Probiotics and premixes in aquaculture

– a solution for antibiotic free feeding in shrimp hatcheries in South East Asia

By Christian Lückstädt

A growing awareness from consumers and producers of aquaculture species has resulted in calls for responsible and sustainable aquaculture. This is particularly so in the much debated shrimp production industry of South East Asia (Feedinfo, 2005). Public opinion and regulation authorities in most export countries now focus on the misuse of antibiotics in aquaculture. Henceforth, public attention has shifted towards production methods (Lückstädt, 2005).

Modern shrimp feed currently contains around 38-42% crude protein. Essential amino acids for shrimps are arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, valine, threonine, and tryptophan. The crude lipid content range from 5-6% and is best with high amounts of n-3 series highly unsaturated fatty acids (HUFAs), while carbohydrates make up around 20% of the diet, mostly to satisfy energy requirements, but also used for feed binding. The energy content of such diets should be around 2850 – 3700 kcal/kg.

However, in order to withstand the high stocking densities in shrimp production (hatcheries and grow-out ponds) and stress situations, directly fed probiotics can be a promising additive to stimulate shrimp growth and secure a low disease response. For shrimp grow-out, Massam (2005) found that directly fed probiotics can be an effective tool to boost survival. Decamp et al. (2005) also studied the effect of probiotics on one Asian shrimp hatchery. However large scale field data are still missing.

Trials with probiotics

In 2005, several trials in South Vietnam in a number of hatcheries using DynaGain products (DynaGain is a trademark of Mangrove Coast Ltd.) containing a single-strain fermented probiotic feed additive (with 3 different strains of *Bacillus* sp., *Enterococcus* sp. and Lactobacillus sp.) were performed. These have been designed to improve bioavailability in shrimp larvae used from early zoea to late post larvae stages and a micronized amino acid and vitamin premix blend for shrimp larvae. The trials were done in 4 provinces in 56 hatcheries from nauplii to post larvae (PL 12). The average results from all farms are shown below. All results are based on triplicates in each farm.

Table 1. Length differentiation in control and treatment (micronized amino acid/ vitamin premix blend) in PL12 of *Penaeus monodon*

Hatcheries	Control	Treatment group[1]
1. province, 15 hatcheries	10.80 mm	11.04 mm
2. province, 12 hatcheries	10.60 mm	10.80 mm
3. province, 9 hatcheries	10.80 mm	11.17 mm
4. province, 20 hatcheries	10.60 mm	10.95 mm

[1] *containing DynaGain(r) NUTRA-ZM 3x*

Table 2. Survival in hatcheries using the probiotic blend in diets until PL 12 in *Penaeus monodon*

Hatcheries	Control containing antibiotics	Treatment group[1]
1. province, 15 hatcheries	50.0%	53.3%
2. province, 12 hatcheries	45.0%	45.8%
3. province, 9 hatcheries	55.0%	58.3%
4. province, 20 hatcheries	50.0%	51.3%

[1] *containing DynaGain(r) LARVAEbiotic*

Based on these results it can be concluded that the chosen additives can be an alternative for an antibiotic-free hatchery operation under the circumstances in Vietnam.

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References are available on request.

Mode of action of probiotics in aquaculture

- *Production of inhibitory compounds*

Here probiotic bacteria release chemicals which have a bactericidal or bacteriostatic effect. Some of these chemicals are: bacteriosins, lysozyme, proteases, organic acids (pH-change)

- *Competition for available energy (nutrients)*

Microbial competition for organic substrates (carbon and energy sources) in the intestinal tract of shrimp means that by increasing the relative numbers of probiotic bacteria, nutrients are consumed which would otherwise be available for the growth of pathogenic bacteria.

- *Competition for adhesion sites*

Bacteria also compete for gut adhesion sites. Adhesion is a prerequisite to colonisation in the intestinal tract. By applying a high number (1012) of beneficial bacteria (probiotics), harmful bacteria (pathogens) are not able to adhere and thus cannot proliferate.

- *Enhancement of immune response*

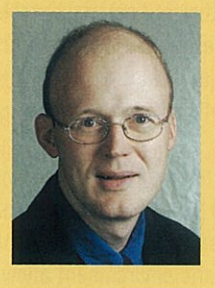
There are many publications available on immune stimulating substances. Most of these are derived from the cell walls of various microorganisms, such as ß-glucans, lipopolysaccharides (LPS) and peptidoglucan (PG). These substances are a first challenge that approaches the shrimp's immune system in response to invading microorganisms.

- *Improvement of water quality*

This is usually associated with *Bacillus* species. In comparison to gram negative, bacteria gram positive strains (e.g. *Bacillus subtilis*) are better converters of organic matter thus producing CO2. This results in lower levels of residues in the pond, so the BOD (biological oxygen demand) and the COD (chemical oxygen demand) are reduced.

- *Enzymatic contribution of digestion*

Certain bacterial species (*Bacillus subtilis*) are known to produce and release enzymes (e.g. amylase, protease) that are able to improve the digestive process in shrimp.



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