and reduce faecal wastes (Figure 7).

## Supplementing phytase to feed helps reduce phosphorus loading in pond water

In densely farmed areas, eutrophication caused by phosphorus pollution significantly reduces water quality and dissolved oxygen levels. Phytase significantly reduces excretion of P and reduces P loading of water. (Figure 8)

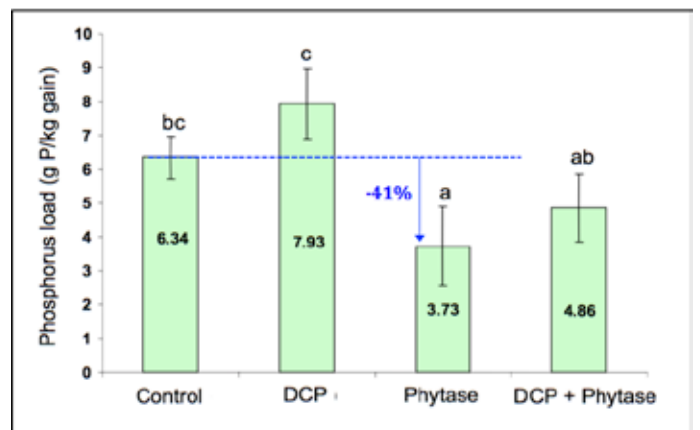


Figure 8. Phytase improved availability of dietary P and reduced P loading in water by 41% (Phromkunthong and Gabaudan, 2006).

## Application of phytase in the feed mill

### Pelleted feeds

In the case of pelleted feeds for carps and other herbivorous fish, both powdered and liquid phytase can be used. Powdered

phytase enzyme can be added to feed mixtures before pelleting if feed production temperatures are not excessively high.

DSM provides two equally effective ways of using phytase enzyme - granulated HiPhos GT and liquid HiPhos L. Use of granulated phytase requires low pelleting temperatures to prevent loss. (Figure 9 and 10).

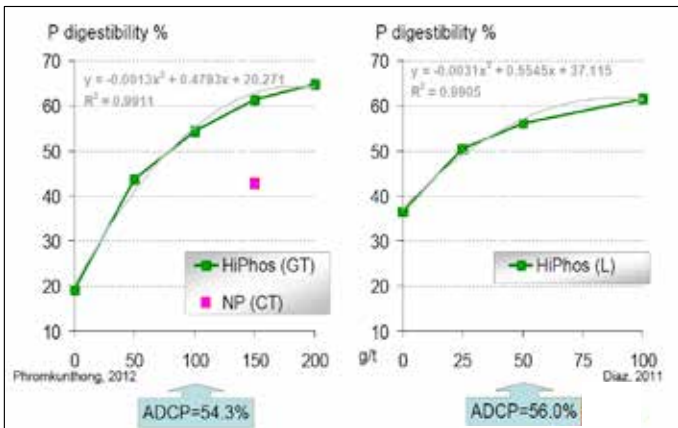


Figure 9. Granulated Ronozyme HiPhos (left) and HiPhos liquid (right) are equally effective at improving P digestibility. The left graph also shows the improved digestibility of Ronozyme HiPhos GT compared to the previous generation of DSM phytase, Ronozyme NP CT.

## Post pelleting in extruded feeds

Extruder and dryer temperatures are usually too high for granulated enzymes. Liquid phytase enzyme can be sprayed on to finished feed after pelleting and drying. Similar to post pellet addition of liquid enzymes, phytase can be sprayed onto feed before oil coating in top-coating mixers, rotary drum coaters, or other types of coaters. Otherwise, dosing with a dedicated enzyme spraying system using either air or water to disperse the enzyme can be adopted. (Figure 11).

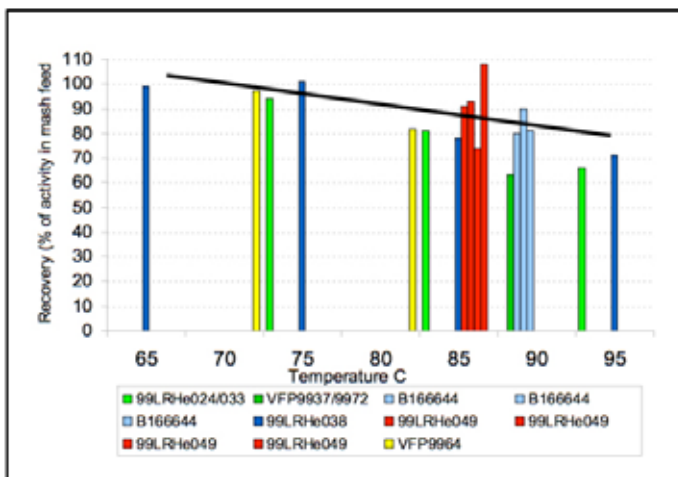


Figure 10. Some loss of enzyme activity can be expected when production temperatures are excessively high.

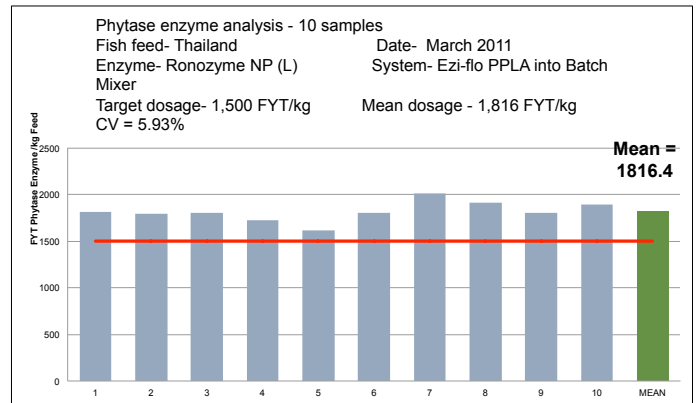



Figure 11. Liquid enzymes can be sprayed onto feeds with high accuracy and reproducibility (a low CV of 5.9% is shown below). Source: Thomas Wilson.

The optimum dose of Ronozyme® HiPhos may vary depending on the composition of the feed formulation, stage of animal growth, and the price of inorganic P supplements. However, DSM recommends a dosage level of 1,500-2,000 FYT for most warm water fish aquafeed formulas in Asia.

In conclusion, the feed miller may consider application of phytase in fish feeds when:

- Fish feed formulas contain a significant percentage of high-phytate plant ingredients.
- Analysis shows high variability of phytate content or phytate-P content in at-risk ingredients (Table 1 and 2). Phytase will help to reduce the effect of the variable phytic acid levels in finished feeds, making feed performance more consistent.
- Fish such as the tilapia show signs of bone deformation and body shortening (indicating a P/Zn deficiency).
- Feeds do not contain high levels of fat, but fish exhibit excessive fat levels in the body, including visceral fat (P deficiency).
- Algal growth in freshwater ponds is excessive without inorganic P being supplemented in feeds.
- Excreted P leads to eutrophication and growth of blue-green algae producing geosmin, an important origin of off-flavour in harvested fish.

References are available on request



**Dr Thomas Wilson** is an Aquaculture Nutrition Consultant for DSM Aquaculture Center Asia Pacific, Bangkok, Thailand.  
Email: [thomas.wilson@fishnutritionexpert.com](mailto:thomas.wilson@fishnutritionexpert.com)



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# Replacing fish meal with a bio-processed protein concentrate in whiteleg shrimp

By Hyeonho Yun, Jehoon Ryu, Seong-Jun Cho and Jun-Young Bae

A solid-state fermented mixture of soybean meal and corn gluten meal via a process incorporating *Bacillus subtilis* successfully replaces up to 30% of fish meal.

The whiteleg shrimp, *Litopenaeus vannamei*, is the most important cultivated shrimp species and has represented the highest value of all traded crustacean products. The global production of this shrimp increased from 154,515 tonnes in 2000 to 3,668,682 tonnes in 2014 (FAO 2016). This species has several characteristics such as rapid growth, good survival in high-density culture and disease tolerance that make it more suitable for aquaculture than other penaeid species (Cuzon et al., 2004).

The major ingredient for shrimp or other aquatic animal feed is fish meal. However, environmental changes and over-capturing of fish results in fish meal production to decrease and price to increase. Many studies have been conducted to replace or reduce the proportion of fish meal in shrimp diets using less expensive alternative protein sources.

Most attention has been paid to the evaluation of plant proteins such as soybean meal, corn gluten meal, cottonseed meal and various legumes. Because of their relatively low price and consistent quality, plant proteins are often an economically and nutritionally viable source of protein. However, they have potential problems such as a shortage of some amino acids, anti-nutritional factors, and poor digestibility and palatability leading to their limited usage.

