Holistic approach to broodstock management

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Current industry challenges

The shrimp industry is increasingly focusing on disease-resistant traits, with some commercial genetic lines now offering organisms selected for both growth and disease tolerance. However, even with genetically superior shrimp lines, challenges remain in consistently producing robust nauplii that can thrive in varying feeding protocols (feeding practices, aquafeed quality), environmental conditions (e.g., salinity, temperature), and farming systems (e.g., high stocking densities, disturbed microbial balance). Nauplii can show inconsistent quality due to variability in broodstock condition, feed composition, and spawning protocols. Biosecurity also remains a persistent concern, requiring screening, disinfection, and facility management protocols.

INVE's holistic product offer

INVE Aquaculture, a leading biotechnology company specializing in early-stage nutrition and health products for fish and shrimp, recognizes the challenges of shrimp broodstock facilities. Managing stress levels in broodstock, maintaining high biosecurity and providing balanced nutrition during acclimatization and maturation are crucial for the long-term success of any maturation facility. To overcome these culture challenges, INVE Aquaculture developed product solutions that work holistically, respecting animal welfare and sustainable practices (Figure 1).



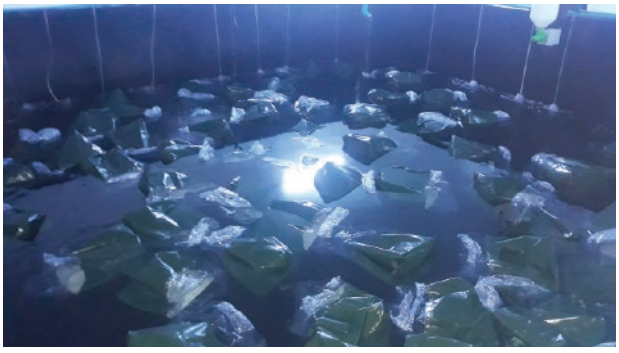
Figure 1. INVE's holistic product offer to overcome the challenges faced by broodstock facilities, including (1) managing stress, (2) building broodstock biosecurity at the gut level, and (3) providing balanced nutrition to support the reliable production of high-quality nauplii.

1. Sano™ S-PAK: Health booster during handling and acclimatization

Broodstock management involves stress-prone procedures that can be mitigated through standardized protocols and the use of functional health diets to enhance robustness and stress resilience.

Functional health diets can be applied as early as the transport of selected juveniles from the ponds to the maturation facilities – common in the Americas with the "All Pathogen Exposed" (APE) approach.

Similarly, "Specific Pathogen Free" (SPF) broodstock destined for Asian markets face long transportation and benefit from the use of functional health diets when applied during the final week before harvest. Continued use during the first week of post-arrival supports faster acclimatization to new culture conditions.



Acclimatization of broodstock to the maturation environment

Sano™ S-PAK is a functional health diet designed to strengthen shrimp resilience to disease and environmental stress. It contains immune stimulants that accelerate immune response, improving survival rates. High levels of antioxidants and vitamins protect against stress-induced radicals, while a tailored micronutrient mix supports osmoregulation and acclimatization. To ensure optimal intake under stress, these functional ingredients are incorporated into a balanced diet formulated with a diverse range of marine protein sources and attractants.

New formulation

Sano™ S-PAK includes an organic acid that suppresses *Vibrio* spp. in the hepatopancreas and gut, while having minimal impact on beneficial *Bacillus* spp. (Figure 2 A-B). Organic acids are known to reduce bacterial outbreaks, promote growth, enhance digestibility, improve mineral bioavailability (da Silva *et al.* 2013), and strengthen shrimp's first line defenses (Sivakumar *et al* 2022). This selective action allows **Sano**™ S-PAK and **Sano**life™ PRO-TAB to work synergistically – clearing *Vibrio* and supporting Bacillus recolonization. Once acclimatized, healthy broodstock can transition to the maturation phase for nauplii production.

2. Sanolife™ PRO-TAB: Building biosecurity at gut level for broodstock and nauplii

Probiotics have long been used in shrimp farming to treat water, break down organic waste, and suppress harmful bacteria such as *Vibrio*. However, in broodstock reproduction facilities, especially those operating flow-through systems, applying probiotics via water treatment remains a challenge. Dietary supplementation offers a promising alternative to support broodstock and nauplii health.

