

# Why live microalgae are better than non-living substitutes for aquaculture feeding?

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Microalgae play a crucial nutritional role for marine animals in open ocean and consequently in marine aquaculture. Most marine invertebrates depend on microalgae for their whole life cycle. Consequently, commercial and experimental mollusc or fish hatcheries need to include a microalgae production system in parallel to their animal production. The main consumers of microalgae in aquaculture are filter feeders (mainly larvae, juveniles and broodstock of mollusc), and live prey (rotifers, artemia) reared for fish or crustacean larvae. Also, it is well known that the productivity of a particular hatchery is strongly related to the quantity and quality of a suitable food source (1).

Live microalgae were traditionally used for bivalves feeding in commercial mollusc hatcheries. Such intensive cultures are costly for producers and many alternatives have been proposed to reduce cost and to simplify production procedures. Non-living food such as microalgae pastes, dried microalgae, microencapsulated lipids, bacteria or yeasts were tested in hatcheries and laboratories with various level of success (2, 3).

## Can non-living microalgae and substitute food sources replace live microalgae?

A major review published by Robert and Trintignac (1997) (3) concluded that non-living diets generally give lower growth and higher mortalities when compared to controls fed with live microalgae. Many criteria are required for a substitute to live microalgae diet in invertebrate rearing, and they have to be met in a single product.

### *Nutrition*

From a nutrition standpoint, live microalgae have higher nutritive values and better digestibility when compared to many substitutes. The nutritional quality of food sources depends on many biochemical constituents such as polyunsaturated fatty acids, vitamins, sterols, and carbohydrates (4, 5, 6, 7, 8, 9).

Bacteria can provide only a part of the metabolic requirements by supplying organic molecules and

vitamins. Under conditions close to those found in rearing facilities, the bacterial input represents less than 15% of the microalgae contribution for mollusc larvae and juveniles of many species (10, 11, 12). Yeast was also investigated as alternative food source but poor results were observed (13, 3). Therefore, these two alternatives are not suitable to replace live microalgae.

But what about treated algae such as dried microalgae or microalgae pastes? The mediocre nutritional value of most dried microalgae compared to live feed and the poor availability of commercial dried products are the main disadvantages. Globally, they showed low level or absence of  $\omega$ 3-HUFA (highly unsaturated fatty acids) and low ingestion or digestion by bivalve larvae (1). This may explain their poor quality as food source for molluscs. Genus *Tetraselmis* seemed to be a good candidate for microalgae paste but its nutritional quality deteriorated quite rapidly (14). Several experiments indicated that these substitutes may be used as supplement when rations of live algae are insufficient. Spray-dried algae and algae paste were found to be useful to replace 50% of live algae. Coutteau and Sorgeloos (1992) (15) concluded that artificial or non-living diets are rarely applied in the routine process of bivalves and are mostly considered as a backup food source.

### *Physical properties*

Substitutes to live microalgae should present an appropriate physical behaviour, which is a significant challenge. They must not aggregate or easily break apart. For example, drying microalgae can cause, due to oxidation, a loss of highly unsaturated fatty acids, (16) which are essential components for larval growth (12). The poor performance reported by operators of dried microalgae was mostly associated with the difficulty to keep cells in suspension without disintegrating them (15). Moreover, when cell walls are broken, high fraction of water soluble components cannot be ingested by the organism and may interfere with the water quality of cultures (17). Then, possible pathogenic bacterial proliferation may occur and cause costly production losses. There are similar

difficulties with algae paste as preparation procedures (centrifugation, flocculation or filtration) and/or preservation techniques (additives, freezing) must ensure that the cell wall integrity is preserved.

### Health

Products other than live microalgae must be exempt of bacterial contamination and must be non toxic. The use of bacteria as food source in hatcheries seems to be invalidated since physical and chemical treatments are often used to limit the development of bacterial contaminations which are responsible of drastic larval mortalities (18). However, in live microalgae culture, the natural bacterial flora was proved to enhance health of molluscs. Langdon and Bolton (1984) (10) showed that antibiotic suppression of microbial flora associated with juvenile oysters fed artificially reduced growth. Oyster larvae fed with live microalgae diets showed improved growth with the addition of some bacterial isolates (19, 20). This advantage may not be possible in a treated algal product since bacteria cells cannot carry on.

### Conclusion

Mitigated or unsuccessful results when using non-living microalgae make us consider live microalgae as the first choice in aquaculture feeding. Only partial replacement for live microalgae is successful in studies using preserved non-living algae (21), microencapsulated diets (10), or spray-dried algae (22). However, no complete replacement has been achieved despite intensive research efforts (23). According to scientific literature, only live microalgae are still answering all organism needs with high nutritive value, appropriate physical properties, and by providing a healthy rearing environment. Therefore, live microalgae are still the optimal choice in real rearing conditions.

### References

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