

An overview of jellyfish aquaculture: for food, feed, pharma and fun

Inês M. Duarte^{1,2}; Sónia C. Marques²; Sérgio M. Leandro²;
Ricardo Calado¹

¹ ECOMARE & CESAM & Departamento de Biologia, Universidade de Aveiro, 3810-193 Aveiro, Portugal
² MARE – CETEMARES, Politécnico de Leiria, 2520-630 Peniche, Portugal
i.duarte@ua.pt

Objectives

- Provide an overview on the state-of-the-art of rearing methods and life support systems for jellyfish throughout the different stages of their life cycle
- Describe the potential applications for jellyfish as resources, namely as food for human consumption, as feed for other organisms, as a source of bioactive compounds for pharmaceutical and other biotechnological applications, and for fun as marine ornamental species

Methods and Results

Jellyfish aquaculture

- Scyphozoa life cycle and reproductive biology
- Breeding methods and conditions
- Life support systems used
- Nutrition requirements

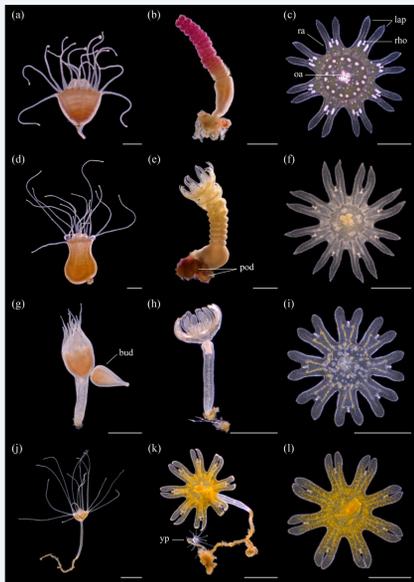


Figure 1. Polyp metamorphosis and production of ephyrae of four scyphozoan species kept in laboratory conditions: *Chrysaora colorata* (a-c), *Chrysaora hysoscella* (d-f), *Cotylorhiza tuberculata* (g-i), *Phyllorhiza punctata* (j-l). Scale bars = 1 mm.

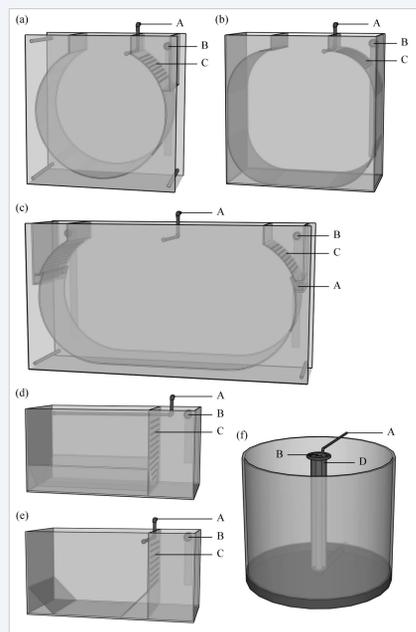


Figure 2. Different types of culture aquaria for jellyfish. (a) Kreisel tank; (b) Pseudo-kreisel tank; (c) Stretch kreisel tank; (d) Modified rectangular tank; (e) Rectangular screen-in flow through tank; (f) Cylindrical tank. A – water inlet; B – water outlet; C – drain screen; D – drain mesh (500 µm).

Establishing a continuous culture of jellyfish in captivity is key to safeguard a regular supply of organisms for research, display or other commercial uses

Food

- ✓ Over 35 species considered suitable for human consumption
- ✓ Numerous health benefits associated with jellyfish consumption
- ✓ Increasing demand for jellyfish products
- ✓ Novel food in western countries

Pharma

- ✓ Growing evidence of beneficial properties
- ✓ Source of bioactive compounds for nutraceutical, cosmeceutical, pharmaceutical and other biotechnological applications.
- ✓ Technically and economically feasible as a supply to the early stages of drug discovery

Applications as resources

Feed

- ✓ Partial feedstock for multiple land animals
- ✓ Feed for the aquaculture of important marine organisms (e.g., fish and lobster larvae)
- ✓ New species for integrated multi-trophic aquaculture with high profitability

Ornamental

- ✓ More than 50 species cultured for public display in zoos and aquariums
- ✓ Supply the increasing demand for jellyfish in the marine aquarium trade
- ✓ Enhance public perception of jellyfish and provide meaningful educational and conservational messages

Conclusions

Jellyfish and jellyfish-derived products will certainly help to alleviate the ongoing pressure on multiple marine bioresources already being overexploited

Aquaculture production of jellyfish may rapidly expand in the upcoming years, with breeding techniques custom-designed for target species maximizing premium biomass and metabolite production

Jellyfish aquaculture will certainly open new opportunities and contribute to the development of sustainable blue bioeconomy frameworks fostering a sustainable valorisation of marine living resources

Acknowledgements

We acknowledge FCT/MEC for the financial support to CESAM (UIDB/50017/2020+UIDP/50017/2020) and MARE (UIDB/04292/2020+UIDP/04292/2020) through national funds and co-funding by FEDER, within the PT2020 Partnership Agreement and Compete 2020. Thanks for financial support are also due to FCT for the PhD grant awarded to Inês M. Duarte (SFRH/BD/146449/2019), and through the project “Jellyfisheries” (POCI-01-0145-FEDER-016772) and the Integrated Programme of SR&TD “SmartBioR” (Centro-01-0145-FEDER-000018), co-funded by Centro 2020 program, Portugal 2020, European Union, through the European Regional Development Fund.

References

Crow J, Howard M, Lévesque V et al. Association Of Zoos And Aquariums (AZA): *Jellyfish (Cnidaria/ Ctenophora) Care Manual*. In Association With The AZA Animal Welfare Committee. Silver Spring, MD:79; 2013. | Guo K, Zhao W, Wang S, Dong S. Study of food web structure and trophic level in the sea ponds of an optimized culture model (jellyfish–shellfish–fish–prawn). *Aquac Int*. 2014;22(6):1783-1791. | Kitamura M, Omori M. Synopsis of edible jellyfishes collected from Southeast Asia, with notes on jellyfish fisheries. *Plankton and Benthos Res*. 2010;5(3):106-118. | Leal M, Rocha R, Rosa R, Calado R. Aquaculture of marine non-food organisms: what, why and how?. *Rev Aquac*. 2016;10(2):400-423. | Leone A, Lecci R, Milisenda G, Piraino S. Mediterranean jellyfish as novel food: effects of thermal processing on antioxidant, phenolic, and protein contents. *Eur Food Res Technol*. 2019;245(8):1611-1627. | Merquiol L, Romano G, Ianora A, D’Ambra I. Biotechnological Applications of Scyphomedusae. *Mar Drugs*. 2019;17(11):604. | Schaadt M, Widmer CL, Sowinski N. Chapter Jellyfish. In: Calado R, Olivotto I, Oliver M, Holt J, eds. *Marine Ornamental Species Aquaculture*. 1st ed. John Wiley & Sons Ltd; 2017:457-473. | Wakabayashi K, Tanaka Y, Phillips BFF. Culture of Slipper Lobster Larvae (Decapoda: Achelata: Scyllaridae) Fed Jellyfish as Food. In: Radhakrishnan EV, Phillips BF, Achamveetil G, eds. *Lobsters: Biology, Fisheries and Aquaculture*, Chapter 11, 1st ed. 2019:519-540.