



**DEPARTMENT OF AQUACULTURE
FACULTY OF AGRICULTURE**

AKU4402

LIVE FOOD PRODUCTION IN AQUACULTURE

**PRACTICAL 6
MARINE ZOOPLANKTON CULTURE
*ARTEMIA (Artemia franciscana)***

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Introduction

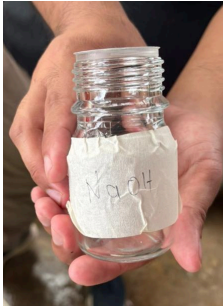
In larviculture, rotifer is the most often utilized live feed when the larvae switch from endogenous (internal energy stores) to exogenous (external) eating. Another crucial live feed is *Artemia* (brine shrimp), which is most frequently utilized when the rotifer stage is over and before the larva is transformed into an inert feed. It serves as the larvae's transitional food before artificial feeds are utilized. Typically measuring between 7 and 12 mm in total length, brine shrimp are primitive crustaceans that belong to the class Branchiopoda. This particular marine creature can tolerate and thrive in a wide variety of salinities. It is extensively dispersed, with over 50 strains identified worldwide to date.

Artemia nauplii are the most popular and commonly used food item among the live diets used in aquaculture, primarily because they are readily available and convenient. The development of latent embryos known as "cysts" is one of *Artemia's* special traits. Large amounts of cysts can be found year-round along the shores of hypersaline lakes and coastal lagoons. They can be gathered, treated, preserved, or sold commercially. *Artemia* cysts can be kept in containers for years and used as a "ready-made" live food source due to their exceptional shelf life.

Objective

1. To maintain the cultivation of *Artemia* and mass culture within the optimum conditions.
2. To understand *Artemia* as a nutritional enrichment for aquatic larvae.

Materials

Name	Function
<p><i>Artemia franciscana</i> cyst</p> 	To be used as the source of embryos that will hatch into nauplii for culture.
Microalgae (<i>Chaetomorpha</i>)	To be used as the primary food source for newly hatched <i>Artemia</i> nauplii.
<p>70 L of incubation tank (bottom funneling)</p> 	To allow efficient hatching and separation of <i>Artemia</i> cysts.
<p>Seawater</p> 	To provide an appropriate aquatic environment.
<p>Sodium hydroxide, NaOH (150 ppm)</p> 	To maintain the culture medium within the desired pH range.

Sodium thiosulphate, $\text{Na}_2\text{S}_2\text{O}_3$ (10-12 ppm)



To neutralize residual chlorine after decapsulation.

Sodium hypochlorite, NaOCl (10 ppm)



To chemically remove the outer cyst shell and enhance hatchability.

Beaker (10 mL, 1 L)



To accurately prepare and measure culture solutions and reagents.

<p>Air blower and tubing</p> 	<p>To maintain continuous water circulation and adequate oxygenation.</p>
<p>Refractometer</p> 	<p>To monitor and control the salinity of the culture medium.</p>
<p>Thermometer</p> 	<p>To monitor and maintain the temperature of the incubation and cultivation tanks</p>
<p>Compound microscope</p> 	<p>To verify the success of hatching and assess the health and development of the nauplii.</p>
<p>Artemia mesh net (40 μm)</p> 	<p>To separate live nauplii from empty cyst shells and other debris.</p>

Methodology

A) *Artemia* Decapsulation

1. A total of 5 g/L of dried *Artemia* cysts was weighed and immersed in seawater for one hour to allow the cysts to rehydrate.
2. After hydration, the cysts were rinsed and placed into a cultivation tank filled with sterile seawater (25–35 ppt), and vigorous aeration was applied.
3. A sodium hypochlorite solution at 10 ppm was then added and mixed with seawater at a 1:1 ratio, and strong aeration was activated to ensure thorough contact between the cysts and the hypochlorite solution for 15 minutes.
4. Once decapsulation occurred and the cysts turned bright orange, a 10 ppm sodium thiosulphate solution was applied to dechlorinate the cysts.
5. The cysts were subsequently washed several times with normal saline to remove any remaining chlorine, and the pH of the incubation tank was adjusted to 8.0–8.5 by adding sodium hydroxide.
6. The cysts were then incubated with strong aeration for 24–36 hours, and a lamp providing more than 2000 lux was positioned above the incubation tank.

