Role of Biological Filters in the Maintenance of Water Quality in the Recirculation System

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Indian major carp Catla catla (catla) larvae were cultured in the recirculating systems maintained in the polyhouse. Three types of biological filtration systems: pebbles filter system, hydroponic system and earthen pot filter system were used in this study. Fish were harvested after 90 days. More than 90% survival was obtained in all these three treatments. There was no significant difference in the survival rate among these three culture systems. Growth of catla was significantly (P < 0.05) higher in the pebbles filter system than other two systems. pH level was always around 7.0. Ammonia and nitrite levels were significantly lower (P < 0.05) in the earthen pot filter system whereas, the phosphate level was minimum in the hydroponic system. The study of water quality parameters in different hours of circulation showed some variations. This study suggest that the combination of earthen pot and hydroponic systems will help to maintain better water quality.
Propagation and Culture of Endangered Freshwater Juvenile Mussels in a Recirculating Aquaculture System

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Although North America contains the greatest diversity of freshwater mussels in the world, roughly 300 species, this family of mollusks is the most imperiled group of animals in the U.S.. Already, 21 species are extinct and 69 species are listed as endangered or threatened. To help prevent additional species loss, biologists at the Virginia Tech Aquaculture Center in Blacksburg, VA, have developed methods to propagate and culture endangered juvenile mussels for release into rivers of the upper Tennessee River drainage. Freshwater mussels have a unique life history, requiring the use of fish in the life cycle. Thus, the process of producing juvenile mussels begins by collecting suitable host fish from the river and holding them in captivity until gravid female mussels can be found. In the laboratory, the larvae (glochidia) in the gills of the female mussel are flushed out using a hypodermic needle filled with water. This non-lethal method allows us to return females to the river once her progeny have been removed. The larvae can number more than 200,000 per female. These larvae are then introduced into a bucket holding the host fish, and aeration is used to keep the water agitated to allow larvae to attach to the gills of the fish. After 1 hour of exposure, the fish are moved to large aquaria where the attached larvae begin the transformation process, which requires 2-3 weeks. Once these young juveniles drop from their host fish, they are collected by siphoning the tank bottoms. They are put in recirculating streams in a greenhouse facility, where they are fed cultured algae until a desired size is achieved for release to the wild, usually 1-2 months. In 1998 and 1999, a total of 150,000 juvenile mussels of 8 species were released into the Clinch and Powell rivers in Tennessee.
Use of Recirculating Aquaculture Systems (RAS) for Eel (Anguilla rostrata) Production in Virginia

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Marketing

There are two markets for eels raised in the U.S. as food fish. The primary market is the value-added eel market in the U.S. and Japan. Kabayaki is a type of “value added” product made by steaming and grilling the eel fillet and adding a special blend of spices. The importation of Kabayaki from China and other Asian countries into the U.S. exceed 5,000 MT per year with a wholesale value of 38 million dollars.

The secondary market for eels, raised in the U.S., is the live export market to Asia and Europe. Japan imports in excess of 48,000 metric tons of live eels per year with an average wholesale value of 6.00 dollars per lb. ($576 million US). The demand for whole eel in Japan for Kabayaki production is increasing by 10% per year. Eels can be grown in the U.S. and shipped into Japan's live market for a wholesale price of $4.50 per lb.

Eel Culture Technology (ECT) is a company that produces fingerling eels for exportation to Asia, Europe, and South America. ECT utilizes Recirculating Aquaculture Systems (RAS) to produce over three million fingerling eels annually. ECT is located 22 miles southeast of Richmond.

Facilities

A 30,000 ft² building, two deep wells producing 30 gallons per min., and two, 56 m³ recirculating systems. Each system contains 24 3-m³ fiberglass tanks, rotating drum filtration, biological filtration, propane heat exchanger, degassing tower, and ultra-violet irradiation. ECT has a permit with Virginia Marine Resource Commission for the annual harvest of 600 kg of glass eels (approximately 3,000,000 glass eels).

Inputs

ECT uses a commercial trout diet produced by Southern States to feed 1-5% eel biomass per day (45% crude protein, 10% crude fat, 4% crude fiber, 1% phosphorus). Each system is capable of receiving up to 75 kg/feed/d or 6 kg/N/d while maintaining adequate water quality parameters for eel culture. Oxygen cones are used to maintain oxygen saturation in the culture tanks from 100-250% saturation. Oxygen is used at a rate of 9-12 g O₂/kg eel bio-mass/d or 0.9 kg O₂/kg feed/d. Fluidized bead filters are used for the removal of ammonia and nitrite. Bio-barrels are used as the fluidized media.
at a rate of 2 ft³/kg feed/d. Sodium Hydroxide (50% Grade) is used at a rate of 1.5 liters/10 m³ refreshment water/d to maintain pH levels between 6.5 and 7.0. The refreshment water has the following characteristics: 120 ppm Alkalinity, 100 ppm Hardness. pH: 7.2, temperature: 55°F. Culture water is recirculated in the culture units from 100-300%/hr.

Outputs

Each system is capable of maintaining eel densities up to 200 kg eel biomass/m³ of culture space or 100 kg eel biomass/m³ of total system water. Each system is capable of producing 18,000 kg of eel biomass per year.
Use of Bead Filter Backwash to Enhance Shrimp Growth

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Floating bead filters used in recirculating aquaculture systems are designed to capture solids and provide habitat for nitrifying bacteria. Periodically, the bead bed needs to be cleaned or backwashed to remove accumulated solids that reduce water flow and interfere with biofiltration. Bead filter backwash typically is in the form of a sludge that contains uneaten feed, feces, live microbes and meiofauna, and other organic matter. Disposal of this nutrient-rich material can be problematic, so alternative uses need to be identified. The objective of this study was to determine if backwash from a propeller-washed bead filter (PBF) could be used as a feed supplement to enhance the growth of juvenile Pacific white shrimp, Litopenaeus vannamei.

Twelve 120-L tanks were stocked with 1.49-g shrimp (SD ± 0.09 g) at a density of 10 shrimp/tank (40/m²). Three treatments (four replicates/treatment) were tested for 43 days and consisted of: 1) shrimp grown in flow-through pond water from an intensive shrimp pond (Pond treatment), 2) shrimp grown in flow-through well water from a seawater aquifer (Well treatment), and 3) shrimp grown in static well water that received additions of bead filter backwash every other day (Backwash treatment). Backwash came from a PBF that was used to filter water from a 58-m² recirculating raceway stocked with L. vannamei at a density of 100 shrimp/m². Shrimp in all three treatments received a 30%-protein feed ad libitum throughout the experiment. In addition to shrimp growth and survival, carbon, nitrogen, and chlorophyll concentrations were determined for organic matter present in samples of pond water, well water, and bead filter backwash.

There was a significant treatment effect on shrimp growth (P<0.05). Growth rates of shrimp in the Pond treatment (1.88 ± 0.11 g/wk) were 300% greater than growth rates of shrimp in the Well treatment (0.47 ± 0.06 g/wk) and 47% greater than in the Backwash treatment (1.28 ± 0.08 g/wk). Growth rates of shrimp in the Backwash treatment were 172% greater than in the Well treatment, and this increase in growth was likely due to shrimp grazing on the nitrogen-rich organic matter supplied in the backwash. Chlorophyll concentrations exhibited large temporal variability in both pond water and backwash, and were several orders of magnitude higher than in well water. Survival was ≥87.5% for all three treatments.

This study indicates that bead filter backwash contains organic matter that can more than double shrimp growth, and these results call into question the need to remove these particles from the culture environment.
Modification of D-Ended Tanks for Flat Fish Culture

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