Has Artemia emerged as a key contributor to enhancing larval *Macrobrachium rosenbergii* survival?

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Artemia is widely accepted as one of the best live food sources for many marine and freshwater microcrustacean species (Yamasaki-Granados *et al*. 2013), and it has now progressed to the level of being a key contributor to the freshwater prawn industry too (Barros & Valenti, 2003).

For the past three decades, the freshwater aquaculture prawn hatchery, Aquaculture of Texas, near Dallas, Texas, has been consistently producing sustainably healthy post larvae at higher survival rates by using Artemia nauplii as a supplement. This prawn hatchery serves local, state, and national prawn farmers and is supported and encouraged by a number of universities, including Mississippi State University, Kentucky State University, the University of Tennessee, Louisiana State University, the MSU Coastal Research, and Extension Center, the University of Georgia, the University of Kentucky, the University of Virginia, Virginia Tech, and Gadsden Community College.

Macrobrachium rosenbergii is a freshwater farmed species in Vietnam, India, Mexico, Thailand, and the United States. It is known as *scampi* or giant freshwater prawn that thrives in tropical and subtropical climatic conditions (FAO, 2011; New, 2012). The yearly global production of giant freshwater prawns was 2,861 tons by the end of 1980. Since then, freshwater prawn aquaculture has increased and has spread throughout the globe, mainly in Asia and the Americas. By 2002, global production has increased more than 80 times since 1980 (from 2,861 tons to 273,736 tons) as of 2019 (FAO, 2021).

M. rosenbergii is a versatile species because of its ability to adapt to a wide range of salinities and temperature conditions, feeds omnivorously and is fed artificial pelleted feed. *M. rosenbergii* breeds in estuaries water, which is also required for larval and post-larval development following incubation. Though the seed is obtainable in natural sources to a limited extent, a consistent supply of seed is required for large-scale production.

The most challenging aspect of shrimp larval rearing is the early larval stages, as they rely on live feeds due to their underdeveloped digestive systems (Agh & Sorgeloos, 2005). Early stages of zoea are fed with phytoplankton and later stages with live feeds such as rotifers and Artemia. Artemia is widely accepted as larval feed in commercial hatcheries due to its nutritional value, palatability, digestibility, versatility, perennial availability, salinity tolerance, dormant cysts availability, and less incubation time.

Materials and methods

An observational field study without any replications was conducted at the Aquaculture of Texas hatchery to assess the performance of *Macrobrachium rosenbergii* prawn post larvae fed with or without Artemia nauplii as a co-feed during their ontogenetic developmental stages from post larvae stage one to stage 36, which is typically the age to stock in nurseries or ponds. The term nauplii in this trial refer to newly formed microscopic free-swimming Instar I larvae.

For this study, 40,000 *M. rosenbergii* post larvae-I were distributed into two 1500-gallon (5678.118 L) fiber-reinforced plastic tanks in a recirculating aquaculture rearing system. In two random tanks, one tank received a commercial diet without Artemia (Diet), while the other obtained Artemia at a rate of 25 Artemia nauplii per post larvae. The temperature was recorded daily, and water quality measures, such as ammonia, pH, nitrite, nitrate, alkalinity, and hardness, were examined weekly. At the end of the study, the shrimp were counted and weighted to evaluate survival,

Table 1. Mean body weight, total tank biomass, final survival and final feed conversion ratio (FCR) of *M. rosenbergii* PL26 fed commercial diet (Diet) and commercial diet with Artemia at 25 nauplii/PL as a co-feed (Diet + Artemia).

	Mean body weight (g)	Total tank biomass (g)	Survival (%)	FCR
Diet	0.046	1595	83.2	0.94
Diet + Artemia	0.054	2021	95.4	0.74