B) *Artemia* Nauplii Harvesting

1. The aeration in the incubation tank was slowed down, and a light source providing at least 2000 lux was placed in front of the *Artemia* incubation tank.
2. The hatched *Artemia* nauplii were allowed to swim toward the light source for 10–15 minutes, during which the empty cysts floated while the unhatched cysts sank to the bottom.
3. The bottom valve was opened to discard the unhatched cysts, and a 400 µm mesh net was also used to filter out the cysts from the nauplii.
4. After filtering the unhatched cysts, the light source was switched off, and the surfaces of the incubation tank were covered with a black material such as cloth or plastic.
5. The light source was then positioned toward the bottom of the incubation tank, allowing the nauplii to swim downward.
6. Any excess cysts were washed out using the double-netting method, with a 250 µm mesh net placed on top of a 400 µm mesh net.

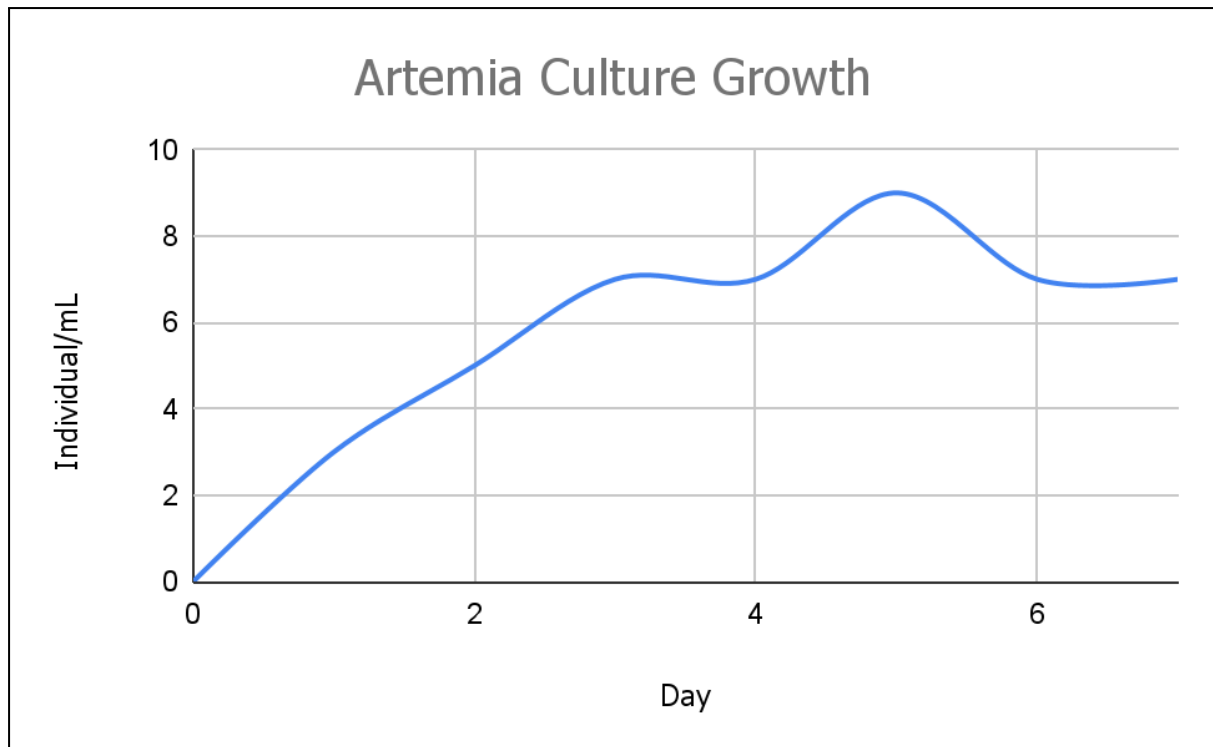
7. The collected *Artemia* nauplii were placed in a cold-water bath to reduce handling stress during the harvesting process or to prevent heat shock.

C) *Artemia* Growth (Cultivation Tank)

1. All harvested *Artemia* nauplii were placed into a 500 L cultivation tank equipped with strong aeration to ensure proper water flow and adequate oxygen supply.
2. The *Artemia* were fed frequently according to their life stages with an appropriate feed, such as microalgae (*Chaetomorpha*) at a cell density of 1.8×10^5 cells/mL.
3. The different stages of the *Artemia* life cycle were observed, and morphological changes between each stage, including nauplii, instar, and juvenile, were recorded.
4. The *Artemia* were harvested according to their life stages and subsequently used as live feed for aquatic organisms such as fish larvae and shrimp larvae.

