RotiGrow *OneStep*™

New All-In-One Rotifer Feed from Reed Mariculture

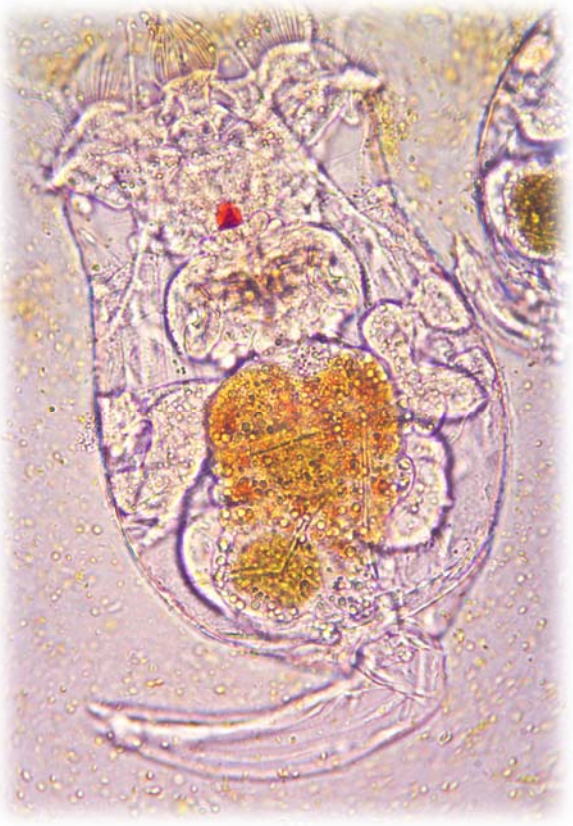
The next step to optimize your rotifer culture operation.
Feed and enrich *in one step, for better nutrition, stronger rotifers, less stress and healthier larvae – with less work and mess.*

Timothy A. Reed, president, CEO and head of research and development, and Eric C. Henry, Ph.D., research scientist at Reed Mariculture Inc. discuss how feed and enrichment of rotifers in one step with their new product, RotiGrow *OneStep*™, results in better nutrition, stronger rotifers, less stress and healthier larvae – with less work and mess.

Rotifers remain the most widely-used live feeds for early stages of larval fish culture, and success depends on having a stable supply of healthy rotifers that deliver the nutrition larvae need for rapid growth and normal development.

The nutritional value of rotifers depends entirely on the feeds used to produce them. Typically, a batch culture is grown to harvest density using a low-cost, yeast-based feed of low nutritional value, and then is switched to a high lipid content "enrichment" feed a few hours before feeding to larvae. This "gut loading" strategy fills the digestive tracts of the rotifers with the lipid-rich feed, to be delivered to the larvae when the rotifers are consumed. But this conventional approach to enrichment is best described as "Too much, too late."

Active, clean, healthy rotifers are essential for healthy larvae. Unfortunately, the extreme lipid content of conventional enrichment feeds is stressful to rotifers, weakening them and reducing their motility. Lipid emulsions foul the enrichment tank as well as the



Rotifer feasting on RotiGrow *OneStep*

rotifers, so much of the enrichment feed is not consumed by the rotifers and is therefore wasted. The emulsion-fouled rotifers then must undergo stressful harvesting and washing procedures before being fed to larvae.

Rotifers that have been stressed by intensive enrichment and washing are invariably compromised. This stress is more evident when the popular "cold bank" technique is used (storing rotifers in a cooler and feeding over 18-24 hours). Temperature shock when enriched rotifers are cold banked often causes the rotifers to eject their gut contents (and enrichment), fouling the cold storage and further weakening or killing many of the rotifers before they are fed to larvae.

A new paradigm

A far more effective enrichment strategy is ***continuous culture grow-out enrichment using enriching, whole-algae growth-feeds so that the entire body of the rotifer is enriched***. The benefits are multiple: (1) Rotifers are not stressed, so they retain good health and motility in the larval tank. (2) The enrichment is in rotifer tissue and more bioavailable (as phospholipids, organically bound minerals and vitamins, etc.). (3) Rotifers require no

washing and in some applications can be fed directly to the larval tank, eliminating the labor of harvesting and washing, and avoiding shocks that cause ejection of the gut contents. (4) Rotifers do not expel their enrichment in cold bank applications. (5) Rotifers enriched during grow-out retain their enrichment in the larval tank longer and deliver more enrichment to the larvae.

About RotiGrow *OneStep*

RotiGrow *OneStep* is a concentrated microalgae-based liquid rotifer feed. Because the microalgal cells are kept hydrated, they retain their full functionality and nutritional value.

RotiGrow *OneStep* provides all these advantages:

- **Full-spectrum enrichment from microalgae** — In addition to optimal highly-unsaturated fatty acid (HUFA) enrichment, RotiGrow *OneStep* provides comprehensive tissue-bound vitamin, mineral, and carotenoid enrichment of rotifers without sacrificing other nutritional factors or stressing the rotifer.
- **Optimal HUFA enrichment with high protein content** — *Eliminates any separate enrichment steps* —Typical analysis (ash free) of rotifers grown on RotiGrow *OneStep*:
- 70% Protein
- 12% lipid
  - ◊ 25% DHA
  - ◊ 7% EPA
  - ◊ 2% ARA

Clean continuous rotifer production on RotiGrow *OneStep*. 1 billion rotifers per day - 35% daily harvest at 3000 rotifers/ml. 22 hours since the last cleaning and the tanks are still clean.

> … consistent feeding and harvest regimes that prevail in continuous culture promote rotifer health, supporting high productivity and nutritional quality.

