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Refrigeration affects fatty acid profile of microalgae

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Test finds similar profile reflected in rotifers that consume them



Microalgae was produced in a hydraulically integrated serial turbidostat algal reactor (HISTAR) system, harvested as a paste, refrigerated, and analyzed.

Live feed production has been recognized as a bottleneck to marine fish larviculture for decades. Most commercial facilities still rely on batch techniques established over 50 years ago. In the past decade, microencapsulated diets have been developed, but live feeds – including rotifers – are still the best diet for marine fish larvae.

A study of the effects of storage under 4 degrees-C refrigeration on the fatty acid composition of freshwater *Selenastrum capricornutum* algal paste determined the toxicological properties of the paste and its effect on the fatty acid composition of rotifers. Although several storage techniques have been developed for algae, no previous data looked at the effects of refrigerated storage.

Rotifers

Rotifers can be grown on microalgae or cultivated on formulated diets. The use of microalgae during the first-feeding process for fish larvae is believed to improve the nutritional condition of the larvae, either directly or through improving the nutritional value of the rotifers they consume within their shared environment.

While marine microalgae likely provide the best polyunsaturated fatty acids profile for marine zooplankton like rotifers, feeding freshwater microalgae has the potential to reduce cultivation costs.

Microalgae production

Microalgae was produced in a hydraulically integrated algal reactor system, harvested as a paste, refrigerated, and analyzed every two weeks. The system contained two 450-liter turbidostats and eight 446-liter continuous-flow reactors. Turbidostat data was collected and transmitted to the process control system via a monitoring unit located at the effluent of the reactors.

The reactors were equipped with a similar monitoring unit with a series of solenoid valves to facilitate sample retrieval. Both monitoring units contained sensors for temperature, conductivity, and pH, and a biomass photocell. Each reactor was continuously illuminated by a 400-watt metal halide lamp.

The system was operated at a system dilution rate of 0.38 per day, with pH of 7.3 ± 2 and temperature at 28 ± 2 degrees-C. Nutrients were maintained in excess within the system via a continuous feed into the reactors and into the turbidostats with each 20-minute harvest. Influent water was pretreated through a sand filter, ozone unit, and UV light. The effluent from the last reactor was passed through a continuous-duty centrifuge for cell separation.

Results

The algae for this study were collected once the system reached steady-state operating conditions. The fresh *Selenastrum capricornutum* paste had an almost threefold greater concentration of unsaturated fatty acids than saturated fatty acids. Over 50% of the unsaturated fatty acids were made up of omega-3 and omega-6 fatty acids.

With an increase in storage time, there was a significant decrease ($P < 0.05$) in the percentage of total unsaturated fatty acids (13 percent), and omega-3 and n-6 fatty acids in the paste. The same trend was observed for the nutritionally important C20:4n6, C20:5n3, and C22:6n3 fatty acids. The paste also reflected a significant increase in total saturated (37 percent) and monounsaturated fatty acids.

The decrease in unsaturated fatty acids combined with the increase in monounsaturated and saturated fatty acids indicated oxidative changes occurred during storage. LC₅₀ values were greater than 200 ppm. No toxic effects were observed in rotifers exposed to algal extracts tested at a concentration representing the normal algal feeding level.

Rotifer content reflects algae

Rotifers fed two- and four-week-old algal paste had a significantly lower total unsaturated fatty acid content and significantly greater total saturated fatty acids than those fed fresh algae. These results parallel the changes seen in the algae during storage.

Compared to fresh algae, there were no significant differences for the n-6 group fed 4-week-old paste or the n-3 and n-6 groups fed 2-week-old paste. The levels of C20:4n6, C20:5n3, and C22:6n3 fatty acids did not differ between rotifers fed fresh or stored algae.

Conclusion

The use of refrigerated freshwater algal paste for production of rotifers results in live feed with adequate nutritional properties for marine larviculture. Use of freshwater algae stored up to four weeks for feeding rotifers intended as a food source for marine larviculture seems viable. This could reduce the costs associated with the production of marine algae and may provide an alternative to cryopreservation.

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