Results

Day and Date	<i>Artemia</i> density (ind./mL)	Gut content (%)	<i>Artemia</i> behaviour	
			Before Feeding	After Feeding
Thursday 27 Nov. 2025	0	0	<i>The Artemia</i> cysts have not hatched yet	
Friday 28 Nov. 2025	3	0	Almost all cysts have hatched into nauplii in the Instar I stage. All nauplii swim actively and erratically.	
Saturday 29 Nov 2025	5	0	Almost all nauplii in the Instar I stage grew to the Instar II stage. The digestive tract and anal opening are visible and developing. All nauplii swim actively and erratically.	
Sunday 30 Nov. 2025	7	0	All nauplii in the Instar II stage grew into juveniles. All juveniles swim actively and erratically.	
Monday 1 Dec. 2025	9	0	All juveniles swim actively and erratically.	
Tuesday 2 Dec. 2025	9	100	All juveniles swim actively and erratically.	All juveniles began to swim actively but swam at a slower speed after feeding.
Wednesday 3 Dec. 2025	7	75	All juveniles swim actively and erratically.	All juveniles began to swim actively but swam at a slower speed after feeding.
Thursday 4 Dec. 2025	7	50	All juveniles swim actively and erratically.	All juveniles began to swim actively but swam at a slower speed after feeding.



Questions

1. Name any other common *Artemia* species and provide its native distribution range.
 - a. *Franciscan artemia*. This species is native to the Americas, ranging from North America to Central America and the Caribbean, as well as Peru and Chile.
 - b. *Artemia persimilis*. It is native to South America's southern cone and lives primarily in salt lakes and coastal lagoons in Argentina and southern Chile.
 - c. *Artemia urmiana*. Native to Iran's Lake Urmia region, it has also been documented in parts of Ukraine and the Crimean Peninsula.
2. Describe the challenges faced by farmers in Malaysia in cultivating a large-scale *Artemia* production. (Kai et al., 2024)

Farmers in Malaysia faced challenges in large-scale *Artemia* production due to high costs in feed, labor, and technology; the need for advanced and scientific practices; environmental and climate-related issues; and the high dependency on imported products. Other issues consist of managing water quality, disease prevention, and achieving high-quality and cost-effective production. In terms of high production costs, this includes the expenses for imported feed and technology, labor, and land. There is also a slow incorporation of advanced methods, scientific practices, and automation in the industry that is rooted in a lack of

advanced technology. In terms of climate change and environmental degradation, they can pose threats such as overfishing and resource depletion, both of which can have a negative impact on the aquaculture industry's long-term viability. Economic and market challenges stem from the high cost of imported products, such as reliance on imported Artemia cysts or other inputs, which raises production costs and limits profitability. Artemia products have limited market access, ensuring that farmers can sell their harvests profitably. In some cases, overproduction can lead to market oversupply and lower prices, jeopardizing the farms' economic viability.

3. What is the common contamination that can impact Artemia's overall growth performance, and how can we mitigate the issue?

The common contamination that impacts the growth of Artemia is from the contamination of bacteria; behind the cause of it are the high levels of bacteria that come from the hatching medium that are causing low hatching of yields and inhibited growth. Low salinity levels in cultivated Artemia could also disrupt both growth and survival when the actual range should be around 35-65 ppt. Despite these factors, it is important to be aware of the cleanliness and to ensure the environment is controlled in order to minimize the chances of contamination.

4. Why is *Artemia franciscana* a widely cultivated species around the world compared to other species of Artemia?

Because of its high nutritional content and usefulness as live food for a variety of aquatic species, *Artemia franciscana* is a plant that is widely cultivated worldwide. It is a favorite option in aquaculture and is especially well-liked as small-sized live feed for aquatic larvae. The species is renowned for its capacity to flourish in challenging hypersaline conditions, withstanding notable variations in temperature, oxygen levels, salinity, and ionic composition. It is widely used in shrimp hatcheries, fish hatcheries, and ornamental fish culture farms due to its versatility and nutritional value. Furthermore, *Artemia franciscana*'s resilience to a range of salinity levels from 10 to 340 g L⁻¹ increases its attractiveness as a live food source.

