

Introduction

Live microalgae is used in hatcheries as food for rearing bivalve molluscs and for enhancing the food value of zooplankton used in rearing the larval stages of some marine fish species. This algae is produced in a variety of large-scale systems.

Bag culture



The Seasalter continuous flow algae culture system.

The challenge for the hatchery operator is to match supply and demand, without over-producing costly algae or failing to provide sufficient algae food.

One way of achieving this would be to use **preserved algae diets**. This could provide an off-the-shelf product to be used as the only food source or as a food supplement.

Preservation methods

Following concentration by centrifugation, algae can be preserved in various ways, to provide a low bulk product. These include:

- storage at low temperature, including freezing
- freeze-drying
- spray-drying

Approach

Experiments using a range of nutritionally valuable algae species to determine:

- most effective method of preservation – by assessing cell recovery, biochemistry and shelf life
- food value of preserved algae for bivalve molluscs
- food value of preserved algae for zooplankton (Rotifers and Artemia)
- food value of zooplankton fed preserved algae for fish larvae

Preservation of algae

Algae species tested	Preservation methods		
	Short term (as live cells)	Long term (as killed cells)	
	Cold storage (+4°C)	Frozen Pastes (-20°C)	Spray-dried
<i>Nannochloropsis occulata</i>	√√√	*****	ΔΔΔΔΔ
<i>Tetraselmis suecica</i>	√√√	*****	ΔΔΔΔ
<i>Rhinomonas reticulata</i>	√√	-	ΔΔΔ
T-ISO	-	**	ΔΔ
<i>Pavlova lutheri</i>	-	*	Δ
<i>Chaetoceros calcitrans</i>	√	-	-
<i>Chaetoceros ceratosporum</i>	√	-	-
Pond water (mixed sp.)	√√√	*****	Not tested

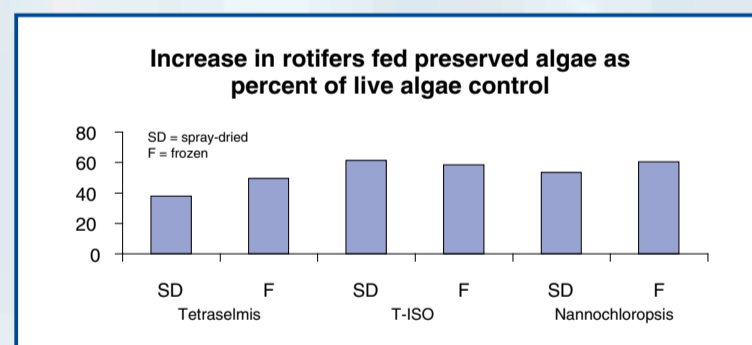
Key: A dash means unsuitable; otherwise, the more symbols, the better.

- Methods have been developed for several species.
- Concentrates can successfully be made for all algae food species.
- Diatoms, which are very useful as bivalve mollusc diets, do not preserve well.
- Freeze-drying was not appropriate for any of the algae tested.
- Shelf life of algae stored at low temperature is limited (2 – 5 weeks)
- Spray-drying and freezing are the best methods but they can destroy some cells and may also bring about some changes in cell biochemistry, including essential fatty acid content. Values in the Table reflect these considerations.

Food value for bivalve molluscs

- Experiments with Pacific oysters and king scallops
- Preserved algae give much lower growth rates than fresh live algae
- Dried algae can be used as a food supplement, but there is still a need for a high proportion of live algae. Evidence from previous work suggests that higher proportions of dried algae may support good growth of clams.

Food value for zooplankton



- Spray dried and frozen algae diets both gave an increase in rotifer numbers but neither were better than live algae diets. There appears to be very little difference between the two methods of preservation and this is probably due to loss of important fatty acids 20:5 (n-3) and 22:6 (n-3) during the preservation processes.
- About 80% of live *Nannochloropsis* could be replaced with spray dried *Nannochloropsis* and about 65% of live *Tetraselmis* could be replaced with the spray dried alternative before rotifer numbers decreased noticeably.
- Rotifers were reared for 24 days using spray-dried *Tetraselmis* alone.
- *Artemia* nauplii and adults were fed spray-dried algae and both were observed to feed upon the food particles.
- A batch of *Artemia* was hatched and reared successfully for 7 days on spray dried algae.
- Algae pastes supplied to Mainland Salmon to evaluate as diets for rearing *Artemia* for feeding to Halibut larvae were used successfully.

Summary

- Algae can successfully be concentrated and preserved. Some species preserve better than others, and the most appropriate method varies with the species.
- Preserved algae are of limited value for bivalves - the best food species do not preserve well and loss of the essential fatty acid 20:5 (n-3) compromises value of other algae.
- Preserved algae diets show some promise as foods for zooplankton in fish culture

Spray dried algae



The Laboratory Spray-Drier and an example of the algae powder produced (*Tetraselmis*).

The future

During this study preserved algae diets have become commercially available. This includes concentrated pastes of killed cells at low temperature, in which the nutritional value is conserved. There has been significant interest and uptake by the fish farming industry for these diets. This trend is likely to continue.

The results from this work have contributed to this development.

Partners

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