

# Science & Solutions

## Certified sustainable Aquaculture

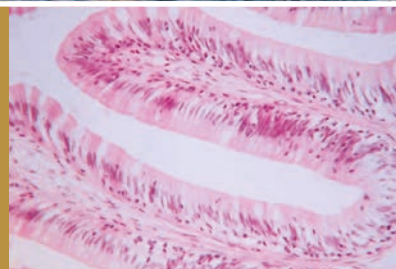
The role of feed additives in aquaculture



Photo: volk65 / iStockphoto

### Benefits of certification

Key standards in certification compliance and achieving them



### Probiotics for health

A tool for better rearing environment and fish health

# Editorial

## Sustainability

Like any form of industrial production, aquaculture has impacted the environment. Despite local government efforts to improve aquaculture sustainability, the concept of sustainability is deeply linked to the economic and social context of the country where development takes place, varying greatly between regions.

With worldwide seafood trade expanding and increased awareness among consumers, there has been growing interest in the certification of sustainable aquaculture products and more standard guidelines defining how the quality and safety of aquaculture products can be improved. However, as markets impose stricter requirements for aquaculture sustainability, small-scale farmers in particular face difficulties in producing for export markets.

For BIOMIN, sustainability in aquaculture has been a key topic for several years. All BIOMIN products undergo a full life-cycle analysis (ISO 14040 & ISO 14044) to quantify the environmental impacts associated with their production. With this, BIOMIN identifies and quantifies the environmental footprint from production, and weighs that against the performance enhancing effects of BIOMIN products in animals. BIOMIN feed additives can be used as an effective and simple tool for feed mill, integrators and farmers to achieve a more sustainable aquaculture industry, accomplishing at the same time the demanding targets imposed by certification organizations.

At BIOMIN we combine the most recent scientific findings with the needs of the aquaculture market. We constantly work towards solutions that allow the aquaculture sector to be more efficient and overcome production difficulties, while at same time grow more sustainably.

This issue of **Science & Solutions** is dedicated to sustainability in aquaculture production; in these pages, we share how aquaculture can be more sustainable without any profit loss. We hope that you will enjoy this issue.



**Rui GONÇALVES**

Technical Manager - Aquaculture



# Contents



Photo: RB/Ried, iStockphoto

2

## Profitable sustainability in aquaculture

Certification focuses on feed efficiency, waste management and disease control—critical factors that spell the profitability of your aquaculture operations.

By *Rui Gonçalves, MSc & Gonçalo Santos, MSc*



7

## Probiotics for health management

Keep pathogenic bacteria at bay while promoting fish gut health and feed value, with probiotics.

By *Jutta Zwielehner, PhD*

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# Profitable sustainability in aquaculture



➔ By complying with the requisite standards, sustainability certification offers a premium price and allows farmers to export to higher value markets.

Consumer awareness of sustainable aquaculture production has led to increased interest in certification for sustainable aquaculture practices. In contrast to common belief, this certification encompasses a broader scope than just environmental issues. It also covers areas such as social responsibility and compliance with legal frameworks.



One of the most widely used certification programs the Aquaculture Stewardship Council (ASC) is based on seven main categories (Figure 1).

Of these, three important categories relate to feed efficiency, waste management and disease control. Within these topics, certification bodies have established specific targets in terms of feed conversion ratio (FCR), waste discharges and water pollution, and the use of medicines as prophylactic measures. These targets present challenges that farmers must face in order to comply with such certification.

