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Science & Solutions

Feed Efficiency on the Spot

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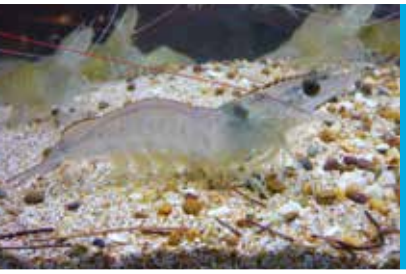

Shrimp Performance with Less Fish Meal

Yellow Catfish and the Mycotoxin Threat

Editorial

Feed Efficiency on the Spot

The aquaculture industry has been facing multiple challenges during the past few years, driven mainly by a higher demand for animal protein, the emergence of various diseases, environmental issues and increasing production costs.

Feeding costs constitute a major concern for most operations, and can be a determinant factor to the aqua business profitability and success. Feed ingredient forecasts point to a limited supply of key ingredients such as fish meal and fish oil, in addition to strong competition for alternative raw materials on a global scale. In this issue of **Science & Solutions** we first illustrate how a phytogenic feed additive can allow for reduced fish meal levels in aquafeeds while maintaining or even improving animal performance.

As the industry becomes more dependent on plant proteins, the risk of mycotoxin contamination in aquafeeds rises. Mycotoxins, along with anti-nutritional factors and environmental challenges, can negatively affect shrimp and fish gut health, leading to an unbalanced microbiota, reduced immunological ability, damaged mucosa and impaired nutrient uptake. The second article discusses recent scientific results of counteracting mycotoxins in yellow catfish.

To keep costs under control and go beyond the limits in feed formulation, nutritionists must apply a holistic approach in the diet development, relying on new technologies to avoid negative impacts in health, feed digestibility and growth performance.

Join us to find out more in this Aquaculture issue of **Science & Solutions**.

We wish you an enjoyable read!

Otavio Serino CASTRO
Technical Sales Manager

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Editor: Ryan Hines
Contributors: Otavio Castro, Rui Gonçalves, Michele Muccio, Gonçalo Santos, Benedict Standen
Marketing: Herbert Kneissl, Karin Nährer
Graphics: Reinhold Gallbrunner, Michaela Hössinger
Research: Franz Waxenecker, Ursula Hofstetter, Paolo Doncecchi
Publisher: BIOMIN Holding GmbH
Erber Campus, 3131 Getzersdorf, Austria
Tel: +43 2782 8030
www.biomin.net

Fish Meal Reduction

By **Gonçalo Santos**, R&D Manager – Aquaculture and **Benedict Standen,** Product Manager Microbials

in Shrimp Feed

Plant-based feed additives can help replace costly fish meal in shrimp feed while achieving desired cost and performance goals.

Photo: Timsa

Shrimp feeds are dependent on fish meal (FM), as this is an important protein source due to its palatability and quality. In recent years, the supply of fish meal has not kept pace with demand, raising prices and leaving shrimp farmers and feed producers looking for alternative protein sources.

Plant protein issues

Significant progress has been made over the past decade in reducing levels of fishmeal in commercial feeds for farmed aquatic animals.

However, plant proteins can affect the production performance and physiological competence due to issues such as amino acid composition, antinutritional factors including mycotoxin contamination and diet palatability. These represent important challenges for aquafeed companies. Phytogenic feed additives (PFAs) in aquatic species improve palatability, feed efficiency and growth—important considerations in fish meal substitution.

Lower fish meal content

A recent trial demonstrates that it is possible to reduce expensive fish meal levels in shrimp feeds without compromising growth performance or feed efficiency. Five diets containing 40.0% crude protein and 8.5% lipid were formulated and fed to white leg shrimp, *Litopenaeus vannamei*, for eight weeks. Three levels of fish meal as a marine-derived protein were used; 25% (FM25), 22% (FM22) and 19% (FM19). The lower FM feeds substituted soybean meal and peanut meal to reach similar crude protein levels. Digestarom® P.E.P. MGE, a phytogenic feed additive, was supplemented to the reduced fish meal diets.

The growth performance after eight weeks is displayed in *Table 1*. Survival in all treatments was above 96%. As expected, FM25 showed the best growth performance in terms of final weight, protein efficiency ratio (PER), feed conversion ratio (FCR) and standard growth rate (SGR). Lower fish meal content reduced performance in general.

However, the addition of Digestarom® P.E.P. MGE improved all these parameters. For example, in the 19% fishmeal group, improvements of approximately 10% were observed in final weight, PER and FCR, and a 3% increase in SGR was achieved when Digestarom® P.E.P. MGE was included in diets.

