



Land-Based, Self-Contained Marine Aquaculture System

The Challenge: In the last decade, global aquaculture production has expanded at a rate of over 10% per year to keep pace with the growing consumer demand for seafood. The farming of marine species must be accelerated to meet the challenge of providing seafood to the growing world population, especially in the face of dwindling marine food sources. One of the major obstacles to the development of marine aquaculture is its interaction with the environment. The potential adverse effects of the chemical and biological waste generated by net pens and pond farming, as well as biological interactions of farmed fish with wild stocks, has been widely publicized. In addition, net pen and marine pond practices exert an adverse effect on the farmed organisms. Fish reared in net pens or ponds are exposed to water-borne contaminants and pathogens, algal toxins and sub-optimal environmental conditions. Furthermore, there is a potential for contamination of both wild fish and fish raised in floating net pens with toxic substances. There is clearly a need for the development of an environmentally friendly commercial aquaculture method that can produce marine finfish that are free from biological contamination.

UMBI Solution: Scientists at UMBI's Center of Marine Biotechnology (COMB) have created a new generation marine aquaculture system that addresses and solves many of the environmental and biological concerns. COMB has developed a recirculating, fully contained and biosecure marine aquaculture technology that is environmentally sustainable and economically feasible. The core of the system utilizes biological filtration units that incorporate naturally occurring microbial processes such as, heterotrophic nitrification, autotrophic denitrification, sulfate reduction and anaerobic ammonium oxidation. These processes control and degrade waste compounds produced by fish that would otherwise accumulate in system water and harm the fish. The ultimate elimination of these compounds by select groups of microorganisms allow for the recycling of tank water and practically eliminates the need for replacing or adding seawater. Moreover, the system collects and digests solid waste products derived from the fish waste or the accumulated excess feed to fuel additional microbial processes whose activities result in the production of methane gas. The methane gas thus generated can be captured and used as a supplemental source of energy. The system produces exceptionally 'clean' fish with accelerated growth rates and can be modified to grow almost any species. The aquaculture facility can be located anywhere there is an adequate fresh water and electrical supply. The facility can be located far away from the shore, in or near the source of demand, thereby reducing transportation costs and the carbon footprint of the operation.

Commercial Applications:

- A high efficiency recirculating marine aquaculture process for producing fish at variable yield densities of up to 70 kg/m³ of water ensures the economic feasibility of farming commercially important fish in urban and rural communities.

Advantages:

- Patented marine recirculating aquaculture system, completely contained and zero discharge indoor system.
- Artificial seawater is used and recycled ~100% and generates negligible effluents.

- Waste products are eliminated by microbial communities and solid waste (sludge) is converted to fuel-grade methane that is captured for use in the system.
- Biosecure and does not allow farmed fish to escape into the environment.
- Environmentally responsible and fully sustainable.
- System is generic for any species; conditions are tailored to meet the specific requirement of the fish of interest thus, growth rate and general performance are optimal and superior to other systems.
- Year round production; fish can reach the market within hours of harvesting.
- Produces fish that are clean and contaminant free.
- Fish produced have ‘sea grown’ levels of omega fatty acids, superior texture and flavor.
- Self-contained systems can be located anywhere, in urban or rural areas, where there is access to water and power. Therefore, can be installed close to centers of demand.

Stage of Development: System has been repeatedly tested at 2 metric ton capacity per 9 month growth cycle. These tanks are operating and inspectable. Modeling studies suggest that a 200 metric ton/year production facility is minimum size that enables a reasonable financial return and economies of scale. Prototype tested with Mediterranean Seabream (aurata, dorade royale), Seabass (Branzini) and Cobia.

Patent Status: Combination of issued patent and patent applications with world-wide rights.

Licensing Potential:

UMBI is seeking exclusive licensees to all or part of this technology. The inventors would welcome the opportunity to work with any licensee to further refine or extend the capabilities of this invention.

UMBI Reference & Inventor: 04-006, 03-007, 01-019, 00-008.
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Relevant Publication:

Yossi Tal,, Harold J. Schreier, Kevin R. Sowers, John D. Stubblefield, Allen R. Place, Yonathan Zohar, (2009) Environmentally sustainable land-based marine aquaculture. *Aquaculture* 286: 28-35.

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