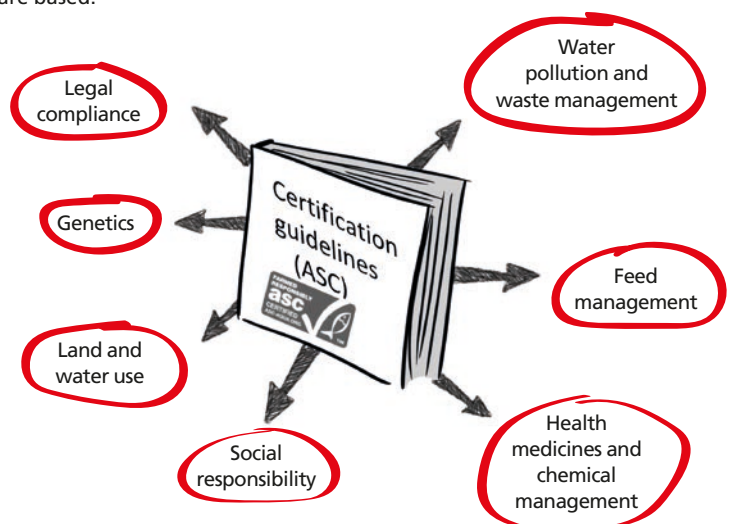
### Certification has its benefits

Farmers are also aware that by complying with such targets, sustainability certification can offer a premium price and allow exports to higher value markets. Feed additives can be used as a tool for feed mill integrators and farmers to achieve the demanding targets imposed by certification organizations.

The use of organics acids, phytochemicals, pre- and pro-

biotics, as well as mycotoxin management, can help the aquaculture industry accomplish some of the requirements for certification process without any profit loss.

**Figure 1.** The seven categories on which the Aquaculture Stewardship Council (ASC) certification for Pangasius farms are based.

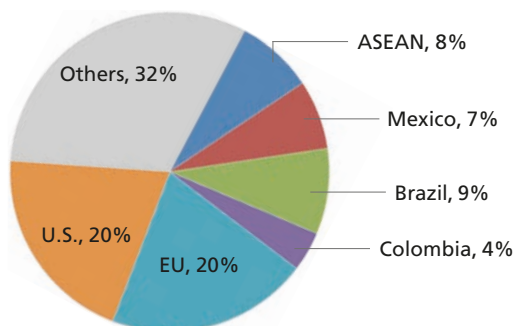


*A very significant reduction in solid waste, phosphorus and nitrogen discharge can be achieved by **improving feed efficiency**, thereby reducing the impact on the environment.*

### Case study: Pangasius catfish

Vietnam is the source of more than 90% of the world's supply of pangasius (*Pangasionodon hypophthalmus*). In the first three months of 2014, Vietnamese pangasius was exported to 126 markets.

**Figure 2.** Pangasius exports from Vietnam, January to March 2014



Source: pangasius-vietnam.com

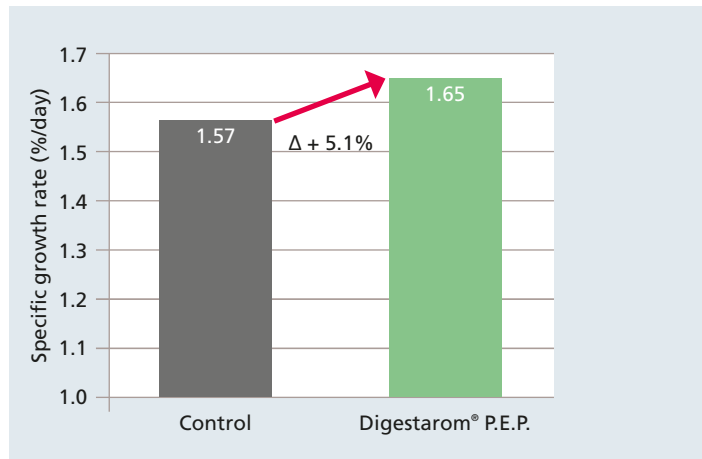
The US is the biggest market with a total export value of \$83.7 million, followed closely by Europe at \$82.8 million. To maintain these numbers and export to international markets, catfish production in Vietnam needs to accomplish international quality certification patterns.

#### • Improving feed efficiency

Phytogenics are known to stimulate digestive secretions, increase villi length and density and increase mucous production through an increase in the number of goblet cells. As a result, phytogenics improve feed digestibility.

Several trials were performed with pangasius to confirm the efficacy of the Digestarom® P.E.P. product line in improving feed efficiency. In a trial performed under commercial production conditions at Hung Ca farm in the Mekong Delta, two 8,000m<sup>2</sup> ponds were stocked and the fish raised to a final weight of 1.1kg.