Better performance, lower fish meal

The addition of Digestarom® P.E.P. MGE to shrimp diets improved growth performance, even when fishmeal components were reduced, as seen by comparing FM19 + Digestarom® P.E.P. MGE with FM22: all performance

Trial results

Table 1. Growth performance parameters of juvenile *L. vannamei* after eight weeks of feeding experimental diets.

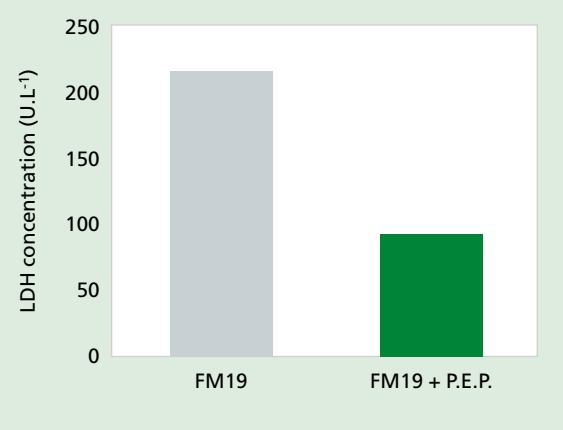
Treatment	Fish meal (%)	Digestarom® P.E.P. MGE	Final weight (g)	PER	Survival (%)	FCR	SGR (%/day)
FM25	25	0	15.36	2.52	98.66	1.02	6.78
FM22	22	0	12.31	2.04	98.67	1.26	6.37
FM22 + P.E.P.	22	200g/t	13.70	2.17	98.67	1.17	6.55
FM19	19	0	12.24	1.96	98.00	1.29	6.36
FM19 + P.E.P.	19	200g/t	13.45	2.10	96.67	1.17	6.54

Source: BIOMIN

Gonçalo Santos, R&D Manager – Aquaculture
Benedict Standen, Product Manager Microbials

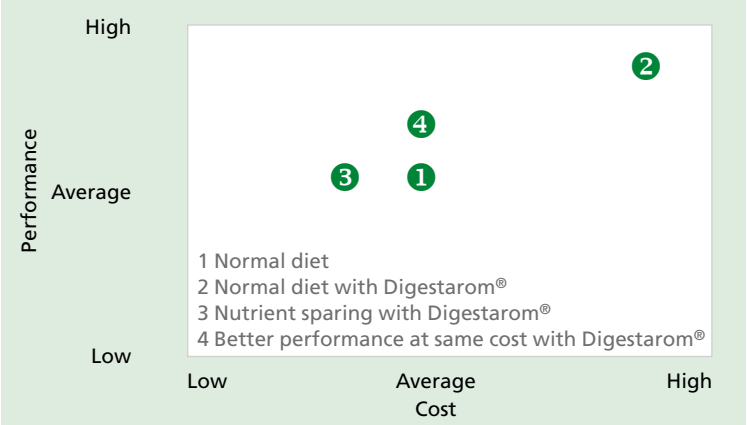
Phytogenic feed additives can play a key role in fish meal substitution

Figure 1. LDH concentration in the hemolymph of shrimp fed experimental diets + Digestarom® after 8 weeks.



Source: BIOMIN

Figure 2. Digestarom® can be used to optimize feed costs due to its nutrient sparing effect.



Source: BIOMIN

parameters were improved (final weight = +8.5%; PER = +6%; FCR = -7%; SGR = +3%).

Muscle protein content

One of the most important parameters for consumers is the protein content in the muscle of the shrimp. Interestingly, the highest muscle protein content was found in the lowest fish meal inclusion diet with Digestarom® P.E.P. MGE (FM19 + Digestarom® P.E.P. MGE), higher even than the positive fishmeal control (FM25).

As an extension to this trial, hematological enzyme activities were investigated. It was discovered that lactate dehydrogenase (LDH) was 57% lower in FM19 + Digestarom® P.E.P. MGE when compared with the fishmeal equivalent, FM19 (*Figure 1*). LDH is an oxidoreductase that catalyzes the interconversion of lactate and pyruvate and it is released into the blood/ hemolymph when tissues are damaged, or under stress. The relatively high levels of LDH in FM19 could be indicative of intestinal inflammation caused by a lower fishmeal inclusion, a condition which is alleviated by Digestarom® P.E.P. MGE.

Cost and performance goals

For feed producers or shrimp farmers looking to get the best performance from their animals, the application of a phytogenic feed additive such as Digestarom® could help in terms of budget and performance parameter goals. Inclusion of Digestarom® can serve to reduce feed costs and/ or improve aquatic animal performance depending on whether the feed formulation is also adjusted. The four main outcomes are illustrated in *Figure 2*.

