

growth, final weight, and economic returns without necessarily compromising survival or FCR. In biofloc and integrated multi-trophic systems, reduced feeding rates or minimum table-based rations have been shown to maintain acceptable growth while markedly improving FCR and lowering feed costs, indicating that natural productivity and microbial flocs can partially substitute formulated feed when feeding regimes are carefully adjusted (Gonçalves et al., 2024). Other studies emphasize the importance of aligning feeding rates and frequencies with shrimp behavior and physiology, demonstrating that strategies such as more frequent small meals, optimal feeding frequencies with automatic feeders, or moderate feed restrictions can enhance growth, feed utilization, antioxidant capacity, and profitability, while avoiding overfeeding and unnecessary nutrient loading.

Nevertheless, despite growing recognition that feeding management strongly shapes growth, feed efficiency, environmental footprint, and economic outcomes, information on optimal feeding strategies for Pacific white shrimp across different culture systems and intensities remains incomplete, especially under commercial-scale conditions. There is a clear need to systematically evaluate how different feeding strategies influence production performance—such as growth rate, survival, FCR, and economic returns—under realistic farming scenarios, including ponds, recirculating systems, and biofloc-based operations. The present study, titled “Effects of Different Feeding Strategies on the Production Performance of Pacific White Shrimp,” aims to address this gap by comparing alternative feeding regimes designed to adjust ration level and feeding pattern, and by quantifying their impacts on growth performance, feed utilization, and production economics. By identifying feeding strategies that balance high productivity with reduced feed inputs and environmental loading, this research seeks to provide practical guidance for farmers to enhance profitability and sustainability in Pacific white shrimp aquaculture.

2 Nutritional Requirements and Feeding Characteristics of Pacific White Shrimp

2.1 Nutritional requirements at different growth stages of pacific white shrimp

Protein is a primary driver of growth in Pacific white shrimp, but the optimal level shifts with body size and developmental stage. Feeding trials across juvenile, sub-adult, and adult stages indicate that crude protein requirements for maximum growth generally fall around 32%-36%, with slightly higher levels for smaller shrimp and modest reductions as shrimp grow larger. In larvae, diets containing about 35% protein have produced superior weight gain and protein efficiency, suggesting that early life stages also benefit from moderately high but not excessive protein inputs (Elfeky, 2022).

Energy supply through lipids must be balanced with protein so that protein is used for growth rather than as an energy source. Studies combining different protein and lipid levels in juvenile shrimp identify an optimal protein-energy ratio around 340 g/kg protein with moderate lipid (about 75 g/kg), which maximizes growth, protein efficiency, and feed efficiency without excessive fat deposition. For postlarval shrimp, graded lipid trials suggest an optimal dietary lipid level near 118-124 g/kg when both growth and stress tolerance are considered, highlighting that very young stages may tolerate or require higher lipid levels to support rapid growth and resilience (Xie et al., 2019).

2.2 Feeding behavior and influencing factors

Feeding behavior in Pacific white shrimp is strongly shaped by environmental conditions, especially temperature. Experimental work shows that at cooler temperatures (around 24 °C-28 °C), juveniles feed slowly on the tank bottom, with long gut-filling and evacuation times and substantial uneaten feed remaining after meals. As temperature rises to 30 °C-34 °C, shrimp swim actively while feeding, fill their guts within 15-20 minutes, and consume nearly all the offered pellets, indicating a sharp temperature-dependent acceleration of intake and digestion. Parallel growth trials confirm that growth rate and feeding rate increase with temperature, but the optimal temperature for fastest growth declines as shrimp size increases, implying that feeding strategies should be adjusted to both size and thermal regime.

Beyond temperature, social and environmental context also modifies feeding behavior and efficiency (Figure 1). Behavioural studies show that stocking density and dominance hierarchies affect how long individuals spend on the feeding area and how feed is partitioned; at higher densities, shrimp show greater relative feed consumption but