The shrimp digestive tract plays a central role in immunity and overall health. A gut dominated by beneficial bacteria can inhibit *Vibrio* colonization and reproduction. Supplementing effective probiotics during the broodstock maturation phase can enhance gut health and improve reproductive performance.

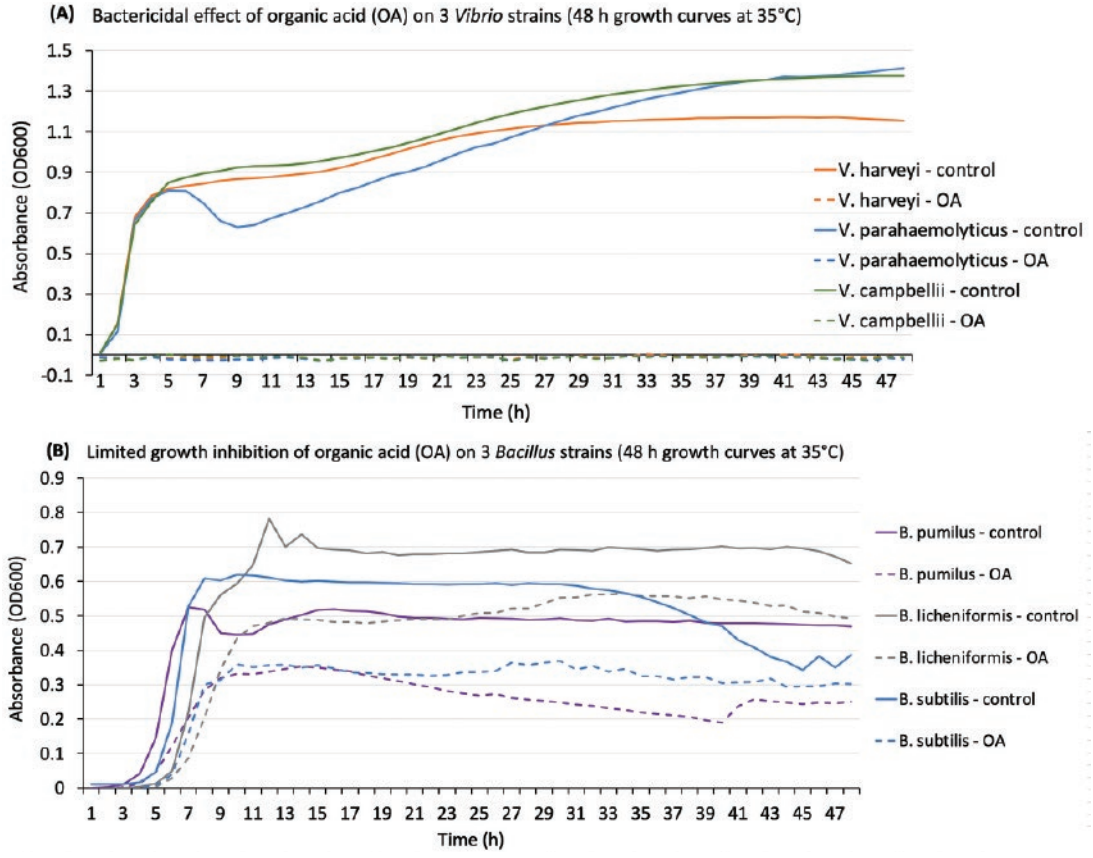


Figure 2. (A) Growth of *Vibrio* spp. in the presence and absence of the organic acid (S-PAK); (B) Growth of *Bacillus* spp. in the presence and absence of the organic acid (S-PAK). While the organic acid shows bactericidal effects on the 3 *Vibrio* spp., the effect on Bacillus strains is more limited.

INVE's latest generation **Sano**life™ PRO-TAB introduces a new approach to shrimp health. This highly palatable dietary wafer is coated with a concentrated blend of proprietary INVE probiotic strains, designed to simplify and strengthen health management for broodstock and their offspring.