AQUATIDE65 (CJ Cheiljedang, South Korea) is a solid-state fermented mixture of soybean meal and corn gluten meal produced via a process incorporating *Bacillus subtilis*. It has increased protein and peptide content, digestibility, palatability and minimal anti-nutritional factors such as galacto-oligo saccharides, trypsin inhibitors, allergens and others. Additionally, it has a minimum of 65% of crude protein contents as well as an amino acid profile which complements the relatively low crude protein content of our previous product Soytide. Because of these advantages, Aquatide65 holds promise as a fish meal replacer for aqua feeds.

The objective of this research was to evaluate the Aquatide65 as a fish meal replacement. As such, it examined factors such as the determination of growth performance, digestibility and immune responses in juvenile shrimp.

## Feeding trial

Juvenile shrimp were transported from NeoEnBiz (Gwangyangsangil, Songak-eup, Dangjin-si, Chungcheongnam-do, Korea) to the Feeds and Foods Nutrition Research Center (FFNRC), Pukyong National University, Busan, Korea. Prior to the start of the experiment, all shrimp were reared in a circular plastic tank with 5,000 L well water and were fed a commercial diet for 2 weeks. For experimental purposes, 9 aquaria with a semi-circulation system were used for rearing shrimp.

Table 1. Typical analysis of Aquatide65

Ingredients	Composition
Crude Protein	≥ 65.0 %
Crude Fat	≥ 3.0%
Moisture	≤ 10.0 %
Crude Ash	≤ 8.0 %
Crude Fiber	≤ 5.0 %
Phosphorous	≥ 1.0%
Peptide (≤ 30kDa)	≥ 70%
<i>Bacillus subtilis</i>	≥ 5 x 10 <sup>7</sup> cfu/g
Trypsin Inhibitor	< 1.0 mg/g
Stachyose	< 0.1%
Raffinose	< 0.05%
Particle Size	200 - 250 um

After a 2-week conditioning period, a group of 15 shrimp with average initial weight of 3.88 ± 0.05 g (mean±SD) were randomly distributed into aquaria in triplicates for each of three experimental diets. The diets were formulated to contain high quality low temperature fish meal (LTFM70) as a control, Vietnam local fish meal (VTFM65), and Aquatide65 (AQ65) as the alternative ingredient of LTFM70 at 30% replacement in feeds. Shrimp were fed four times a day (08:00, 12:00, 16:00, 20:00 h) at 4% of wet body weight in the first 4 weeks and 3% in the second 4 weeks to apparent satiety.

For the apparent digestibility coefficient of ingredients, one diet with LTFM70 or reference diet and another diet with VTFM65 were used as controls. The experimental diets consisted of 70% reference diet LTFM70 and 30% test ingredient. Fifteen shrimp with an average initial weight of 6.83 ± 0.32 (mean±SD) were randomly distributed in each of 30 semi-circulated tanks in triplicates. Shrimp were fed the experimental diets to apparent

Table 2. Experiment diets for the feeding trial.

	LTFM70 % ingredients	VTFM65 % ingredients	(AQ65) % ingredients
Fish meal, Denmark LT	27.0	0	0
Fish meal, Vietnam	0	28.6	0
Aquatide65	18.9	0	9.5
SBM 44%, South America	27.0	27.0	27.0
Wheat flour	30.3	30.3	30.3
Fish oil A/C	1.50	2.30	2.00
Lysine	0.00	0.00	0.40
Methionine	0.00	0.00	0.06
Others	14.2	14.2	14.2
Total	100	100	100
Proximate composition			
Crude protein (%)	40.7	41.0	41.3
Crude lipid (%)	8.6	8.7	8.6

satiation level. The faeces collection was carried out four times a day by a sieving process for 30 days.

The non-specific immune parameters such as SOD and lysozymes were analysed by spectrophotometer and haemolymph indexes by blood analyser (DRI-CHEM 4000i- Fuji Dri-Chem Slide- 3150, Minato-ku, Tokyo, Japan).



Figure 1. Semi-recirculation system for the feeding trial at FFNRC, Pukyong National University, Busan.

## Growth

In terms of growth performance, shrimp fed the experimental AQ65 diets showed weight gain of 189%, which was higher than that for shrimp fed diets with VTFM65 but not significantly different ( $p > 0.05$ ). Growth of shrimp fed diets with LTFM70 showed the highest weight gain at 198%. However, there was no significant differences among shrimp fed all diets ( $P > 0.05$ ). Feed efficiency and protein efficiency ratio of shrimp fed all the diets have the same weight gain trend. Survival rate recorded no significant differences and ranged from 82.2% to 86.7%.

## Apparent digestibility of ingredient

With regard to apparent digestibility coefficient of ingredients, (ADI), shrimp fed LTFM70 showed significantly higher values (97.3%) than those of shrimp fed VTFM65 and AQ65 ( $P < 0.05$ ). However, there were no significant differences between shrimp fed VTFM65 and AQ65 ( $P > 0.05$ ). ADI of diet VTFM65 was 94.9% whereas the ADI of diet AQ65 was 95.7%. Generally, plant based protein has low digestibility. However Aquatide65, fermented by *Bacillus subtilis* improved protease activity and protein peptidisation for better bio-availability, and is similar to fish based ingredients.

## Protease activity

Similar trends were observed in protease activity and non-specific immune responses to growth performance. Also, AQ65 showed numerically the highest value in lysozyme activity (10 U/mL) among the three diets, and protease activity (1.73 mU/mL) in comparison with that for LTFM70 and VTFM65 at 1.63 mU/mL and 1.60 mU/mL, respectively (Figure 3.).

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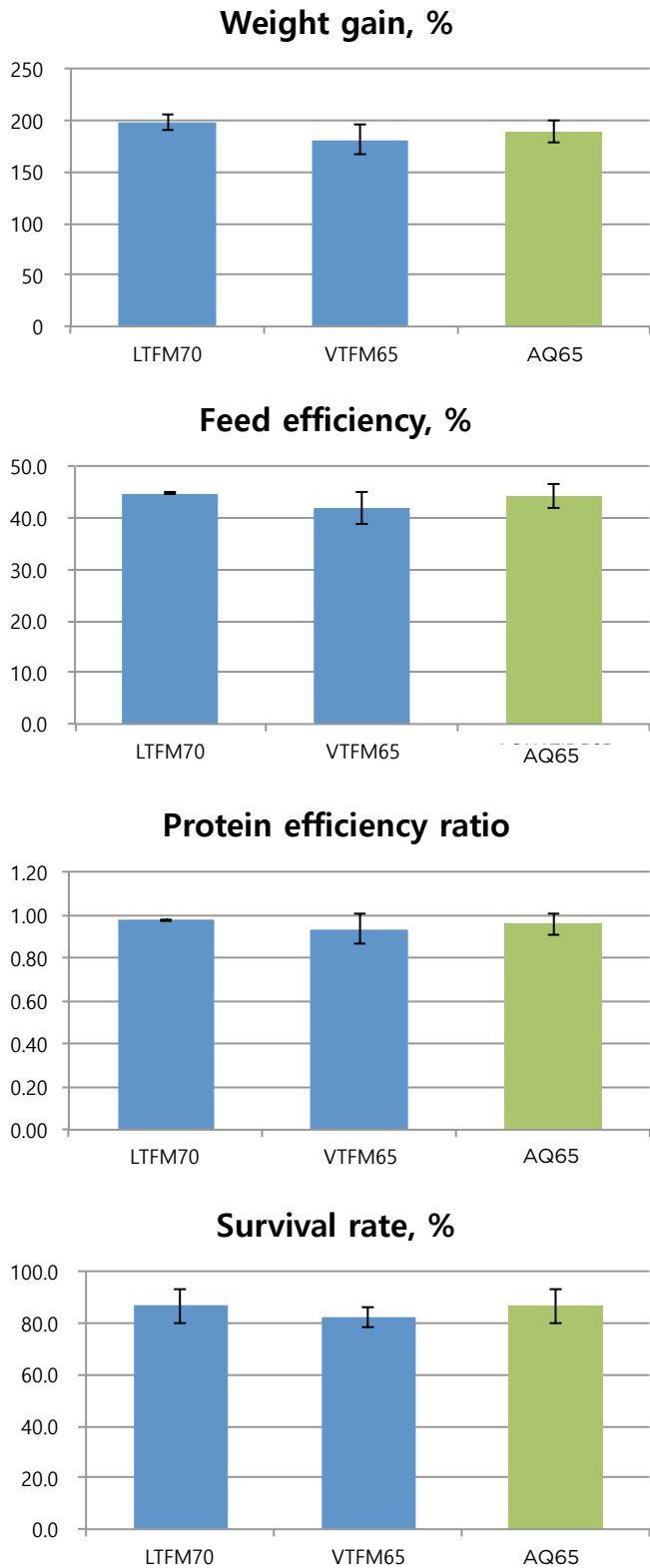


Figure 2. Weight gain, feed efficiency, protein efficiency ratio and survival rate of juvenile shrimp fed experimental diets for 8 weeks.