Scenario 1 represents the control and acts as a baseline, i.e. normal feed with normal performance. *Scenario 2* builds on this with the addition of Digestarom®, resulting in higher feed costs matched by increased performance. *Scenario 3* is built around the nutrient sparing effect; it allows farmers to reduce their feed costs by using cheaper ingredients, include Digestarom® to achieve typical performance, but still maintain the economic benefits. In *scenario 4*, farmers can reformulate the diets by using cheaper ingredients, include Digestarom® (thus maintaining feed costs) and achieve higher animal performance.

New Research on the Mycoto

By **Rui Gonçalves**, Scientist - Aquaculture and **Michele Muccio**, Mycotoxin Risk Management Product Manager

A new study shows the potential harm and way to protect yellow catfish from aflatoxins. New data reveals that other mycotoxins also pose a threat.

xin Threat to Yellow Catfish

Photos: Tyler Olson, zhengzaishuru

Yellow catfish (*Pelteobagrus fulvidraco*) is an important commercial freshwater species in China, with promising market potential across Japan, South Korea, East and South Asia. Due to its high market value, yellow catfish farming has increased rapidly in recent years. A new study by researchers in China demonstrated the effectiveness of Mycofix® Secure in offsetting the negative effects of aflatoxin B_1 (AFB_1) on yellow catfish.

Table 1. Experimental diets.

Diets	AFB_1 in ppb		Mycofix® (%)
	Added to diet	Analyzed on diet	
Without Mycofix®	0	12	0
	200	269	0
	500	648	0
	1000	1186	0
With Mycofix®	0	27	0.2
	200	233	0.2
	500	573	0.2
	1000	1114	0.2

Source: Xinxia et al. 2016

Yellow catfish is an important commercial species in a number of Asian countries

Trial set-up

Twenty four yellow catfish weight 2.02±0.10 g/fish were randomly distributed into 24 net cages (2.0×2.0×2.0 m). Fish were hand-fed to apparent satiation one of eight experimental diets (*Table 1*) containing different concentrations of pure AFB1 with or without the addition of Mycofix® Secure.

In analyzing the experimental diets, AFB_1 levels were found to be higher than the amount added to feed by the researchers. This is probably due to the natural aflatoxin contamination of ingredients used in the basal diets.

Weight gain

Greater concentrations of AFB_1 in diets were strongly correlated with lower weight gain (*Figure 1*). This negative response was considerably less pronounced when Mycofix® Secure was added to the contaminated feed.

At 1000 parts per billion (ppb) of AFB_1 in diet, Mycofix® Secure improved weight gain by 9.64%.

Feed efficiency

The presence of AFB_1 in the diet at levels of 500 ppb or higher led to a significant increase in the feed conversion ratio (FCR), as shown in *Figure 2*. At 1000 ppb of AFB_1 in diet, the FCR rose by 60%. Catfish fed diets with 500 or 1000 ppb of AFB1 and Mycofix® Secure had much better feed efficiency (up to 36% improvement) than the control groups.

Survival rate

Survival rates decreased significantly with the increase of AFB_1 in diets. At 1000 ppb of AFB_1 in diets, survival fell 22% compared to control treatment. Application of Mycofix® Secure improved survival rates by up to 10.8% (*Figure 3*).

Overall, researchers found a negative relationship between the AFB_1 levels in the diet and fish survival, growth performance and feed efficiency. They also identified suppressed immunity parameters in catfish fed AFB_1-contaminated feed. Diets containing 1000 ppb AFB_1 were highly toxic to yellow catfish.

Mycofix® Secure decreased the negative impact of AFB_1 toxicity on yellow catfish. These results could represent enormous direct revenues for catfish farmers throughout Asia.

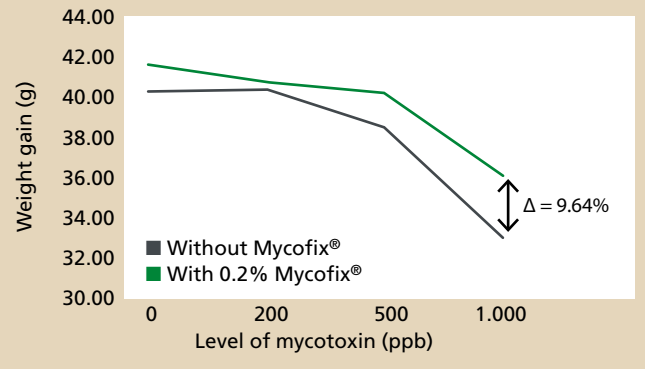
Aflatoxin not the only threat

Being an omnivorous freshwater fish, yellow catfish have a high probability of consuming mycotoxins in feedstuffs—and not just aflatoxins. A look at the most common ingredients in yellow catfish diets —soybean meal, rapeseed meal, cotton meal and wheat meal— reveals the presence of several other major mycotoxins that can also impair health and performance.

