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Aquafeeds

Tests study fresh marine ingredients in shrimp larval diets

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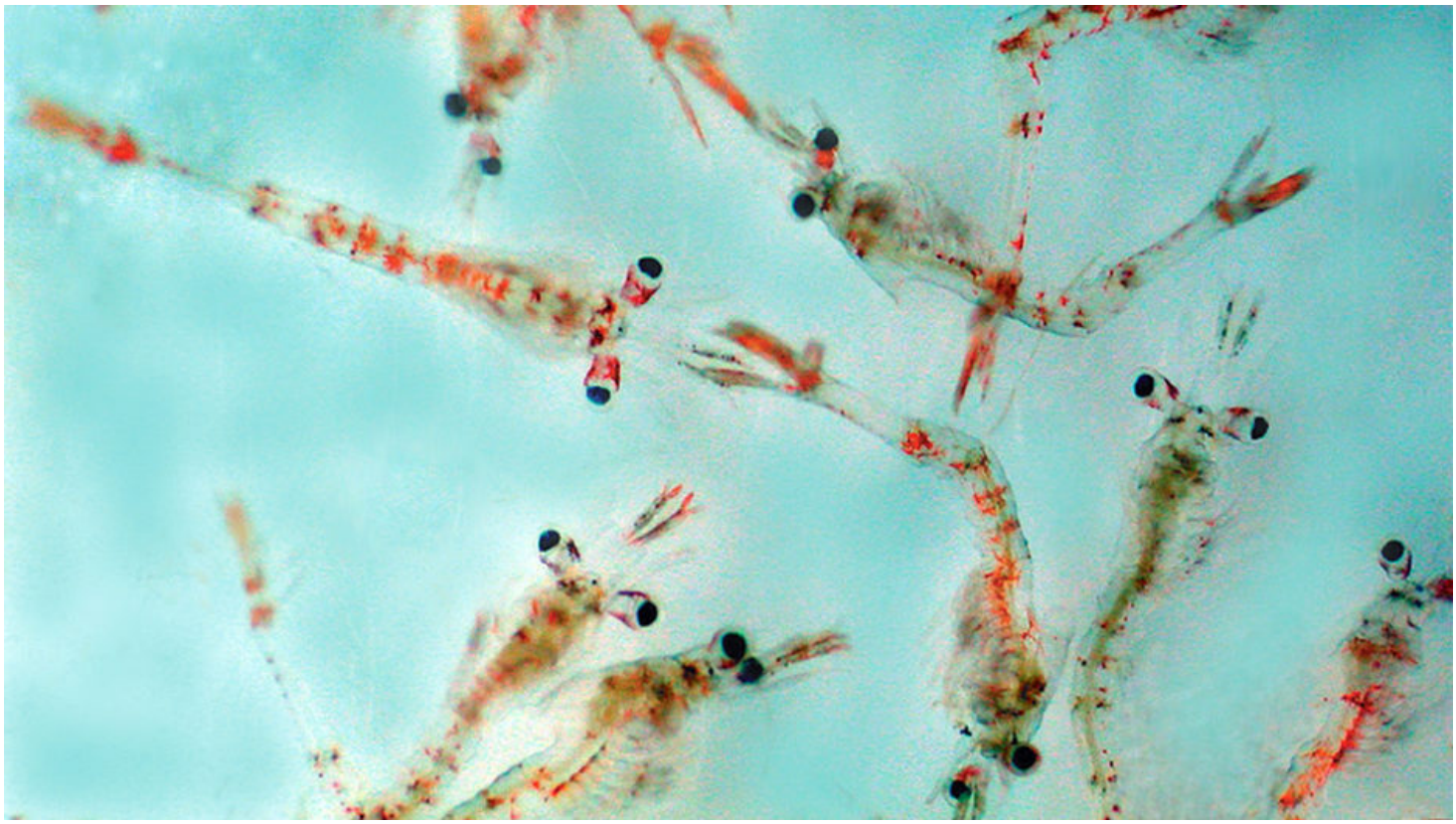
Higher inclusion rates increase general performance