**Figure 3.** Growth performance of the control and Digestarom® P.E.P.



Dietary supplementation with Digestarom® P.E.P. led to 5.1% higher specific growth rate (SGR) and 6.7% lower FCR (Figure 3).

Nutrient utilization improved as FCR became more efficient. Through enhanced FCR, farmers could achieve one of the most important requirements for the certification programme—nutrient utilization efficiency. This improvement also has direct positive effects on feed cost, water quality and nitrogen discharge.

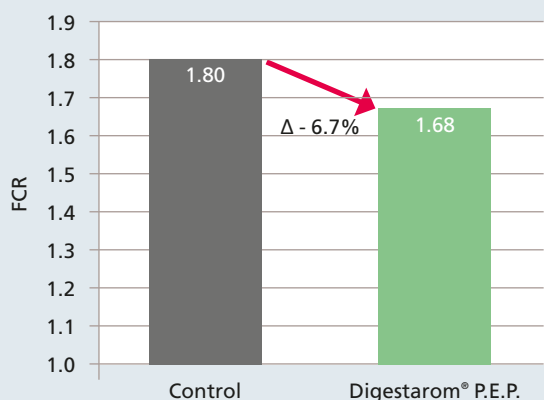
#### • Reducing nitrogen discharge

Through improved protein utilization, phytogenic feed additives can also decrease ammonia emissions and organic matter discharge. Considering a 6.7% reduction in FCR and assuming an average apparent dry matter digestibility coefficient (ADC) of 75%, the reduction in waste output to the environment would be 21.4 tonnes (Table 1).

#### • Sustainability is profitable

It is estimated that feed costs in Vietnam are about 80% of total production costs. It therefore stands to reason that if we could reduce the feed given but produce

groups.



the same quantity of fish, we could increase profits while limiting nitrogen discharge.

On this trial, improvement in fillet colour allowed the fish supplemented with Digestaron® P.E.P. to be sold at US\$0.76/kg instead of US\$0.75/kg (prices in July 2010, Vietnam). The 6.7% reduction in FCR also helped the farmer reduce feeding costs.

Finally, we could conclude that the inclusion of Digestaron® P.E.P. resulted in a total extra revenue of US\$10,046 per 8,000m<sup>2</sup> pond, and a return of investment (ROI) of 1:5.8. This does not even consider the premium price that farmers can receive if production is certified.

Through phyto-genetics nutrient utilization efficiency is improved, directly reducing feed costs and nitrogen discharge. Improved nutrient sparing also reduces the impact on the environment, leading to improved water quality, pond eco-system and better sludge control. Farmers also gain the benefit of a higher quality fillet.

### Prophylactic antibiotic replacements

Acidifiers can act in the intestinal tract to reduce pH-levels in the stomach and particularly in the small

**Table 1.** Nitrogen discharge reduction from the use of Digestaron® P.E.P.

	Control	Digestaron® P.E.P.
Production*	368.1	343.4
FCR	1.8	1.68
Feed used*	662.6	576.9
Waste output*	165.6	144.2
	Δ=21.4	

\*Values in tonnes, calculations based on ADC=75%

**Table 2.** Cost-benefit results from the use of Digestaron® P.E.P. for an 8,000m<sup>2</sup> pond.

	Control	Digestaron® P.E.P.
Revenue from sales	274.539,64	262.592,94
Total feed cost	283.924,49	249.197,45
Revenue - feed cost	-9.384,85	13.395,49
Net income		13.395,49
ROI		1:5.8

\*Values are in US dollars.

<sup>1</sup>Prices were calculated based on actual fish prices in Vietnam (July 2010). For >20% white fillet, fish price was US\$0.76/kg. For 0% white fillet and >20% pink fillet, fish price was US\$0.75/kg.

intestine, inhibiting the growth of Gram-negative bacteria through the dissociation of acids and production of anions in the bacterial cells. Acidifiers also act as preserving agents by reducing the pH of feed, and thereby inhibiting microbial growth.