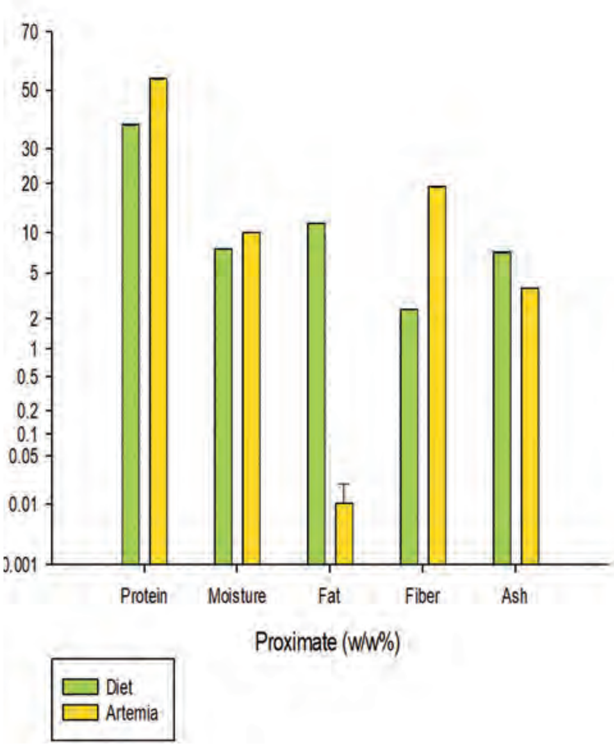

Figure 1. Proximate composition of diets used in *M. rosenbergii* PL26 fed commercial diet and commercial diet with Artemia at 25 nauplii/PL as a co-feed.

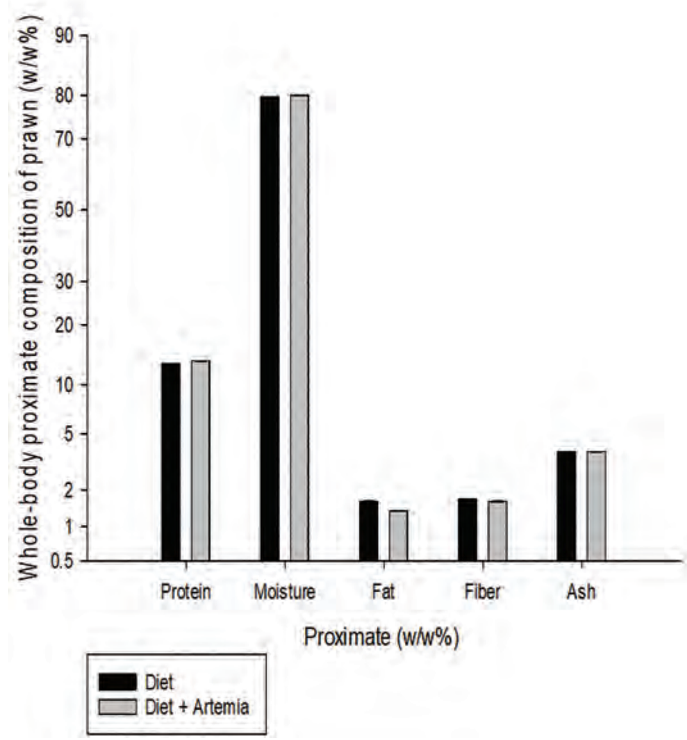

Figure 2. Proximate composition (as is basis) of whole-body *M. rosenbergii* PL26 fed commercial diet and commercial diet with Artemia at 25 nauplii/PL as a co-feed.

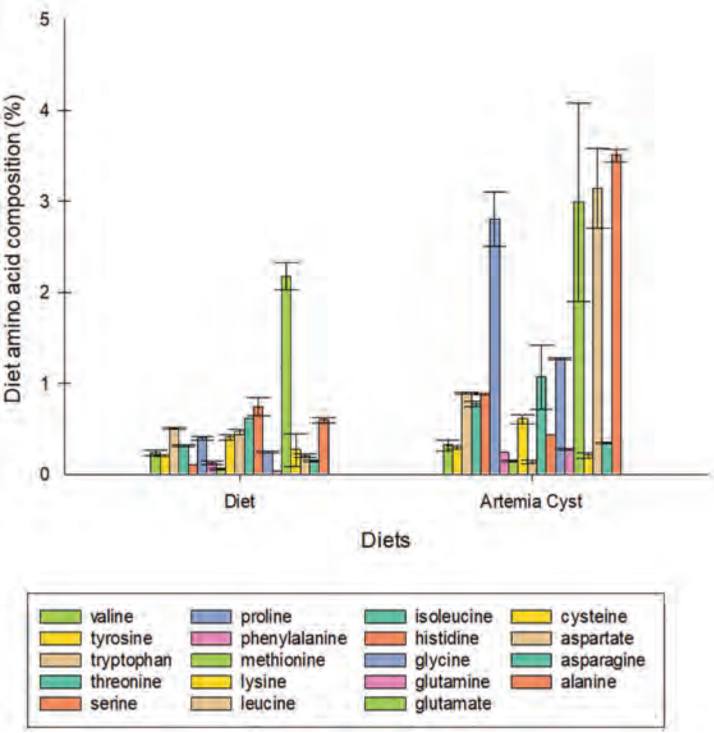

Figure 3. Amino acid composition of diets used in *M. rosenbergii* PL26 fed commercial diet and commercial diet with Artemia at 25 nauplii/PL as a co-feed.