A recent trial conducted at a commercial *Penaeus vannamei* broodstock facility in Ecuador evaluated the impact of **Sano**life™ PRO-TAB during the reproduction phase. Two feeding programs were compared: a control group receiving standard maturation pellets and live food, and a probiotic group receiving the same diet plus 0.4 g/shrimp/day of the probiotic wafer. Each of the six monitored tanks housed 120 broodstock (70 females, 50 males).

Results showed that daily copulation rates nearly doubled in the probiotic group (9%) compared to the control (5%). Fecundity also improved, with the probiotic group producing 172,000 eggs/female on average — an increase of 6% over the control. Notably, egg production remained consistently high across consecutive spawning days in the probiotic group, while the control group showed a decline in the last days. As hatching rates were similar among treatments, nauplii production mirrored these trends: 157,000 nauplii/female in the probiotic group versus 128,000 in the control.

Microbiological assays revealed a significant reduction in *Vibrio* counts in broodstock hepatopancreas – the shrimp's key organ – from the probiotic group, especially by day 8 of the trial.

The total *Vibrio* count of nauplius V showed that the group of broodstock fed with probiotic wafer produced nauplii with a lower quantity of *Vibrio* compared to the control group.

Trial data showed that broodstock fed with probiotic wafers not only produced more eggs and nauplii, but also better quality nauplii as the total *Vibrio* count is reduced compared with control group.

While probiotics are widely used in shrimp farming, their dietary application in broodstock and the resulting impact on offspring have been underreported. INVE's research highlights **Sano**life™ PRO-TAB as a valuable tool for hatcheries seeking improved performance and biosecurity. By fortifying gut health, this innovative probiotic wafer supports healthier broodstock and high-quality nauplii.

3. BREED-S: Balanced nutrition enriched with key nutrients for improved biosecurity

Proper nutrition is essential for the energy-intensive process of shrimp maturation. Common food sources include polychaetes, sand worm, squid, oyster, Artemia biomass and krill – used live or fresh-frozen, and sourced locally or imported. However, these food sources pose challenges such as pathogen risks, seasonal availability, price volatility, inconsistent nutrition, and sustainability concerns, all of which hinder standardization in feeding protocols. Pathogen exposure remains the greatest threat to sustainable shrimp production, as SPF animals can quickly lose their status when fed live or fresh-frozen food; even frozen food may transmit disease.

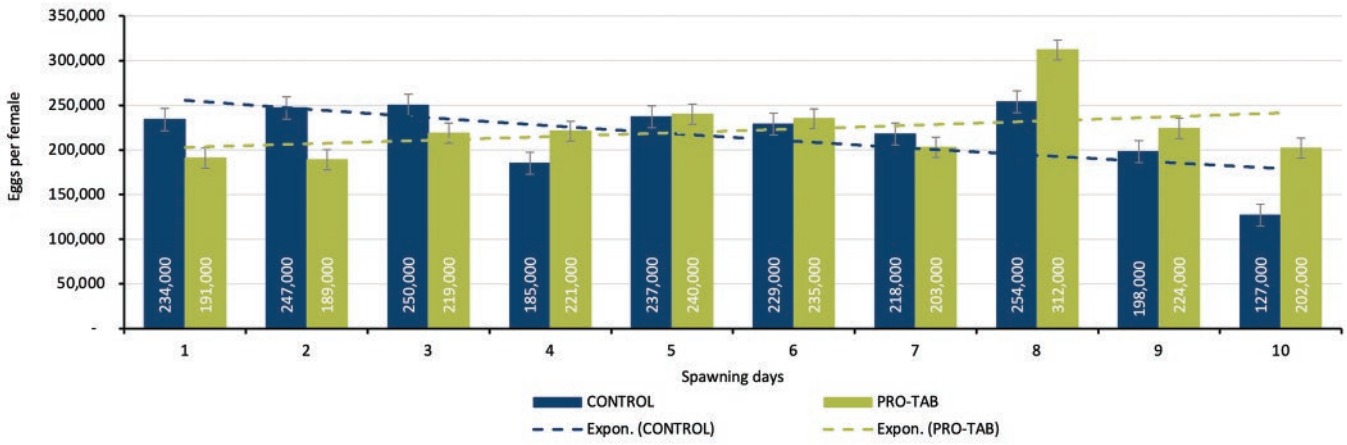


Figure 3. *Vibrio* analysis of broodstock hepatopancreas during the production phase