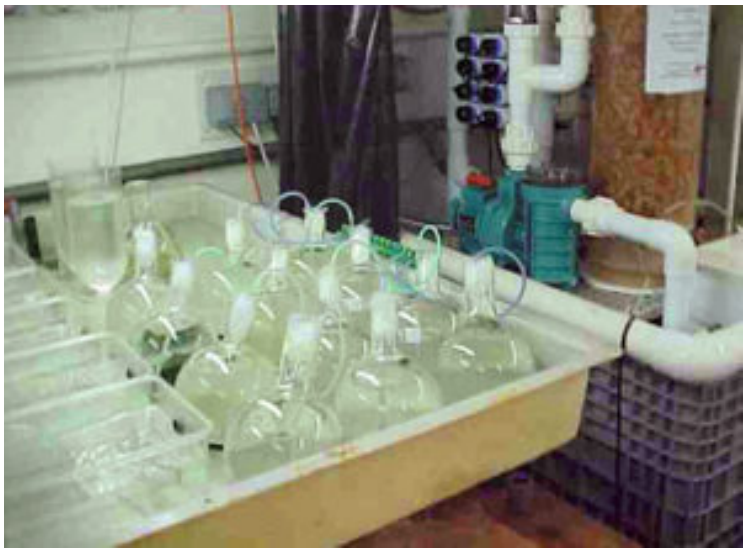
Shrimp larvae stop depending solely on their yolk reserves when they molt into the zoea stage and start deriving their required nutrients externally through feeding activity. In nature, the zoea and mysis stages depend on microalgae or a combination of microalgae and zooplankton as their major food sources. In hatcheries, live food is typically provided throughout these early larval stages to improve survival and growth results.

The continuous improvement of artificial, inert diets is significantly reducing the dependence on expensive microalgae and artemia cysts. Artificial diets also serve as research tools that allow the study of the nutritional requirements of larvae during the complicated ontogenetic and behavioral changes they undergo during larval development.

Live food factor

The complete substitution of live food under experimental conditions has been achieved with two commercially important penaeid shrimp species: *Penaeus monodon* and *Marsupenaeus japonicus*. But much information is still needed for a full understanding of the role of nutrition in shrimp larviculture.

For instance, the extraordinary biological value of live food cannot be entirely explained by analyzing its biochemical composition. This special value is referred to as the “live food factor” in algae, artemia, squid, etc. These live food factors can be nutritional components, enzymes, attractants, hormones, antimicrobials or something else.



Two-l flasks used in the *Fenneropenaeus indicus* trial.

Small-scale trial tests survival, disease resistance

During 2001-2002 at the University of Wales in Bangor, United Kingdom, a larval shrimp diet that included fresh and fresh-frozen marine ingredients formulated with an increased percentage of marine animal protein (diet F) was compared with a control diet, U. Table 1 shows the main differences in the formulation between feeds.

Wouters, Ingredient comparison between diets U and F, Table 1

Ingredient	Diet U	Diet F
Fresh	32%	59%
Marine sources	35%	69%

Table 1. Ingredient comparison between diets U and F (dry matter basis).

The authors tested diets at a 100 percent feeding rate with a single dose of algae in zoea I during larviculture of the penaeid shrimp *Fenneropenaeus indicus*. In a small-scale, experimental setup using 2-liter bottles to maintain the larvae, survival rates obtained at the end of this short culture test were 73.4 percent and 81.3 percent for treatments diets U and F, respectively (Table 2) – an excellent result at 100 percent feeding with artificial diets.

Wouters, Performance of *Fenneropenaeus indicus* larvae, Table 2

Parameter	Diet U	Diet F
Survival (%)	73.4[a]	81.3[a]
Length (mm)	29.4[a]	3.02[a]

Table 2. Performance of *Fenneropenaeus indicus* larvae at mysis I (before challenge test).

Animals at mysis I were challenged with 10^5 CFU per milliliter *Vibrio salmonicida* during 36 hours to evaluate disease resistance. This *Vibrio* was proven pathogenic to juvenile shrimp in preliminary tests. As shown in Fig. 1, shrimp larvae fed diet F were more resistant ($P < 0.05$) to the *Vibrio* pathogen than those fed diet U.

Live-food substitution trial

P.