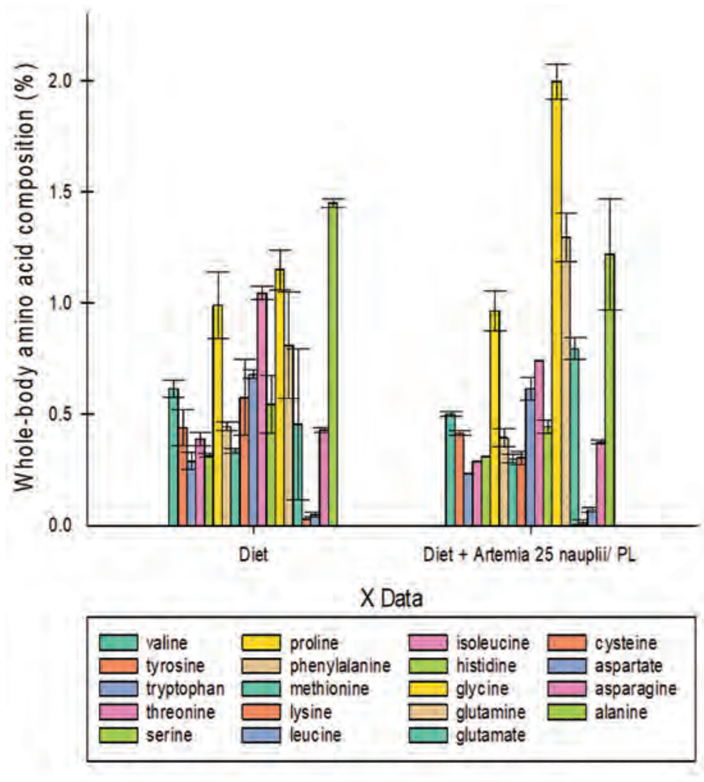

Figure 4. Amino acid composition (as is basis) of whole-body *M. rosenbergii* PL26 fed commercial diet and commercial diet with Artemia at 25 nauplii/PL as a co-feed.

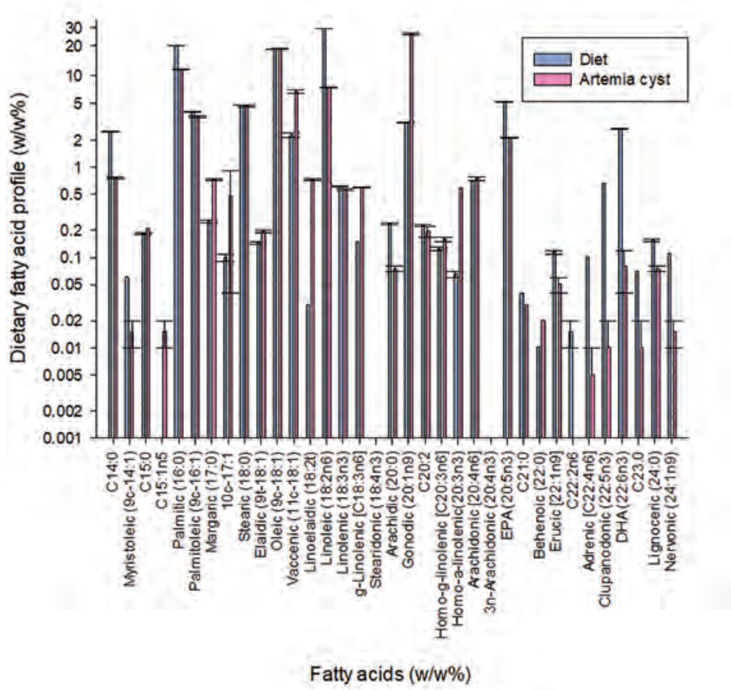

Figure 5. Fatty acid composition of diets used in *M. rosenbergii* PL26 fed commercial diet and commercial diet with Artemia at 25 nauplii/PL as a co-feed.