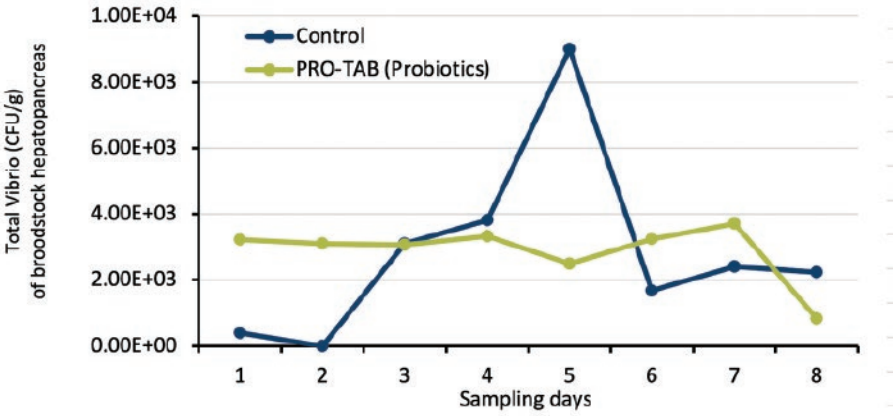


Figure 4. *Vibrio* analysis of broodstock hepatopancreas by different sampling days during the production phase

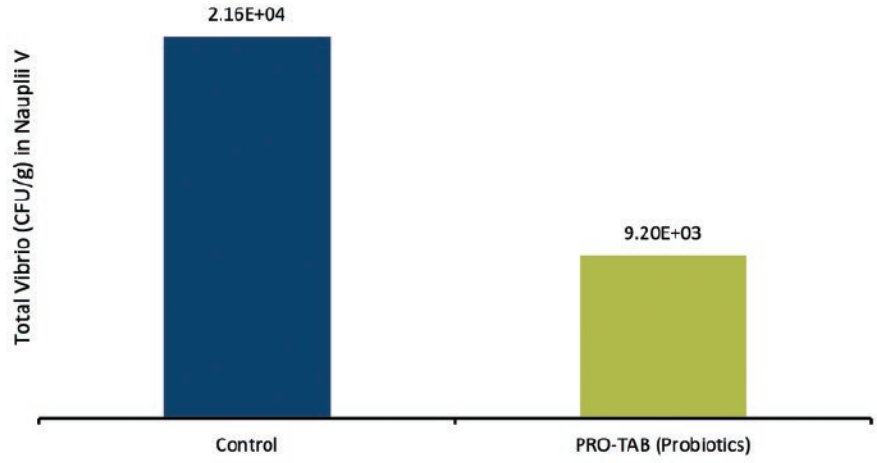


Figure 5. *Vibrio* analysis nauplii V stage with different broodstock dietary treatments

Formulated diets offer a safer alternative, being heat-treated and produced under controlled conditions to minimize contamination. Although replacing live polychaetes without affecting nauplii output remains difficult, other fresh-frozen foods can be replaced more easily with formulated diets, improving biosecurity, nutritional consistency, and nauplii quality.

BREED-S™ is a complete, semi-moist diet formulated for shrimp broodstock, offering balanced nutrition through a blend of high-quality marine protein sources enriched with essential fatty acids (EPA, DHA and ARA), phospholipids, cholesterol, astaxanthin, and vitamin and mineral premixes. Its semi-moist texture enhances palatability for optimal ingestion. **BREED-S**™ can therefore be used during quarantine (animal reception) and throughout production, partially replacing fresh-frozen food to support consistent performance.

In a recent trial with *Penaeus vannamei*, **BREED-S**™ was used to replace 25% and 40% of the fresh-frozen polychaetes and squid in the maturation protocol. Four maturation tanks of 8 m³, each stocked with 100 females, were divided into two groups: two tanks received a 25% fresh food replacement (FFR) treatment, and two tanks received a 40% FFR treatment.