Discussion

Based on the results obtained, the cultivation of *Artemia franciscana* in this experiment showed a clear progression of life cycle stages accompanied by distinct morphological and behavioral changes. On Day 0, no *Artemia* were observed, indicating that the cysts were still undergoing hydration and incubation. By Day 1, *Artemia* density increased to 3 ind./mL, where most cysts had hatched into nauplii at the Instar I stage. At this stage, *Artemia* relied fully on endogenous nutrition from the yolk sac because essential organs such as the mouth, anus, and digestive tract were not yet functional. Morphologically, Instar I nauplii appeared simple with an umbrella-shaped body, which is characteristic of newly hatched *Artemia*. This explains why gut content remained at 0% during the early days, as feeding on external food was biologically impossible at this stage (T et al., 2025).

As the culture progressed to Day 2, *Artemia* density increased to 5 ind./mL, and most individuals developed into the Instar II stage. During this stage, important morphological changes were observed, particularly the formation of a functional digestive tract and anal opening. The development of these organs marked the transition from yolk-dependent nutrition to exogenous feeding. Although gut content was still recorded as 0%, this was likely due to the short time interval between gut development and feeding observation. According to Thirunavukkarasu et al. (2024), Instar II *Artemia* rapidly undergo organ differentiation, allowing them to begin filter-feeding once suitable food is available. This stage is critical because it determines the survival and growth potential of *Artemia* in mass culture systems.

From Day 3 onwards, all Instar II nauplii developed into the juvenile stage, with *Artemia* density increasing to a maximum of 9 ind./mL on Days 5 and 6. Juvenile *Artemia* showed more complex morphology, including the development of thoracopods, which function in locomotion and feeding. The presence of thoracopods allowed *Artemia* to swim actively and filter microalgae efficiently from the water column. This explains the consistent observation of active and erratic swimming behavior before feeding. In this experiment, *Chaetomorpha* sp. was used as the primary food source, providing essential nutrients to support growth and development. Microalgae are known to be an effective food source for *Artemia* juveniles because they are easily filtered and contribute to gut fullness and energy supply (Phosphea, n.d.).

The gut content data clearly reflected feeding activity and digestion efficiency. On Day 5, gut content reached 100% after feeding, indicating that all juvenile *Artemia* successfully ingested *Chaetomorpha* sp. Following this, gut content decreased to 75% and 50% on subsequent days, which may be due to increased competition for food, variations in feeding rate, or differences in digestion time among individuals. After feeding, *Artemia* were observed to swim more slowly, suggesting that energy was redirected toward digestion rather than continuous movement. This behavioral change is commonly reported in *Artemia* culture and indicates normal physiological responses after feeding (Thirunavukkarasu et al., 2024).

Overall, the results demonstrate a strong relationship between *Artemia* life cycle stages, morphological development, feeding behavior, and culture performance. The successful transition from the Instar I non-feeding, yolk-dependent stage to Instar II initial feeding stage and finally to juvenile active filter feeders with developed thoracopods confirms that the culture conditions and feeding regime using *Chaetomorpha* sp. were suitable. Understanding these developmental stages is important in aquaculture, as different *Artemia* life stages have different nutritional roles when used as live food for fish and shrimp larvae. Therefore, this experiment successfully met its objectives and enhanced practical understanding of *Artemia* biology and its application as live food in aquaculture systems.

Conclusion

In conclusion, the cultivation of *Artemia franciscana* was successfully maintained from day 0 (November 27) to day 6 (December 3) under optimal conditions, including strong aeration, an adequate source of light, filtered seawater with stable salinity, and a near-perfect pH (alkalinity) level. Routinely, the *Artemia* culture will observe its growth before feeding. However, on day 7 (4 December), due to a storm, an electrical blackout occurred, causing the aeration supply failure. As a result, this batch culture crashed, and more than half of the population density survived. This occurrence highlights the challenges and importance of maintaining the *Artemia* cultivation under strict supervision and perfect water conditions, as the *Artemia* is sensitive to sudden changes in water quality. Overall, *Artemia* is an essential live food for fish larvae and other aquatic organisms, not only for larval growth but also for the survival rate in future development.

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