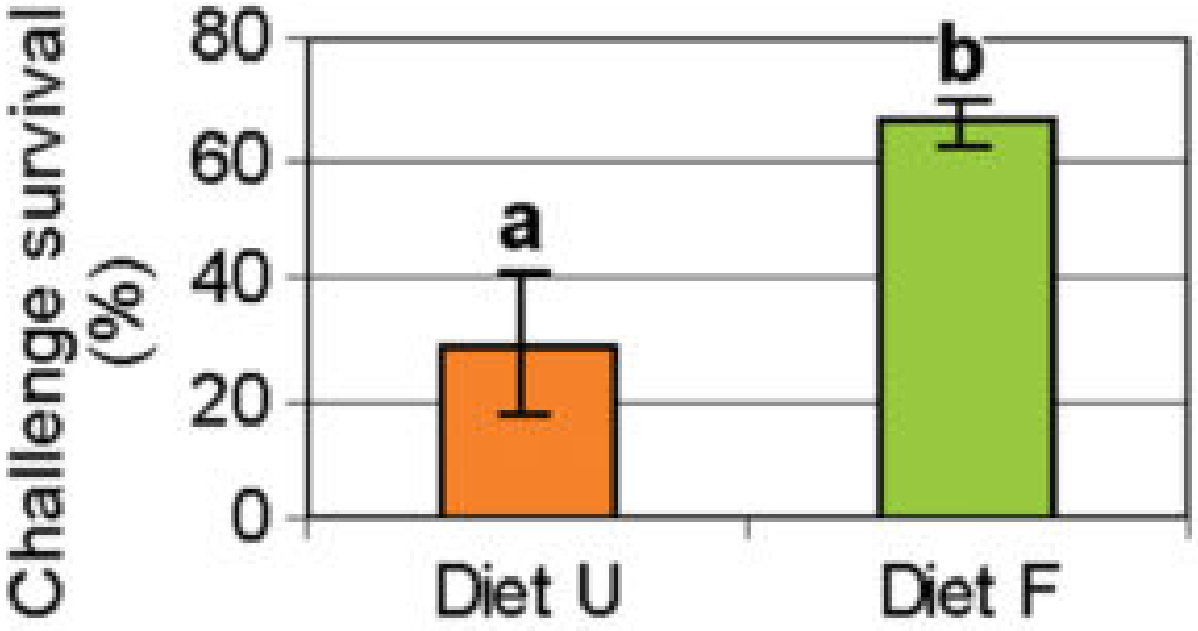


Fig. 1: Mean survival of *Fenneropenaeus indicus* larvae after challenge with *Vibrio salmonicida*.

monodon were cultured from zoea I to postlarvae PL_1 in a large-scale setup at the IATEC research facilities in Thailand. This setup included triplicate 3-metric tons (MT) concrete larviculture tanks run under typical commercial conditions. At the end of the trial, which fed the shrimp diets U and F, production variables were measured, but there were no facilities to perform a challenge test.

The trial demonstrated the possibility to substitute live food without jeopardizing commercial production results. No significant differences ($P > 0.05$) were recorded between treatments receiving 25 percent or 100 percent diet U.

Growth increase

The shrimp fed diet F outperformed shrimp fed diet U in terms of growth and larval development (Table 3), indicating a beneficial effect for fresh marine ingredients in larval shrimp diets. The most probable explanation for this positive effect was the better utilization of key nutrients by avoiding the double processing of premium marine ingredients.

Wouters, Performance of *Penaeus monodon* larvae, Table 3

Parameter	Diet U	Diet U	Diet F
Live food substitution (%)	25	100	100
Survival (%)	90[a]	91[a]	95[a]
Final dry weight (mg)	61[ab]	50[a]	75[b]
Larval stage index	7.0[b]	5.5[a]	6.4[b]

Table 3. Performance of *Penaeus monodon* larvae in a large-scale system fed diets U and F as live-food substitutes.

During preparation of diet F, ingredients were not dried and milled into a meal, but included as fresh or fresh-frozen material directly into the processing line. This is also a good approach to retaining the attracting characteristics of marine ingredients.

Conclusion

A higher inclusion rate of fresh or fresh-frozen marine protein sources increases the general performance and live-food-replacing capacity of larval shrimp feeds. This can help reduce the dependence on cultured microalgae and artemia cysts during seedstock production at shrimp hatcheries.

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