Several aquaculture trials performed with the Biotronic® product line show that through the efficacy of these products as natural growth promoters, the use of antibiotic growth promoters can be totally dismissed. This fulfils one of the most important criteria for certification without any loss in growth performance.

In addition, the decreased uptake of biological organisms through feed will improve the health status of cultured fish, reducing disease outbreaks without any need for veterinary medicines.

## How feed additives improve aquaculture efficiency

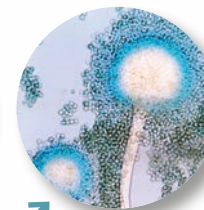


Phytochemicals stimulate digestive secretions and improve FCR, thereby reducing waste discharges.

Photos: serezhnyy, iStockphoto



Probiotics modulate the gut microflora, reducing the incidence of pathogens and the need for antibiotic treatments.



Controlling mycotoxins helps counter negative effects in aquatic species.

### • Tools for improved gut health

Preventing diseases is surely more cost effective than treating ill animals. Probiotics are able to modify the intestinal microbiota, secreting antibacterial substances (bacteriocins and organic acids) that compete with pathogens to prevent their adhesion to the intestine.

Probiotics also compete with pathogens for the nutrients necessary for pathogen survival, producing an anti-toxin effect. The use of AquaStar® Hatchery/Growout can improve the health status of aquatic animals by reducing diseases outbreaks and the need for veterinary medicines.

### • Pond management

Intensive fish farming produces large amounts of organic waste which accumulate in the pond bottom and cannot be utilized by the phytoplankton. Oxidation of these organic waste compounds depletes the dissolved oxygen deep in pond bottom soils, leading to the formation of toxic metabolites. This contributes greatly to deteriorating water quality and disease occurrences.

A useful and sustainable tool for managing the pond environment is the application of AquaStar® Pond/ Pond-Zyme. This type of bioremediation uses selected strains that focus on reducing pathogenic bacteria, enhancing the mineralization or degradation of organic matter, and removing undesirable waste compounds.

Despite not being therapeutic agents, these beneficial bacteria alter directly or indirectly the composition of the microbial community in the rearing environment, and consequently in the fish gut, improving animal health and performance.

### Managing mycotoxins in feed

#### • Preventing diseases and efficiency losses

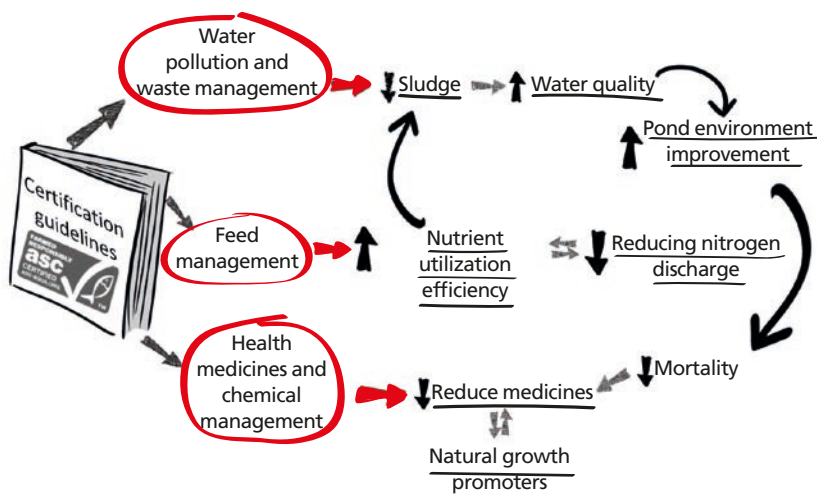
Ingested mycotoxins may lead to an overall decline in performance which may ultimately result in economic losses. It is difficult to observe directly the negative effects of mycotoxins in aquaculture species as most of the symptoms of mycotoxicosis are subclinical and hard to detect.

Several studies have highlighted the negative effects of mycotoxin-contaminated feeds in aquaculture. Some of these effects are reduced growth, increased production costs, overall negative effects on the pond eco-system, immune suppression and decreased disease resistance.