Samples of these ingredients were tested as part of the 2015 BIOMIN Mycotoxin Survey for the presence of aflatoxins, zearalenone (ZEN), deoxynivalenol (DON), T-2 toxin (T-2), fumonisins (FUM) and ochratoxin A (OTA). As

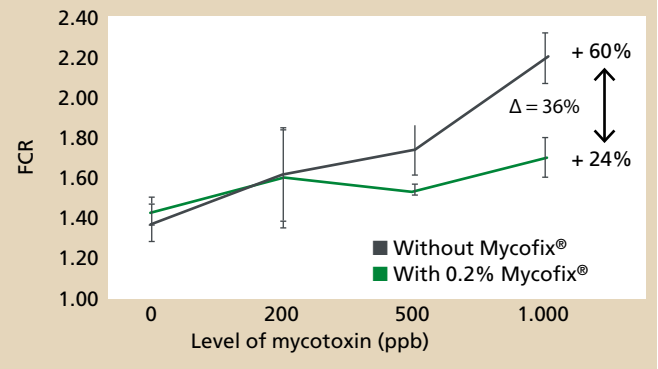
Rui Gonçalves, Scientist - Aquaculture
Michele Muccio, Product Manager

Figure 1. Weight gain of yellow catfish.



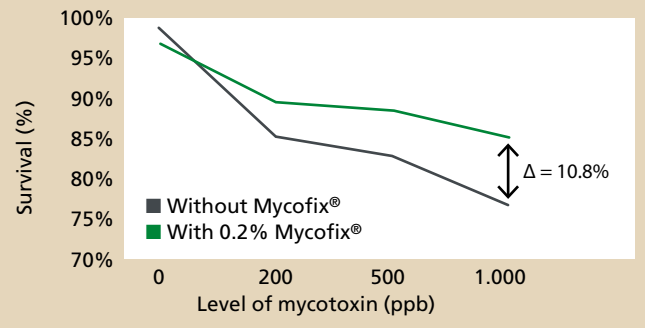
Source: Xinxia et al. 2016

Figure 2. Feed conversion ratio of yellow catfish.



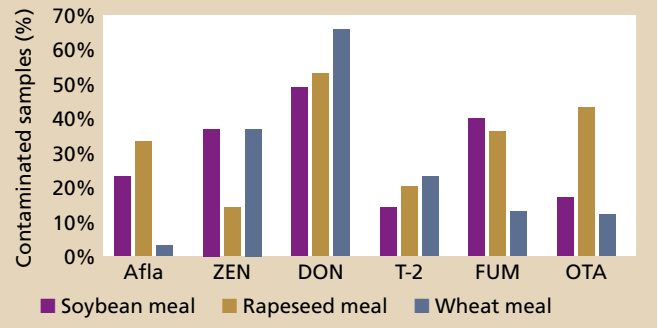
Source: Xinxia et al. 2016

Figure 3. Survival rate of yellow catfish.



Source: Xinxia et al. 2016

Figure 4. Mycotoxin occurrence in yellow catfish diet ingredients.



Source: BIOMIN, 2015

Figure 4 shows, mycotoxin contamination of these commodities is high.

Soybean meal

All main mycotoxins were present in soy samples in percentages that vary from 14% in the case of T-2 toxin to 49% for DON.

Rapeseed meal

For rapeseed meal, DON was found in 53% of samples, at an average concentration of 820 ppb. OTA was detected in 43% of samples. Afla, ZEN, T-2 and FUM were all detected in 11%, 41%, 5% and 36% of samples respectively.

Wheat meal

Regarding wheat meal, the most frequently occurring mycotoxin was DON, detected in 66% of samples at an average concentration of 807 ppb. ZEN was detected in 37% of samples.

Cotton seed meal

335 of the cotton seed meal samples were contaminated by aflatoxins on average value of 2,038 ppb and maximum value of 16,258 ppb (not shown).

Fusarium toxins including ZEN and DON were also found in considerable amounts.

Broad spectrum protection

A number of common molds found in the field produce a variety of harmful mycotoxins that make their way into feeds and impair fish health and performance. Different groups of mycotoxins differ structurally from one another, and therefore require different solutions. A robust mycotoxin risk management program that combines several strategies, or modes of action, to counteract a broad range of different mycotoxins offers better protection for animals and farmers' profits.

Being an omnivorous freshwater fish, yellow catfish have a high probability of consuming mycotoxins in feedstuffs—and not just aflatoxins.

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