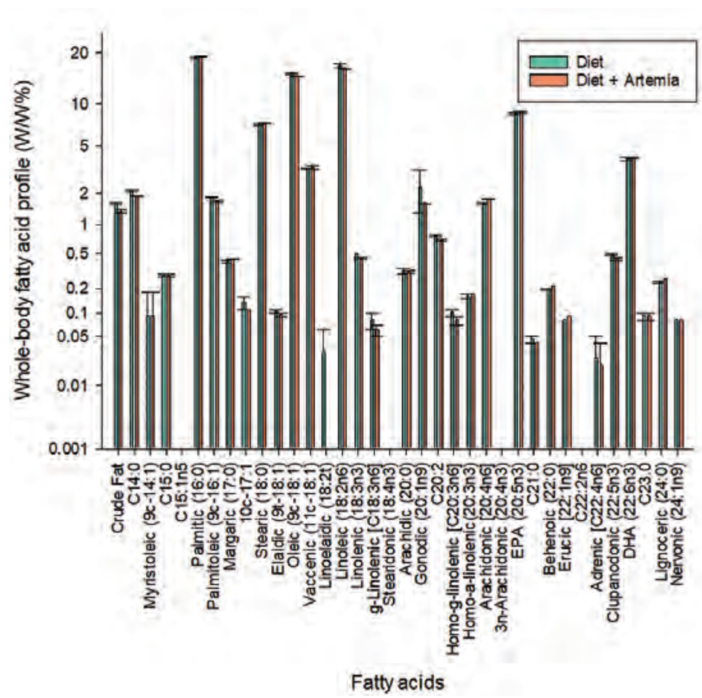

Figure 6. Fatty acid composition (as is basis) of whole-body *M. rosenbergii* Pl26 fed commercial diet and commercial diet with Artemia at 25 nauplii/PL as a co-feed.

growth rate, and food conversion rates (FCR) for each treatment. Samples were collected for proximate, amino acid, and fatty acid analysis.

Results

Even though this was an observational study, an increased survival, biomass, mean body weight, and lower feed conversion ratio (FCR) was observed in the tank fed with Artemia, whereas all tanks had similar whole-body proximate, amino acid, and fatty acid composition (Table 1, Fig. 1-6).

Discussion

Several alternative feeds, both living and inert, have been evaluated in fish and crustacean hatcheries as a supplement or replacement for Artemia nauplii (Kurmaly *et al.*, 1989). Wan (1999) developed a number of semi-purified spray-dried meals and tested them on larval striped bass, *Morone saxatilis*, and freshwater prawn, *Macrobrachium rosenbergii*. Both species' larvae accepted the meals, but the overall growth and survival rates were much lower than those of Artemia-fed larvae. Other studies on Penaeid shrimp and *M. rosenbergii* larvae indicated that Artemia nauplii replacement diets did not work effectively for those species (Lovett & Felder, 1988; Samocha *et al.*, 1989; Lavens *et al.*, 2000).

The poor efficiency of micro diets is due to a misconception of larva nutritional needs (Sorgeloos & Léger 1992). However, the success of prepared diets for larvae is based on factors other than nutritional content. It is crucial to understand the behavioral, mechanical, and physiological processes that occur during consumption before critical nutrients may be adequately assessed (Jones *et al.*, 1997). Feed must be recognized, collected, accepted, and consumed successfully by the larvae. Thus, inert food particle size, consistency, texture, and density may influence the larval selection and, as a result, ingestion (Barros & Valenti, 2003).

A few studies suggested that Artemia biomass could be used as a protein source in post-larval *Macrobrachium rosenbergii* diets. Anh *et al.* (2009) conducted a 30-day feeding experiment. Prawn larvae fed a diet containing about 40% crude protein from Peruvian fishmeal had a lower survival rate (46%) than other Artemia diets.

Conclusion

Co-feeding Artemia during the PL stages of *Macrobrachium rosenbergii* at 25 nauplii/PL showed to be beneficial by improving growth, survival, and FCR, according to this field trial.

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References available on request.

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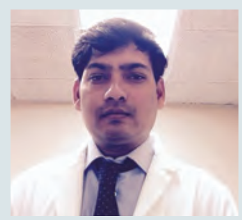

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