In general, these results indicate that the *Bacillus subtilis* fermentation strain improved growth performance, immune responses and digestive enzyme activity in shrimp like probiotics. Olmos and Paniagua-Michel (2014) reported that excellent results have been obtained in *L. vannamei*, *Oreochromis niloticus* and *Atractoscion nobilis*; increasing digestion-assimilation of vegetable ingredients, improving feed conversion ratio (FCR)

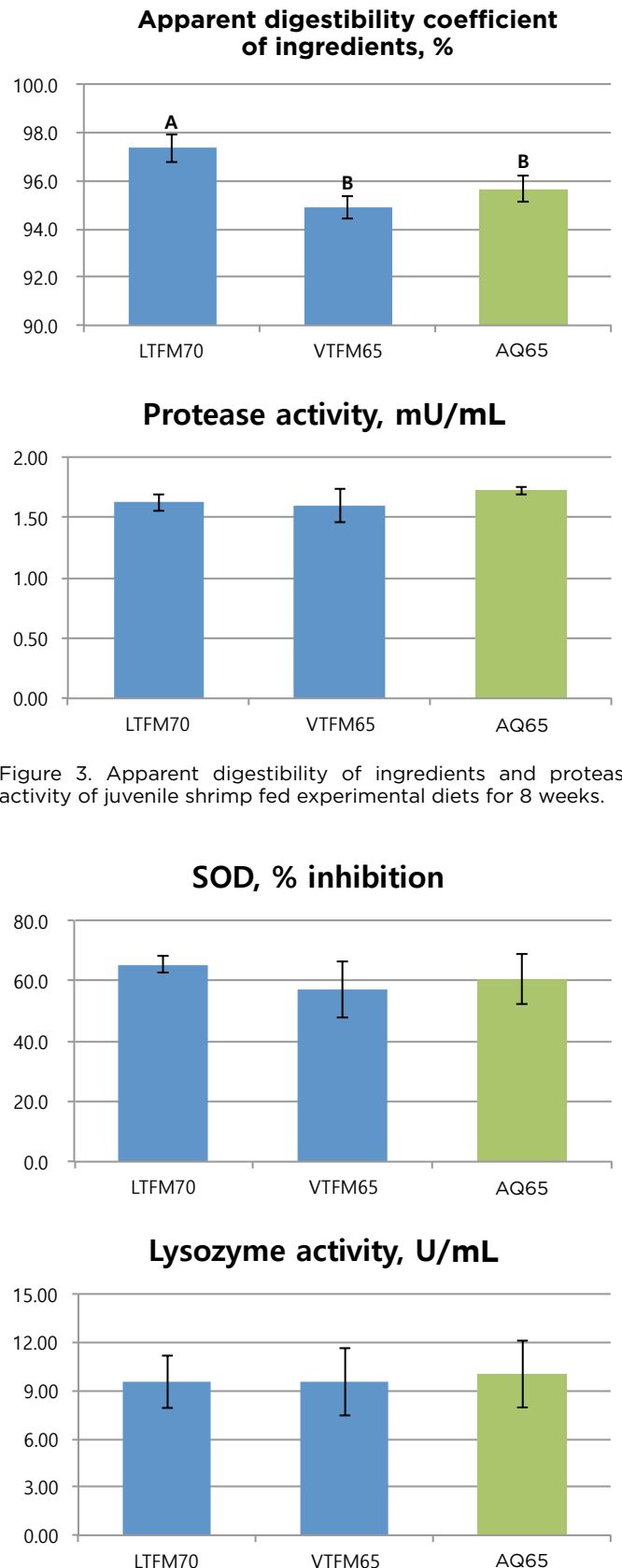


Figure 3. Apparent digestibility of ingredients and protease activity of juvenile shrimp fed experimental diets for 8 weeks.

Figure 4. Superoxide dismutase and lysozyme activity of juvenile shrimp fed experimental diets for 8 weeks.

and inducing optimal growth on cultivated animals, when a *B. subtilis* probiotic strain has been added to feeds. In addition, inhibition of pathogens proliferation and increased health status of animals were also improved.



Marketing Aquatide65 at Asian Pacific Aquaculture 2016, Surabaya, Indonesia

Generally, plant protein ingredients are well known to partially replace fish meal in shrimp and fish diets. In this case, we show that this, a bio-processed protein concentrate, could replace up to 30% of LTFM70. It would be possible to replace fish meal by more than 30% for shrimp diets. Diet AQ65 had equal and/or better performance with VTFM65 and would be a competitive feed ingredient for shrimp diets. In addition, unlike fish meal which is subject to price, supply and quality fluctuations, the product has consistent quality and quantity.

## Conclusion

Based on these results, we concluded that Aquatide65 could replace fish meal up to 30% of LTFM70 in the shrimp diet.

Representing a more cost effective feed ingredient compared with LTFM70 and VTFM65, it showed similar and/or better performance based on growth performance, apparent digestibility of ingredients, protease activity and non-specific immune responses. It would be a promising and sustainable ingredient to replace fish meal and will provide additional advantages for shrimp farming.

**Hyeonho Yun**, PhD is Senior Analyst and **Jun-Young Bae**, PhD is Product Manager of Aquatide65, at CJ Cheiljedang Center, South Korea. Email: jy.bae1@cj.net

**Jehoon Ryu**, PhD is Senior Researcher and **Seong-Jun Cho**, PhD is Senior Manager, at the R&D Center, Life Ingredient & Material Business Unit, CJ Cheildang, South Korea.

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# Innovations for farmed seafood

By Zuridah Merican

## A French processor scores by innovating farmed shrimp products and the story on the farming process on packaging.

MITI is a small seafood processing company in Nantes, northern France. At the core of its processing business, is innovation in value adding for seafood, and in particular farmed shrimp. Relative to several processing companies in Asia, its facilities cover only 2,500m<sup>2</sup> in the 'little rungis' enclave in Nantes Island in the Loire River, where there is a gathering of food processing enterprises. There are several firsts for this company employing only 65 workers and with an annual turnover of €15.5 million.

Miti means 'ocean' in Polynesian. The forte of Miti is its precept, 'Taste and Innovation', leading it to use only quality and premium raw materials to produce a range of value added products such as peeled shrimp, marinated shrimp and a range of cold and warm seafood aperitifs. It is the first processor to achieve the AB (Agriculture Biologique) certification with shrimp from OSO, Madagascar. This is France's organic certification programme prior to a standardised European Union organic certification. In 2004, it was the first French seafood processor to be honoured at the annual Prix d'élite at the Global Seafood Exposition in Brussels.

## An affinity to farmed shrimp

Pierre Roffino, Miti's President who started the company in 2002, always had an affinity with farmed tropical marine shrimp and went all out to create value added seafood products based on farmed shrimp. His seafood business came after spending 8 years in Asia and Tahiti on research and development where he stayed in places such as Pulau Sayak in Kedah, Malaysia for the implementation of the marine shrimp breeding programme under France's AquaCop, a development agency. Returning to France, Pierre joined the Adrien Group, which is engaged in seafood processing.

"When I returned to France in 1995, I discovered that we had a culture of eating whole cooked shrimp. Whereas in Asia, they transform shrimp into several value added products such as dim sum. The most elaboration for the shrimp is peeled shrimp from Holland where we then eat with a sauce.



The cooker for HOSO shrimp operates overnight for early morning deliveries to many parts of France. Consumed on the day of delivery, the shrimp is part of the seafood platter popular in seafood restaurants.

"There is a lot of room to innovate with several recipes and product forms. At the Adrien Group, we began to produce frozen shrimp rings. Frozen products is a different market as there is a change in colour from the ice. I tried to overcome this practice by producing fresh cooked shrimp."

Roffino then worked with Ecuadorian shrimp integrators, Frescamar and Omarsa. He discovered that fresh cooked shrimp rings were a better option. Later, Roffino went on to produce cooked head on shell on (HOSO) vannamei shrimp from Ecuador, sold daily to the Rungis market and wholesalers all over France.

## A relationship business

"In this seafood processing business, it is not only buying the products. What matters more is the long term relationship with our suppliers. We have total confidence in our suppliers. We have been working with Omarsa for the last 20 years. We have visited their farms and they have come over to visit our processing facilities. Farming shrimp is also in my blood and I understand the production process.

"I know that my current suppliers can provide the HOSO shrimp of A5-A4 grade (colour on the salmon fan) which consumers in France demand. In the case of peel deveined (PD) shrimp, we can only buy A3-A4 grade shrimp. We only need small volumes of 700-800 tonnes per year and so we can afford to be choosy."

Aside from these Ecuadorian companies, Miti also gets shrimp from farms of Bumi Surabaya in Indonesia and Blue Archipelago (BAB), Malaysia.



The packaging for 'La Rouge du Belize' shrimp has an explanation on the appearance of farmed shrimp, to assure customers who usually compare appearances of farmed versus wild caught shrimp.



Miti's shrimp rings

"Over the years, we have developed a great partnership as we both believe in quality products. This is a special niche that both companies play in the supply chain. BAB's shrimp meet the colour that Miti requires for the French market," said Ronnie Tan, Vice President, BAB.