Symptoms of mycotoxicosis in aquatic species can pass unnoticed and economic losses are usually associated with diseases outbreaks rather than mycotoxins. The incorporation of Mycofix® in aquafeed can help mitigate the negative effects of mycotoxins, mainly tissue damage, that can lead to poor growth performance and disease susceptibility.

The use of feed additives through different strategies can help farmers achieve better aquaculture practices. This will enhance growth, survival and feed conversion rates, and increase tolerance to diseases, as well as better environmental conditions. Feed additives can support a more sustainable and profitable farm (Figure 2).

Figure 4. How feed additives improve the sustainability and profitability of your farm







# Probiotics for health management

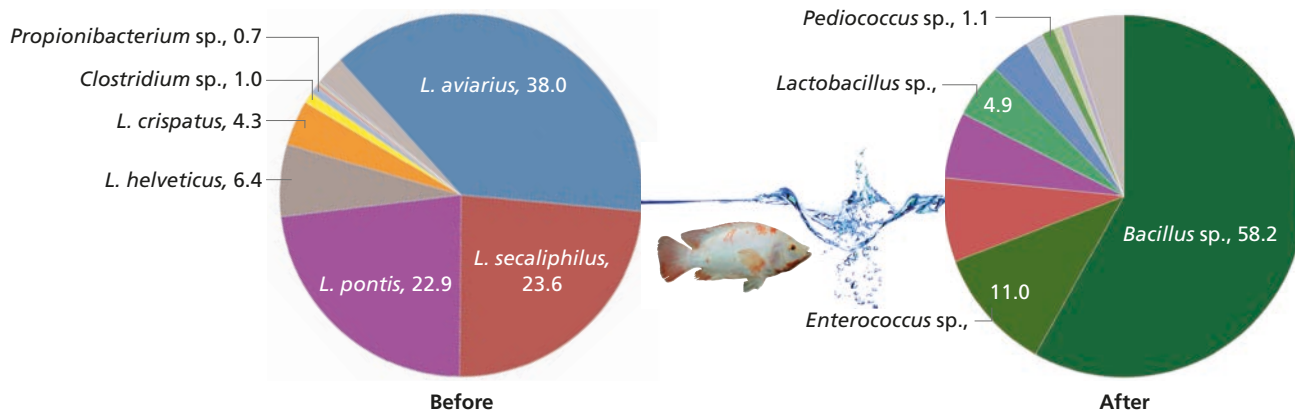
Aquatic animals have a much closer relationship to their external environment than terrestrial animals and are thus more susceptible to pathogens in their environment.

**I**n the aquatic world, potential pathogens are able to maintain themselves in the external environment of the animal (water) and proliferate independently of the host animal. These potential pathogens are

taken up constantly by the animal through the processes of osmoregulation and feeding.

Based on the intricate relationship of aquatic organisms with their external environment, probiotics in

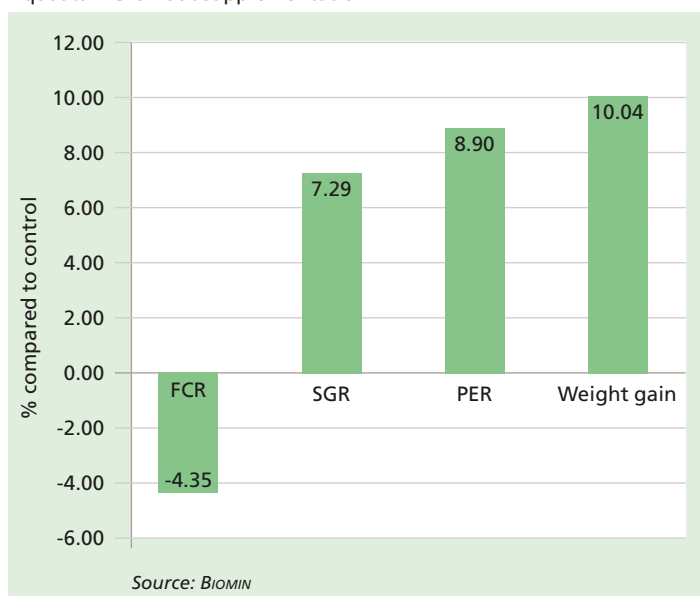
**Figure 1.** Microbiota composition of tilapia before (left) and after (right) supplementation with AquaStar® Growout at a dosage of 5kg/tonne feed for 8 weeks. The initial weight of the fish was 55 ± 1g. AquaStar® probiotic strains are shown in different shades of green. Figures are in %.