- **Healthy rotifer cultures** — Rapid growth, fouling minimized, reduced bacteria loads.
- **Higher yields at high densities** — Rotifers can double daily at densities over 5 million L-Type rotifers per litre. **RotiGrow *OneStep*** grows rotifers as well as *Nannochloropsis* or **RotiGrow *Plus***.
- **Concentrated, clean, liquid form** — Exceptionally easy to use, produces cultures with minimal foaming or clumping, requiring less maintenance.

The best way *is* the low-cost way

Use of **RotiGrow *OneStep*** eliminates stress inducing and costly additional enrichment and washing stages, and even allows enriched rotifers to be pumped continuously from the rotifer culture tank into the larval tank. This saves both the labor costs and added complexity of setting up enrichment feeding schedules, rotifer washing, and other handling procedures, and their opportunities for mistakes.

Additional savings can be realized by optimizing rotifer culture practices to include:

1. Continuous culturing offers several advantages over batch culture:

a. Rotifers are most productive under stable conditions. The consistent feeding and harvest regimes that prevail in continuous culture promote rotifer health, supporting high productivity and nutritional quality.

   i. Once the culture reaches the target density only a fraction is harvested (typically 20–50%), and this harvest can be repeated every day, indefinitely.

b. The rotifers have a younger age distribution than in batch cultures, due to the high daily harvest rate. Younger rotifers feed more actively, are more fecund, and are more vigorous swimmers in the larval tank.

c. Simplified management of culture operations by using the same feeding and harvest levels every day, thus minimizing the opportunities for costly mistakes.

d. No interruption of rotifer production while a new culture grows to harvest density.

e. No need for tanks to be frequently emptied, cleaned, refilled and re-inoculated, further minimizing the opportunities for mistakes, and saving unnecessary labor.

2. Intensive culturing saves precious hatchery floor space, and reduces the number of culture tanks to be managed:

a. Intensive cultures (3 –10 million rotifers per liter) require smaller volumes and so less space in hatcheries.

b. Intensive cultures are more readily enclosed, to improve control of culture conditions and exclude contaminants.

c. Intensive cultures require less water, and more concentrated rotifers are easier to harvest.

d. High-density cultures are fed high-quality, high-density feeds (concentrates). The consistent concentration of these feeds enables automated delivery to the culture by metering pump, improving consistency and reliability of feeding.

Grow-out enrichment with **RotiGrow *OneStep*** and adoption of these optimal rotifer culture practices enables hatcheries to lower costs, improve the reliability of rotifer production and produce more nutritious and more vigorous rotifers, for improved growth and survival of larvae. Step up to *OneStep*!

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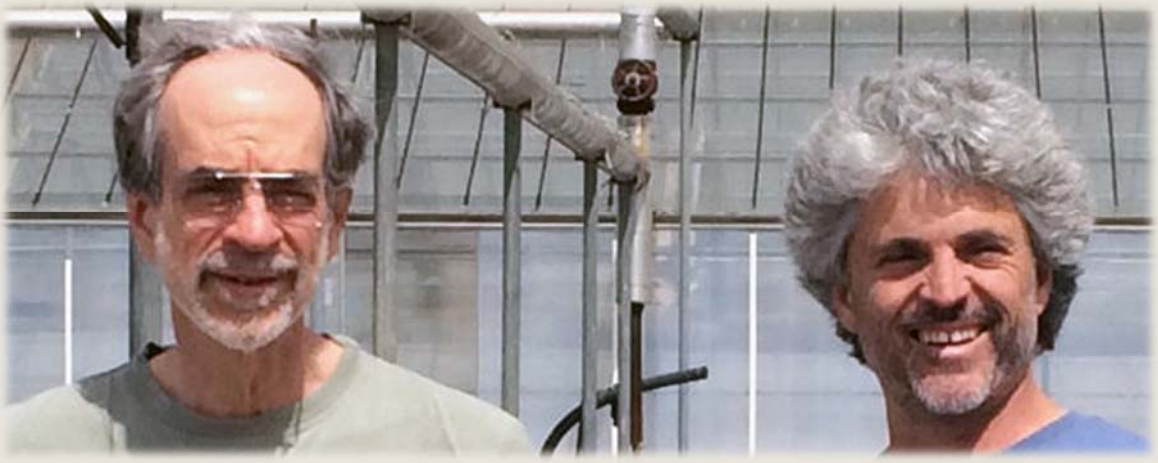
About the authors



Left: Dr. Eric Henry. Right: Timothy A. Reed

Dr. Eric Henry earned his Ph.D. in phycology (algae studies) at the University of British Columbia and continued academic research on algae for the next 16 years, authoring or co-authoring 25 research papers in scientific journals. In 1996 he joined the private sector to develop algal mass culture and associated aquaculture technologies, and he has been part of the Reed Mariculture team since 2003. Eric works on algal and zooplankton culture, development of new products, and provides customer technical support relating to uses of Instant Algae®, rotifer culture and larviculture of shellfish and finfish. For more information, contact Eric at Eric@reedmariculture.com.

Reed Mariculture
ENSURING HATCHERY SUCCESS

Timothy A. Reed is the originator of the ideas and foundational research of Reed Mariculture Inc.'s core competencies and biosecure processes. As CEO, he sets the direction for the company, assuring that Reed Mariculture continues to stretch the boundaries of what is possible in the development of marine aquaculture feeds. Tim's pioneering drive has led Reed Mariculture to become the world's largest producer of marine microalgae concentrates for larval fish, bivalves, crustaceans, and other filter feeders. Tim received his BA from University of CA, Riverside with a double major in Sociology and Economics, and a Masters in Statistical Economics from UC Santa Cruz. For more information, contact Tim at Tim@reedmariculture.com.
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