## Farmed HOSO shrimp

These are frozen 'cooker quality' shrimp cooked at Miti. Currently, this is specific for shrimp from two suppliers; organic monodon shrimp from OSO in Madagascar and vannamei shrimp from Belize Aquaculture, Belize. These are for niche markets all over France. Again, there is a 15 years relationship with OSO and 5 years with Belize Aquaculture. Of course, the quality of the shrimp matters too.

The cookers segment is uniquely French. Here shrimp are defrosted at 10°C and cooked at 90-95°C. Miti has engineered to link the cookers to heat exchangers to enable the company to save as high as 30% in energy costs. On his part, Roffino focussed his attention on quality for the final products.

He said, "In the packing of HOSO shrimp, I have recalibrated the weighing machine to distribute only 1.9kg of shrimp into 2 kg boxes. In this way, packers complete the final 100g and can pay attention to the product quality."

Shrimp from Belize is marketed as 'La Rouge du Belize' (Red from Belize). The demand for this shrimp is about 500 tonnes/year but supply has been declining from 120 tonnes/year to as low as 60 tonnes/year. This shortage of supply is because of early mortality syndrome in Belize. Shrimp at Belize Aquaculture is farmed in biofloc systems. It is inevitable that the hepatopancreas is darkish and visible through the carapace.

"Usually for French consumers, this is not acceptable as they are used to shrimp farmed in open systems such as from Ecuador and organically farmed shrimp in Madagascar. The hepatopancreas in these shrimp are not apparent. However, we see biofloc farming as a sustainable model. This is a new era in shrimp farming and we intend to educate consumers," said Roffino.

"Boxes of the 'La Rouge du B elize' shrimp now carry a message on farmed shrimp. This clearly explains that 'the farming conditions and the richness of the pond water is the source of the colouration of the shrimp'. With this message we are educating



Wild caught shrimp from OSO in Madagascar

the consumer of the fundamentals of farmed shrimp which will always be dissimilar to wild caught shrimp.

"This is a step forward as the seafood processing industry in future will depend more on farmed shrimp. Even within the farmed shrimp category, consumers need to learn not to expect the same physical properties among shrimp cultured in low density, in biofloc and in intensive systems."

## Introducing the tilapia

"My business is to do something with a good product. With the various products available, my role is to push the limits of innovation and work on fish species such as the tilapia," said Roffino.

"I have the opportunity to work with Regal Springs in Indonesia and Mexico which have a fantastic tilapia product. I have to create an equally fantastic product for the market in France. With high pressure (6,000 bar) pasteurisation processing, we were able to produce a tilapia product, which looks like cooked fish. This maintains the protein structure and colour. To start, our product range is ready to cook natural fillet or marinated with herbs, or ready to eat with vegetables.



New heights for Pierre Roffino with the launch of the brand 'restauration Miti' with a range of products treated by cold pasteurisation.



Cold pasteurised tilapia fillet, ready to cook.

In 2015, Roffino and three other food processors in Nantes formed SAS HPP Atlantique to co-invest in this new procedure which extends the shelf life of food products. Helped by a government subsidy, the group has installed in Miti's facility the largest equipment of this type in France, with the group sharing the costs of operations.

The tilapia is not well known among French consumers. Alain Renaux, Commercial Director, said, "Initially we had a difficult time explaining to consumers how the tilapia is farmed. Fortunately, certifications such as ASC (Aquaculture Stewardship

Council) have worked in convincing consumers to accept such exotic products as the tilapia."

Currently, the supply of tilapia comes from the ASC certified farms of Regal Springs, the largest tilapia producer. For the uninitiated consumer, brochures tell the story on the tilapia and its characteristics and feeding based on marine and plant proteins. Also detailed is the exceptional farming model adopted by Regal Springs, which clearly respects the environment, guarantees participation of the local communities as well as improves their livelihood.

## Soon a larger facility

A roundup of Miti's shrimp product range shows various value added products, from natural shell-off shrimp to marinated shrimp with various sauces to match traditional tastes, such as shrimp with dried tomatoes and olives, shrimp with mayonnaise to shrimp in exotic soya sauce with ginger. There is also a product range using AB accredited shrimp, provenance Ecuador. Other seafood products include preparations such as squid and mussels in a sauce as aperitifs.

As it grew, the company has been slowly taking over any available space around it. It started only with 120m<sup>2</sup> and today has expanded to 2,500m<sup>2</sup>. Further expansion will be a new facility covering 5,000m<sup>2</sup>, about 10km away but still along the Loire river. This will give it space for additional processing lines and space to freely innovate more value added products.



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# Expanding value addition in Vietnam

Bringing higher margins through value creation, a major seafood processor leaps up on the value chain through cooked coated value added pangasius products.

Godaco Seafood FSC, one of the fastest growing seafood processing companies in Vietnam announced in August, that it has began production at its new processing plant in Ben Tre Province, An Hiep, in South Vietnam. Covering 20 ha and with an investment of more than USD 20 million this is the largest facility for cooked, breaded and coated products and value addition of seafood in Vietnam. With the latest equipment, mainly from Marel, and JBT, Godaco will focus on cooked and value added products for the local and international markets. The products include, breaded, marinated, coated and tempura as well as skewers and mixed species rolls. The new factory also does custom portioning and cutting of sashimi grade products.

“Currently, Godaco is the eighth largest pangasius integrator in Vietnam. However, as a seafood processor, we want to be a leading player in the value addition for seafood in Vietnam. This is part of its new strategy to bring cooking and value addition back to Vietnam. For many years, Vietnam has been exporting raw pangasius fillet to Europe or the USA and they do the value addition,” said Jonathan Forrest Wilson, Executive Director, at the Godaco booth during Vietfish 2016. Based in Malaysia and Vietnam, Wilson is on the board of Godaco, representing Navis, its equity partner as well as having direct managerial responsibility in the company and directly driving the value added business.

“We have seen offer prices by importers for the pangasius fillet declining over the years which translates to lower ex-farm prices for the pangasius fish. For many years, profit margins for pangasius farmers have been squeezed by processors and importers of traditional fish fillets, demanding low prices for their harvests. The diversification of products can help boost the value of the pangasius. It is important for the economy of Vietnam that the pangasius farming industry continues. Similar to the Thai chicken industry, we want to supply value added seafood to the US, European and Asian markets,” added Wilson.

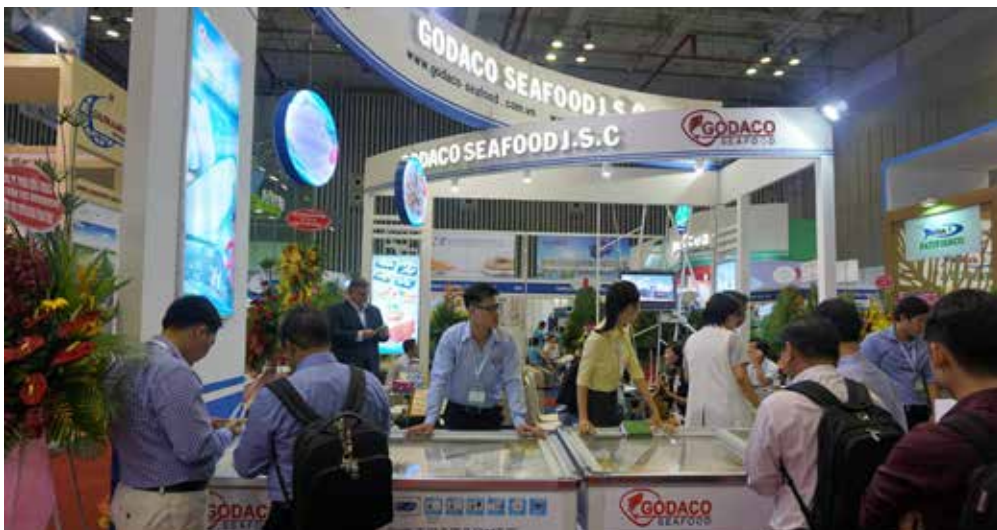
“Recently, Godaco introduced value added products for the institutional market in Japan which include tempura and breaded pangasius. This is possible as in Japan, small cuts of the pangasius can be categorised as ‘white fish’ thereby entering the market neutrally. First orders from the factory also were shipped to Europe. These initial orders were tempura and karage style pangasius fully cooked in the new factory. Other value added products are marinated pangasius with various seasonings, seafood mix of squid, shrimp and clams, seafood skewer with vegetables and cuttlefish and pangasius skewer. We also target the reprocessing sector. Recently, we started custom processing and portioning with salmon from South America,” said Wilson.

In 2013, private equity firm Navis Capital Partners invested in Godaco. The investment from Navis enables the company to accelerate its expansion plans and increase global export sales of its two key products, ASC (Aquaculture Stewardship Council) certified pangasius and MSC (Marine Stewardship Council) certified clams. The new funds will also be used to expand processing and farming capacity as well as finance the company’s entry into the US market. It has its head office in Tien Giang Province and besides this new factory in Ben Tre, it has three other seafood processing plants, and one trade office in Ho Chi Minh City. Godaco exports its products to Japan, Korea, the United States, Australia, European Union, South America and to several Asian countries.