aquaculture are defined as live microbial adjuncts that exert beneficial effects on the host by one or more of these mechanisms:

1. Modifying the host-associated or ambient microbial community
2. Ensuring improved feed use by enhancing its nutritional value
3. Enhancing the host defense against diseases
4. Improving the quality of its ambient environment.

**Figure 2.** Tilapia growth performance over 6 weeks, with and without AquaStar® Growout supplementation.



### Modifying the ambient microbial community

Once established in the gut, probiotic bacteria can produce extracellular enzymes that improve digestion or aid in pathogen defense by producing inhibitory compounds. The prerequisite for any direct beneficial effect in the host is the establishment of the probiotic bacteria as part of the indigenous gut microbiota.

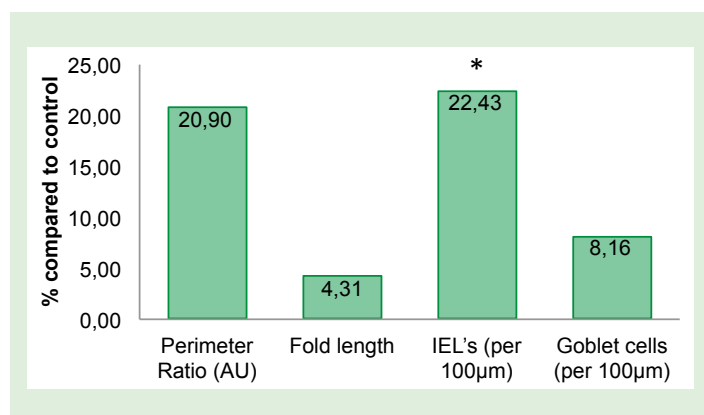
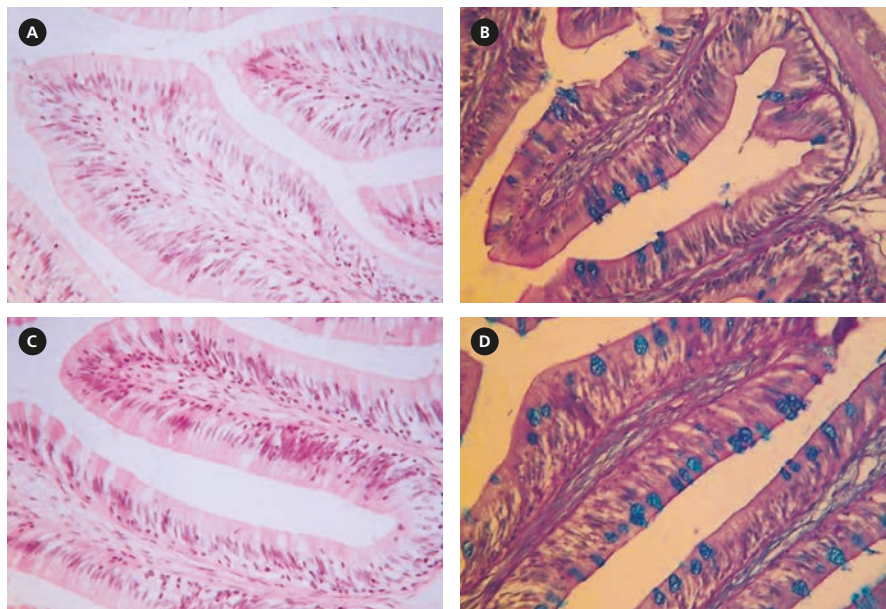
Figure 1 demonstrates that in juvenile tilapia (*Oreochromis niloticus*), the application of AquaStar® Growout led to an efficient colonization of the gut. AquaStar® bacteria (green) were detected over two weeks after the end of the probiotic treatment, although at rapidly declining levels.