BREED-S™ was administered as the first meal of the day, following siphoning, and was never mixed with fresh-frozen feed in the same feeding session. Overfeeding was avoided by replacing enough fresh-frozen food with **BREED-S**™ (Table 1).

Notably, broodstock in the 40% FFR group consumed less total dry matter, as the amount of frozen feed was significantly lowered to enhance the animals' appetite for the formulated diet. The balanced, nutrient-dense composition of **BREED-S**™ led to faster satiety in females at the higher replacement level, indicating improved feed efficiency compared with the lower FFR treatment.

The increased FFR level of 40% had a positive impact on fecundity (egg/female) and nauplii production as compared to the 25% FFR level (Figure 6).

Table 1. Feeding regime based on actual fed quantities of BREED-S™ pellet, frozen squid and frozen polychaetes

	% Wet weight of broodstock biomass				% Dry weight of broodstock biomass			
Treatment	**BREED-S**™	Squid	Polychaetes	Total	**BREED-S**™	Squid	Polychaetes	Total
25% FFR	1.6	11.9	10.6	24.1	1.2	2.4	1.6	5.2
40% FFR	2.4	7.9	7	17.3	1.8	1.6	1.1	4.4

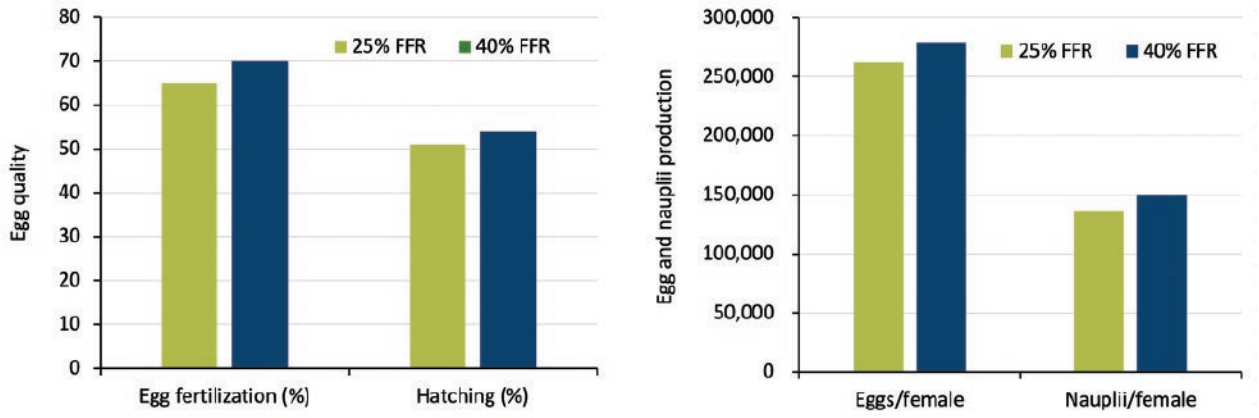


Figure 6. Egg fertilization, egg hatching, egg production per female and nauplii production per female increased with increased fresh food replacement with BREED-S™

These results highlight the benefit of a high share of formulated pellets in broodstock nutrition. It is possible to replace the bulk of fresh-frozen food, maintain nauplii production with a more biosecure feeding protocol.

In this case study, the 40% FFR feeding regime reduced the maturation feeding cost by 30%. Ultimately, all stakeholders down the value chain (hatchery, farm, exporter) will benefit from high-quality nauplii produced with a more biosecure feeding protocol.

Conclusion

Sustainable shrimp production requires successful maturation practices as first phase in the production cycle. Biosecure and standardized nutrition remains one of the key challenges. **Sano**™ S-PAK health booster increases shrimp resilience and inhibits *Vibrio* growth. **Sano**life™ PRO-TAB recolonizes gut and hepatopancreas with probiotics, further guarding the health status of broodstock at gut level and improving performance and nauplii health. Finally, **BREED-S**™ shrimp maturation diet replaces the bulk of fresh-frozen food during acclimatization and maturation, improving biosecurity, nutritional consistency and nauplii quality.

References

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