## Leading pangasius integrator

Godaco is one of the pioneering companies in Vietnam. It started in 1998 in seafood processing and then ventured into pangasius farming. Today, the total area of farming is 200 ha, producing more than 100,000 tonnes of fish. A hatchery with a 50 million annual production of fingerlings and a 147,000 tonnes per year aqua feed mill support the farming activities. Two of its farms, Thanh Long and Con Linh A farm comprising 50% of its farming area have the ASC certification. It is now working on ASC certification for its other pangasius farms. Raw material for its seafood processing business comes from these farms as well as others owned and operated by Godaco. The company is 100% self sufficient in farming. By products from processing include fish meal and oil as well as fish skins.

A more recent addition to its farming business is tilapia production in ponds. This is still in the early development stages.



Godaco at Vietfish 2016 in August

# JV feed factory officially opened in Turkey



From left to right: Bora Aydemir, General Manager of BioMar-Sagun, Ole Christensen, Vice President, BioMar EMEA Division, Carlos Diaz, CEO of the BioMar Group, Ahmet Sagun, Owner of the Sagun Group and Oğulcan Sagun, Vice Chairman of the Sagun Group

Danish feed company BioMar and Turkish seafood company Sagun, officially opened the Joint Venture state-of-the-art fish feed factory in Turkey in August.

The BioMar-Sagun fish feed factory based in Söke, Turkey opened with a ribbon cutting ceremony attended by more than three hundred guests. The factory has 50,000 tonnes production capacity and will supply locally produced high performance diets including grower feeds for trout, sea bass and sea bream. Other more specialised feed types in the BioMar-Sagun product portfolio such as hatchery diets and fry feeds, will be produced at other BioMar factories and distributed through BioMar-Sagun. BioMar-Sagun will mainly serve Turkey, but it will also start export sales to some of the neighbouring countries.

Bora Aydemir, General Manager of BioMar-Sagun underlined that in addition to a complete range of high performance diets the company will provide Turkish fish farmers with BioMar's well-known technical support to help farmers achieve a more cost efficient production. Turkish fish farmers will receive guidance for appropriate farm management, nutrition, and feeding strategies that will eventually create a more efficient, sustainable and profitable aquaculture activity.

The management of both Joint Venture partners were very pleased to see that the project has become a reality. The CEO of the BioMar Group, Carlos Diaz stated: "Turkey is a great country with excellent natural conditions for aquaculture and a high potential for growth. As BioMar Group, we are delighted to be a part of the Turkish aquaculture industry. We have a great team here in Turkey. We believe in ourselves, we believe in our

partners, and together we hope to make a solid contribution to the continued development of the aquaculture industry and to help realise the full potential for aquaculture in Turkey".

Likewise, the Vice Chairman of Group Sagun, Oğulcan Sagun said, "We are proud to be partners with the global fish feed giant BioMar. With BioMar's knowledge and expertise in fish feed, we are determined to contribute to developing and bringing an innovative perspective to the Turkish aquaculture industry".

According to Aydemir, the company will utilise the strengths of both partners in the joint-venture and strive for the development of a sustainable and profitable future for the aquaculture industry of Turkey. "We are here to supply our customers with efficient feed produced at a state of the art factory, and to make a notable difference in the Turkish aquaculture industry. We are here to innovate aquaculture".

The BioMar Group is a leading supplier of high performance feed to the global aquaculture industry. Currently, BioMar produces feed at factories in Norway, Chile, Denmark, Scotland, Spain, France, Greece, Costa Rica, China, and Turkey. The Sagun Group was established in 1950 and today it is one of the leading Turkish companies within aquaculture. The main business areas are fish farming, processing and trading as well as fish export/import. The Sagun Group consists of six different companies, operating ten production facilities across Turkey. The BioMar-Sagun factory in Turkey is situated in Söke near Izmir. BioMar-Sagun is a 50-50 Joint-Venture between the BioMar Group of Denmark and the Sagun Group of Turkey. [www.biomar-sagun.com.tr](http://www.biomar-sagun.com.tr)

# “Bringing the shrimp industry to a New Normal” at TARS 2016

Nutriad, once again sponsored The Aquaculture Roundtable Series (TARS), which was held on August 17-18 in Phuket, Thailand. TARS 2016 attracted key players in the shrimp industry involved in the production of broodstock, aquafeed and post-larvae; farm owners and major suppliers in the region focusing preventing and controlling future disease outbreaks in shrimp aquaculture in Asia.

TARS is a recognised platform for aquaculture professionals in Asia-Pacific to exchange insights and experiences. The objective of this year's event was to bring the industry to a “New Normal” following the devastating impact of the hepatopancreatic necrosis disease (AHPND - initially called early mortality syndrome or EMS) on shrimp production in China, Thailand and Malaysia. Shrimp farming in Thailand alone has cumulated losses in excess of USD 5 billion since the AHPND outbreak in 2013 and saw 100,000 jobs lost as a result, according to speaker Andy Shinn of Fish Vet Group.

Commented Allen Wu, APAC Manager Aquaculture with Nutriad: “The industry aims to achieve its objective of getting to a new normal through better health management and improved control of the variables in shrimp farming; build on up-scaled industrialization and develop technical, operational and



Allen Wu



Mercè Isern Subich

production efficiency from breeding to grow out. Our additives range provides support to the industry in overcoming some of their key challenges related to nutrition and health.”

Dr Maria Mercè Isern Subich, Nutriad's Business Development Manager Aquaculture Health presented a well-received talk on “*Health Management for Profitable and Safe Aquaculture Production*”, in which she contrasted the European approach and legislation in fish production with the current practices and challenges in the Asia-Pacific shrimp farming sector.

## Targeting growth in Indonesia

Indolivestock, which is one of the largest livestock tradeshow in the region, was held in Jakarta from July 27-29. For the first time species specific elements were incorporated; Indo Fisheries 2016 and Indo Dairy 2016. Indonesia is a dynamic feed producing country in the region, with a production of 16.4 million tonnes in 2015, representing a 10% growth since 2014. At the show Nutriad launched their three generations of mycotoxin deactivators; Toxy-Nil Dry, Toxy-Nil Plus and Unike Plus as well as Sanacore®GM for aquaculture.

BK Chew, Regional Director Asia Pacific for Nutriad said “We are excited about the Indonesian market and at this show we work towards fulfilling our strategy of becoming the practical expert in mycotoxin management, offering our services to poultry breeders, broilers, layers and cattle”.

More than 12,000 trade visitors and delegates attended the expo, seminar and technical presentations. Nutriad was one of the 350 exhibitors from 33 countries that presented itself to the regional feed community.

Glenn Ferriol, Area Manager, added that “Nutriad is also offering services that come with our mycotoxin deactivators to the Indonesian market. For example we launched our Mycoman app, which helps our clients with their mycotoxin risk management”.

The aquaculture industry in Indonesia is expanding rapidly.



Glenn Ferriol



Ho Gim Chong

Nutriad has been working with producers in the area for many years. At the show Nutriad had interactive sessions with customers and distributors alike. Ho Gim Chong, Technical Manager Aqua elaborated on the launch of Sanacore GM in Indonesia: “We are encouraged by the feedback from our customers, showing reduced mortality caused by bacteria (co-) infections e.g. *Vibrio* sp. of shrimp and gut parasites of fish,” and is convinced that the Nutriad portfolio will help aqua producers in Indonesia solve some of their key challenges.

Nutriad delivers products and services to over 80 countries through a network of own sales offices and distributors. Supported by 4 application laboratories and 5 manufacturing facilities on 3 continents. More information at [www.nutriad.com](http://www.nutriad.com)

## Transfer of probiotic business

Evonik signed a purchase agreement on July 4, 2016, for acquisition of the probiotics business of the Spanish company NOREL, a global supplier of animal feed ingredients. The agreement sees Evonik acquiring Norel's probiotics product portfolio as well as the company's site in Leon (Spain). The business will be integrated into Evonik's Animal Nutrition Business Line. The parties have agreed not to disclose details of the transaction.

Evonik is currently expanding its portfolio of sustainable and healthy solutions in the field of animal nutrition and striving to provide innovative solutions for antibiotic-free livestock management. Food safety and quality are increasingly important to end consumers. "There is great awareness for the relevance of animal feed quality for sustainable livestock management, as it influences both animal and human health," says Dr Emmanuel Auer, head of the Animal Nutrition Business Line of Evonik.

"For us, this acquisition marks an important step into the probiotics market. By combining the technologies of Norel and Evonik we can create a platform for the development of new customer solutions, which are built around probiotics product

families and application services," said Auer. "We want to position Evonik as an innovative solution provider in the field of antibiotic-free livestock management". Norel's portfolio includes a range of probiotic products for application in poultry and pigs, as well as in aquaculture, and whose effects have been scientifically proven.