As intestinal bacteria proliferate in the gut, they improve the nutrient utilization and lead to better nitrogen retention in the body. Probiotics reduce the nitrate content of feces and the impact on the environment through lower waste discharge. It is likely that the environmental benefits also extend to the quality and quantity of the phytoplankton populations in the pond.

### Improved feed value

Several probiotic strains produce digestive enzymes, thus facilitating feed utilization and digestion. As a result, growth performance is improved. Figure 2 shows tilapia growth parameters after supplementation with AquaStar® Growout. The average weight as well as specific growth

**Figure 3.** Light micrographs of the mid-intestine of tilapia fed either the control (A & B) or Aquastar® (C & D) diet after 8 weeks of experimental feeding. Abundant IELs are present in the epithelia and a distinct sub-population of acidophilic granulocytes (stained pink) are scattered in the mucosa. Light microscopy staining: A & C: H & E; B & D: Alcian-Blue-PAS stained. Scale bars = 100µm. IELs: Intra-epithelial lymphocytes



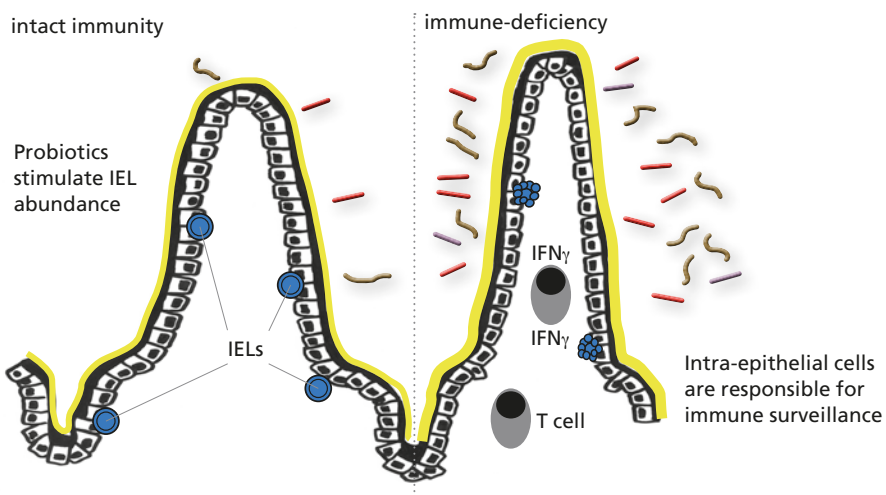
**Figure 4.** Immune parameters and gut health indicators were improved by the feeding of AquaStar® probiotics. Values are shown relative to control, asterisk indicates a significant difference ( $p < 0.05$ ). IEL's, intra-epithelial lymphocytes

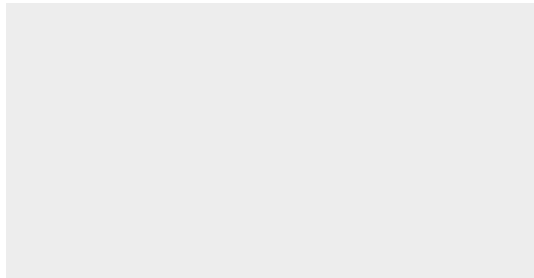
rate (SGR) increased significantly. Protein efficiency ratio (PER) was higher and feed conversion ratio (FCR) improved.

### Enhancing the immune response

Fish immune cells do not need priming. They immediately release cytokines that kill infected target cells. Probiotic organisms can stimulate this innate immune response as demonstrated in *Figure 3* and *Figure 4*. A higher level of intra-epithelial lymphocytes (IELs) suggests an elevated localized immunological response (*Figure 4*).

### The gut mucosa is the first line of defense





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