"For the last 25 years we have worked on probiotic products and taken these from their development stage straight through to commercialization. Products such as Ecobiol® and Fecinor® are already available in many markets. That's something we're very proud of, and we are pleased that our probiotics business has found a new home and future within Evonik", says Francisco Moral, Managing Director of Norel.

Norel's probiotics business gives Evonik access to this product range and to more than 20 markets including the European market. "Our aim is to be able to provide the most comprehensive and effective solutions possible in the field of animal nutrition in order to contribute to the sustainable nutrition of a growing world population," stressed Auer. More information at [www.norel.net](http://www.norel.net)

## Device to reduce stock losses in fish farms



Giana Gomes with a barramundi

A hand-held device is being developed to help reduce massive losses in fish farms. The project is being developed by PhD candidate Giana Gomes from Sustainable Tropical Fisheries and Aquaculture, JCU, Australia. In March 2016, Gomes received the Minister of Science and Innovation Awards to develop her project. These awards recognize the best emerging young Australian talents in Agriculture, Fisheries and Forestry with an AUD 22,000 prize for each award.

Gomes originally from Brazil, is a qualified veterinarian and has 14 years of experience working in the aquaculture industry. "We know that disease is one of the biggest problems in aquaculture causing around 40% of economic loss," Gomes said. The idea is to develop an on-farm device that is able to detect and quantify pathogens.

"We detect the parasite cells in the water using advanced biotechnology techniques," added Gomes. "Because the animals are under water, it is difficult to see signs of problems until they are sick. Once fish are infected the spread of pathogens is very fast." Generally, aquaculture farms are remotely located so the aim is to avoid time-consuming tests usually performed off-site. Quick detection of pathogens is crucial to avoid high death rates in aquaculture farms. "The current process involves sending fish samples to laboratories hundreds of kilometres away. It takes days or weeks to get results back to farmers" Gomes said.

This digital device will be portable, simple to use and will accelerate the response capability of farmers to disease outbreaks. Gomes is developing the detection tool for marine fish white spot caused by the protozoan parasite *Cryptocaryon irritans* and she will first try out the device in farmed barramundi. She hopes to have a prototype to beta-test within the next three years.

# Supporting the Blue Economy Challenge

Team members from Ridley's Aqua Division, have accepted an invitation to join the Blue Economy Challenge as a technical partner, a role which includes sitting on the judging panel. "I am confident that this partnership with the knowledgeable staff at Ridley will lead to great outcomes, in particular, the identification of the most innovative, forward-thinking, and scientifically robust solutions for replacement aquaculture feed," said Alex Dehgan, CEO, ConservationXLabs.

"Ridley is committed to the sustainability of its products and business practices. Partnering with an initiative like the Blue Economy Challenge, allows Ridley to take this commitment beyond our doors and out into the wider world," said CEO Tim Hart.

DFAT's Blue Economy Challenge Manager, Stephanie Kimber, welcomed Ridley to the initiative. "DFAT's innovationXchange was created to seek out new types of partnerships with private

sector actors in support of our international development goals. By participating in the Blue Economy Challenge, Ridley welcomes development and we look forward and we look forward to seeing some exciting outcomes from the collaboration."

Ridley is Australia's largest commercial provider of high quality, high performance animal nutrition solutions and an integrated supplier of innovative, high yielding and sustainable aqua feeds to the fast growing aquaculture sector.

The Blue Economy Challenge aims to crowd source the world to find solutions to the challenges facing our oceans. The goal is to encourage innovations that will revolutionise aquaculture in the developing world. Focusing on the Indian Ocean region, where transformations in aquaculture can help eradicate poverty, end hunger, and ensure access to safe, nutritious and sufficient food all year round. More information at [www.ridley.com.au](http://www.ridley.com.au)

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## Increase in raw material from by-products for marine ingredients supply

Scientists at the University of Stirling, Scotland have used models of current and future fisheries and aquaculture production, based on FAO data, to provide estimates for the future availability of raw material for marine ingredients. The model shows an increasing availability of raw material from byproduct derived from aquaculture as that sector continues to grow, but also confirms an underutilisation of byproduct from both fisheries and aquaculture at the current time. As the total volume of raw material, and fishmeal and fish oil production increases, byproduct is predicted to provide an increasing proportion of the total. This work was commissioned by IFFO in order to quantify the potential volume of future global raw material supply.

Europe currently uses proportionately more byproduct for fish meal and fish oil production than other regions. Asia, and China in particular, shows the most potential for future marine ingredient supply from under-utilised resources in both fisheries and aquaculture. Fish oil is predicted to grow slower than fish meal, as future contributions from aquaculture are likely to include increasing proportions of low-oil yield farmed freshwater species. Logistical and practical difficulties account for the current under-

utilisation of byproduct in marine ingredient production. The full report may be accessed on the IFFO website [http://www.iffo.net/system/files/Report%20IoA%20IFFO%20project%20Final\\_0.pdf](http://www.iffo.net/system/files/Report%20IoA%20IFFO%20project%20Final_0.pdf).

Dr Neil Auchterlonie, Technical Director of IFFO said "Models such as this are useful in providing an overview of future scenarios for the industry, and are important in managing the security of supply of marine ingredients within global food supply chains. The Stirling University team has provided some excellent predictions of future supply of these vital ingredients into aquatic and terrestrial protein production systems."

IFFO represents the marine ingredients industry worldwide, with members in more than 60 countries and account for over 50% of world production and 75% of the fishmeal and fish oil traded worldwide. Approximately 5 million tonnes of fishmeal are produced each year globally, together with 1 million tonnes of fish oil. IFFO's headquarters are located in London, UK and it also has offices in Lima, Peru, and in Beijing, China. IFFO is an accredited Observer to the UN Food and Agriculture Organisation (FAO).

# AMF based shrimp nursery technology for EHP mitigation



Dr Arasu, CIBA presented on the overall issues in shrimp farming and the necessary adoption of smart shrimp farming practices

Shrimp farmers in India are encountering a multitude of disease problems from running mortality syndrome (RMS), *Enterocytozoon hepatopenaei* (EHP), white spot syndrome virus (WSSV) as well as other bacterial and viral infections. For the shrimp industry to resolve the EHP disease outbreak, natural bioremediation of culture system through the aerobic microbial floc (AMF) driven nursery technology is considered viable for disease mitigation. Hence "AMF-based shrimp nursery technology for EHP mitigation" surfaced as an important theme in a national shrimp farming workshop on May 20.

The workshop "Smart Shrimp Farming'16" was organised by the Fisheries College and Research Institute (FCRI), Ponneri, Tamilnadu Fisheries University, India. It was attended by 60 participants from farmer communities, industry, academia and government. There was a diverse coverage of presentations by experts and research scholars.

The keynote address on the role of standard management practices (SMPs) in shrimp health management was given by Dr S Felix, WAS-APC Director and Dean of FCRI. He focused on shrimp production, biosecurity and health management aspects. He also recommended that closed shrimp culture systems with enhanced biosecurity protocols be implemented to address the spread of EHP in shrimp farming.

Felix said that there is a lack of knowledge on SMPs among the Indian farmers. They should strictly follow basic procedures in shrimp farming starting from pond preparation to harvest practices. For instance, they should use quality broodstock from certified hatcheries and avoid feeding broodstock with live feeds such as polychaetes and artemia from wild sources. However, the use of shrimp nursery systems to prevent diseases has increased and opens up the potential applications of AMF technology.

Dr Arasu, principal scientist (retired) from the Central Institute of Brackishwater Aquaculture (CIBA) spoke on the overall issues in shrimp farming and the necessary adoption of smart shrimp farming practices such as provision of intensive aeration at high stocking density, polyculture of shrimp with fish, and the practice of SMPs.

OIE expert, Dr Sahul Ahmeed discussed emerging pathogens in aquaculture: its impact and solutions. He highlighted the cause and impacts of WSSV in Indian farms and the prototype for disease diagnosis at farm level. He also discussed the clinical signs of EHP, stating the disease transmission could be vertical or horizontal and the causative agent of EHP requires an intermediate fish host for transmission. The spore forming nature of the fungus causes a dreadful impact, with the quality of post larvae a result of quality parent stock.

Dr A Gopalakannan, Assistant Professor presented on the application of molecular PCR in his talk, "Molecular diagnostic protocols for emerging pathogens". He emphasised on the difference between RT-PCR and Nested PCR methods and the use of Insulated Isothermal Pocket PCR to obtain results within 30 minutes in post larvae screening.

The second session began with the talk on "AMF Technology: Innovative biosecurity intelligence system for disease mitigation". Menaga, research scholar from ICAR-Central institute of Fisheries Education Mumbai, detailed the protocols for AMF development and its management with respect to C:N ratio. Suriyakala, a shrimp farmer, shared her experience of adopting biofloc technology in farming. Leading hatchery owners and farmers of Tamilnadu debated on contemporary issues.



Demonstration at the Research Farm Facility of FCRI, Ponneri



# ASIAN-PACIFIC AQUACULTURE 2017

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*All info: [www.was.org](http://www.was.org)*

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# Health and nutrition at Aqua Days



Feeding pangasius in Vietnam

“Are farmed fish weaker than in the past?,” asked Dr Alessio Bonaldo, Associate Professor in the Department of Veterinary Medical Sciences at the University of Bologna, speaking at the 2016 BIOMIN Aqua Days held in late August.

His answer: Yes, for two main reasons. First, less fish meal and fish oil in diets, and second, the intensification of aquaculture have led to weakened immune systems. Part of the solution involves meeting the nutritional requirements of farmed species.

“Functional feeds can be good tools to increase the health and performance of your fish,” he explained. He also highlighted the benefits of nutritional solutions. “Used carefully and correctly, in the end it’s better to use functional feeds—even if the cost is higher.”

## Nutritional focus

“Shrimp feed formulation is moving from an ingredient- to a nutrient-based approach,” said Dr Alberto Nunes, Associate Professor at Labomar, the Institute of Marine Sciences of the Federal University of Ceará in Brazil. He went on to note the advances in supplementation, formulation and understanding of nutritional requirements made in recent years.

“It is possible to completely replace fish meal in shrimp feeds, provided you have correct supplementation,” he stated. Producers have adapted to these developments.

“In many countries, farmers no longer care about the fish meal content of shrimp feeds,” he stated. “Rather, farmers want to see performance in the pond.”

“Supplementation with phytogenic feed additives has been shown time and again to offer consistent performance improvement in fish and shrimp,” highlighted Carina Schieder, Product Manager of Phytogenics at Biomin.

## Pond management

Good quality feeds, though beneficial are not without some drawbacks. “Only 30-35% of nutrients in feed are retained in animals. As a result, around 70% of those nutrients remain in the pond. In combination with excreta and organic matter, undesirable pond conditions can quickly develop,” stated Anwar Hasan, Technical Manager of Aquaculture, Biomin Singapore. “Poor water quality increases stress and susceptibility of shrimp to pathogens,” he added.

“Bioremediation strategies can stabilize pond sediment and improve farm profitability,” said Dr Jutta Kesselring, Biomin’s Development Scientist.

## Pathogen control

The use of Biotronic® Top3, an organic acid-based feed additive, can support animal health. “When aquafeeds are treated with Biotronic® Top3, animals tend to be more resistant to pathogens—which means lower mortality and higher growth performance,” stated Dr Antonia Tacconi, Product Manager of Acidifiers. “These results stem from better feed hygiene and a direct antimicrobial effect that reduces the bacterial load in the gastrointestinal tract,” she explained.

## Mycotoxins represent a real risk to aquaculture

“Mycotoxins represent a real risk to aquaculture,” said Rui Gonçalves, Biomin’s Aquaculture Scientist, citing recent data from a recent peer-reviewed scientific study showing that deoxynivalenol and fumonisins were the most common mycotoxins found in finished aquafeeds (Gonçalves et al. 2016). A full 76% of samples tested contained 2 or more mycotoxins. A total of 41 finished aqua feed samples from Europe and Asia were analysed.

“Though it may be a relatively new topic for the industry, mycotoxins are important to aquaculture in terms of the negative effects in animals,” said Gonçalo Santos, R&D Manager of Aquaculture, Biomin.

Michele Muccio, Mycotoxin Risk Management Product Manager added, “While each mycotoxin has its own structure and particular effects, we know that generally mycotoxins reduce growth, increase mortality and decrease weight gain”.

## Immune suppression

Anwar Hasan stated that “aquaculture producers in Asia Pacific countries face challenges such as early mortality syndrome (EMS) and white feces syndrome (WFS).” Each year the shrimp industry suffers losses of more than USD1 billion due to early mortality syndrome or acute hepatopancreatic necrosis (EMS/AHPND). “Mycotoxins have an immunosuppressive effect, making fish and shrimp more vulnerable to opportunistic pathogens,” pointed out Gonçalves.

These remarks were made at the 2016 Aqua Days hosted by Biomin. More than 60 aquaculture industry members from 16 countries attended the event from August 23-25 in Austria. The program consisted of conference sessions on important topics affecting the aquaculture industry, an overview of its R&D activities with on-site tours of the research center in Tulln, Austria.



# VIV ASIA 2017

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# New model for large pumps

Pentair has announced the release of a new model in the Verus pumps line. This is the Verus Max, which is its largest pump. Available with flow rates up to 2,000 gpm, Verus Max pumps are designed for large commercial applications where flow rate and turnover demands are high.

Pumps in the same class are often times over-engineered resulting in unnecessary costs being passed onto the customer, said Pentair. Utilising a practical and robust design approach, Verus Max pumps offer exceptional value without compromising on quality or performance. Thanks to its relatively light weight for its size, installation and maintenance of Verus Max is simple compared to metallic pumps with similar capacities. Designed for the most challenging of aquatic system environments, Verus Max pumps are constructed using rugged and reliable components which include an IE2-rated TEFC motor, stainless steel hardware and glass reinforced thermoplastic housing. (More information:www.pentairaes.com)



## What to look forward to in Aqua Culture Asia Pacific in 2017

In 2017, we will cover what is trending and technologies for the next step in aquaculture in Asia Pacific. Our topics are most relevant to the industry to help companies reach marketing targets.

Volume 13 2017						
Number	1 - January/ February	2 - March/April	3 - May/June	4 - July/August	5 - September/ October	6 - November/ December
<b>Issue focus</b> <i>Recent developments and challenges for the next step</i>	Microbial Management	Hatchery & Nursery Technology	Sustainable & Responsible Aquaculture	Revisiting Shrimp Nutrition	Biosecurity & Disease Management	E-aquaculture & commerce
<b>Industry Review</b> <i>Trends and outlook, demand &amp; supply</i>	Marine Shrimp	Marine Fish	Aqua Feed Production	Tilapia	Catfish	Genetics
<b>Feeds &amp; Processing Technology</b> <i>Technical contributions from feed industry</i>	Fish Meal & Marine Protein Replacements Feed Enzymes	Novel Ingredients Micro Feeds Feed Additives	Lipids & Minerals Performance Feeds for Intensification	Extrusion & Processing Feed Additives	Sustainable Feeds Feed Safety and Hygiene	Functional Feeds for Health
<b>Production Technology</b> <i>Technical information and ideas</i>	SPF/SPR/SPT shrimp	Cage Culture Automation	Controlled systems/RAS	Disease Mitigation	Finfish Industrialisation	Aeration Technology & Waste Treatment
<b>Aqua business</b> Feature articles	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					
<b>Deadlines for Technical articles</b>	<b>November 16, 2016</b>	<b>January 16</b>	<b>March 13</b>	<b>May 15</b>	<b>July 17</b>	<b>September 18</b>
<b>Deadlines for Advert Booking</b>	<b>November 23, 2016</b>	<b>January 23</b>	<b>March 20</b>	<b>May 22</b>	<b>July 24</b>	<b>September 25</b>
<b>Show Issue &amp; Distribution at these events as well as local and regional meetings</b>  <b>*Show preview</b>	<b>VIV ASIA 2017</b> March 15-17 Bangkok, Thailand	<b>Giant Prawn 2017</b> March 20-24 Bangkok, Thailand <b>Seafood Global Expo</b> April 25-27 Brussels, Belgium	<b>*World Aquaculture 2017</b> June 26-30 Cape Town, South Africa	<b>*Asian Pacific Aquaculture 2017</b> July 24-27 Kuala Lumpur, Malaysia <b>The Aquaculture RoundTable Series, (TARS 2017)</b> TBA <b>Vietfish 2017</b> August 29-31 Ho Chi Minh City, Vietnam		



## 6th International Conference of Aquaculture Indonesia

This is an annual event for the Indonesian Aquaculture Society (MAI), an independent and non-profit professional organisation for the aquaculture industry. This 6th International Conference of Aquaculture Indonesia (ICAI) 2016 will be held on October 27-29, 2016 at the Mercure Hotel, Kuta-Bali. Participation will be aquaculture stakeholders in Indonesia as well as from other countries, comprising academicians, technicians, private industries/companies, researchers, government representatives, farm managers and owners, traders and others.

This conference has the support of the Indonesian government which has the mandate to increase seafood production to meet demand from domestic and international markets. The theme of this conference "Sustainable Aquaculture For The Future" is relevant to address the latest issues in the aquaculture industry in Indonesia and other ASEAN countries. Some of the aquaculture commodities to be covered are catfish, pangasius catfish, tilapia, gouramy, milkfish, grouper, pompano, ornamental fish, shrimp and seaweeds.

Indonesia has a target in aquaculture. It wants to be among the leading contributors to global fish supply with an annual production of 17 million tonnes. To realise this target, it requires support from all stakeholders to work together with the government. The academia and research fraternity also play an important role with the revitalization and intensification in aquaculture. Aquaculture has an important role in the national economy in various ways (social, economic and food source).

According to Professor Rokhmin Dahuri, President of MAI, "A sustainable aquaculture is needed in Indonesia including infrastructure development, investments, environmentally friendly production and human resources. Growth of the global aquaculture industry including that of Indonesia, will be severely restricted if the industry remains reliant on fish meal and fish oil as key ingredients in aqua feeds. Looking at new sources of omega 3 will be important in developing sustainable aqua feeds. In the next ten years, aquaculture in Indonesia will face challenges for its sustainable development. This conference will allow us to look at the many threats and opportunities and consider how best to manage our aquaculture industry."

ICAI 2016 will include plenary and topic-based concurrent sessions during the two day conference. The concurrent sessions will cover the following

- Disease and Aquaculture Sustainability
- Aquaculture Management and Technology
- Feed Management and Nutrition
- Genetics and Breeding
- Aquaculture Business and Marketing

There will also be a Farmers Day and Applied Technology Forum.

More information: [www.icaiaquaculture-mai.org](http://www.icaiaquaculture-mai.org)



## NEXT ISSUES

### November/December 2016

**Issue focus: Probiotics**

**Industry review: Freshwater Fish/Prawn**

**Feed/Production Technology: Nutrition & Formulation/Aeration Technology/Water Treatment**

**Deadlines: Articles - September 15, Adverts - September 22**

### January/February 2017

**Issue focus: Microbial Management**

**Industry review: Marine Shrimp**

**Feed/Production Technology: Fish Meal & Marine Protein Replacements/Feed Enzymes/ SPF, SPT, SPR shrimp farming.**

**Deadlines: Articles - November 15, Adverts - November 22**

Email: [zuridah@aquasiapac.com](mailto:zuridah@aquasiapac.com); [enquiries@aquasiapac.com](mailto:enquiries@aquasiapac.com) for details



## March 20 - 24, 2017, Bangkok, Thailand

The Asian Institute of Technology (AIT) in Bangkok will organise GIANT PRAWN 2017 (GP 2017), an international conference and trade show, from March 20-24, 2017. The venue is the AIT Conference Centre Hotel (AITCC) located within one of the green and quiet university campuses in Thailand. There are several concurrent events as detailed below. The organiser is encouraging those interested in holding a special session on any related topic to contact him. There will be a trade show to display the global aquaculture industry.

- GP 2017 will have a four-day conference (March 20-23, 2017) comprising sessions with invited speakers and submitted abstracts related to the farming of the freshwater prawn *Macrobrachium* spp. The technical program will have invited speakers from 16 countries; Australia, Bangladesh, Brazil, China, India, Malaysia, Myanmar, Indonesia, Israel, Pacific Islands, Russia, Spain, Thailand, Vietnam, UK and USA. Selected papers

presented at the conference will be considered for publication in the Giant Prawn Special issue of the Journal of the World Aquaculture Society

- Prior to the conference, March 17-19, 2017, there will be a three-day training program on Advances in Giant Prawn Hatchery Management. This is to address a range of technical issues in prawn hatchery production facing many countries in the region. Global experts in prawn hatchery technology will conduct the training.
- A farm tour on March 24, 2017 to prawn hatchery and farms in Thailand will give an excellent overview of prawn farming practices in Thailand.

More information: The early bird registration will end by October 31, 2016. Email: [salinkr@ait.asia](mailto:salinkr@ait.asia) (Dr Salin R Krishna); [www.giantprawn.org](http://www.giantprawn.org)

# 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](mailto:zuridah@aquasiapac.com)

**September 6-8**  
**Seafood Expo Asia**  
**Wanchai, Hong Kong**  
Web: [www.seafoodexpo.com/asia](http://www.seafoodexpo.com/asia)

**September 20-23**  
**Aquaculture Europe 2016**  
**Edinburgh, Scotland**  
Web: [www.easonline.org](http://www.easonline.org)

**September 23-25**  
**India International Seafood Show 2016**  
**Visakhapatnam, Andhra Pradesh**  
Web: <http://internationalfair.in/>

**September 26-30**  
**Certificate in Aqua Nutrition**  
**26-30 September 2016,**  
**Bangkok, Thailand**  
Email: [agrischools@progressus.asia](mailto:agrischools@progressus.asia)  
Web: [www.progressus.asia](http://www.progressus.asia)

**September 28-30**  
**Aqua Fisheries Myanmar**  
**Yangon, Burma**  
Email: [sabrina.hoang@veas.com.vn](mailto:sabrina.hoang@veas.com.vn)  
Web: [www.veas.com.vn](http://www.veas.com.vn)

**October 19-21**  
**AquaSG 16**  
**Singapore**  
Email: [info@aquasg.com](mailto:info@aquasg.com)  
Web: [www.aquasg.com](http://www.aquasg.com)

**October 27-29**  
**6th International Conference of**  
**Aquaculture Indonesia (ICAI) 2016**  
**Kuta-Bali**  
Email: [icai.aquaculture@gmail.com](mailto:icai.aquaculture@gmail.com)  
Web: [www.icai.aquaculture-mai.org](http://www.icai.aquaculture-mai.org)

**October 31-November 2**  
**International Fisheries Symposium**  
**(IFS2016)**  
**Phu Quoc Island, Vietnam**  
Email: [ifs2016@ctu.edu.vn](mailto:ifs2016@ctu.edu.vn)  
Web: <http://ifs2016.ctu.edu.vn/>

**November 2-4**  
**China Fisheries and Seafood Expo**  
**(CFSE)**  
**Qingdao**  
Email: [seafoodchina@seafare.com](mailto:seafoodchina@seafare.com)  
Web: <http://chinaseafoodexpo.com>

**November 9-11**  
**Taiwan International Fisheries**  
**and Seafood Show**  
**Kaohsiung**  
Email: [taiwanfishery@taitra.org.tw](mailto:taiwanfishery@taitra.org.tw) /  
[stenly\\_yonardi@myexhibition.com.tw](mailto:stenly_yonardi@myexhibition.com.tw)  
Web: [www.taiwanfishery.com](http://www.taiwanfishery.com)

**November 21-25**  
**Certificate in Aqua Feed Milling**  
**Bangkok, Thailand**  
Email: [agrischools@progressus.asia](mailto:agrischools@progressus.asia)  
Web: [www.progressus.asia](http://www.progressus.asia)

**November 28-December 1**  
**LAQUA 2016**  
**Latin American & Caribbean**  
**Aquaculture 2016**  
**Lima, Peru**  
Web: [www.was.org/www.marevent.com](http://www.was.org/www.marevent.com)  
(for exhibition)

**2017**  
**February 19-22**  
**Aquaculture America 2017**  
San Antonio, USA  
Web: [www.was.org](http://www.was.org)

**March 15-17**  
**VIV Asia 2017**  
**Bangkok, Thailand**  
Web: [www.vivasia.nl](http://www.vivasia.nl)

**March 20-24**  
**Giant Prawn 2017**  
**Bangkok, Thailand**  
Email: [salinkr@ait.asia/new](mailto:salinkr@ait.asia/new),  
[macrobrachium@yahoo.co.uk](mailto:macrobrachium@yahoo.co.uk)

**April 4-6**  
**International seminar on Advances**  
**in Fish Health**  
**Putrajaya, Malaysia**  
Email: [isafe@upm.edu.my](mailto:isafe@upm.edu.my)  
Web: [www.isafe.my](http://www.isafe.my)

**June 27-30**  
**World Aquaculture 2017**  
**Cape Town, South Africa**  
Web: [www.was.org](http://www.was.org)

**July 25-27**  
**Asia Pacific Aquaculture 2017**  
**Kuala Lumpur, Malaysia**  
Web: [www.was.org](http://www.was.org)

# Food for thought

The annual meeting of the  
European Aquaculture Society

aquaculture  
europe  
Edinburgh



16

September 20-23  
Scotland



**eas40**  
european  
aquaculture  
society **years**

[www.easonline.org](http://www.easonline.org)



**marine**scotland



All info on:  
[www.easonline.org](http://www.easonline.org)

Organised by the European Aquaculture Society with the cooperation and support of Marine Scotland,  
part of the Scottish Government and The Marine Alliance for Science and Technology for Scotland



# CREATES THE VALUE OF PRAWN



Uni-President implements traceability through all sectors along with supply chain. Biosecurity hatchery produces SPF (Special Pathogen Free) and SPR (Special Pathogen Resistant) larvae. Quality program of prawn feed plants was certified by ISO 22000 & HACCP.



• No.16-18-20, DT743 Road, Song Than II Industrial Zone, Di An Ward, Di An Town, Binh Duong Province, Vietnam  
• Tel: +84-650-3737626 - Fax: +84-650-3790819  
• Email: aquafeed@upvn.com.vn



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