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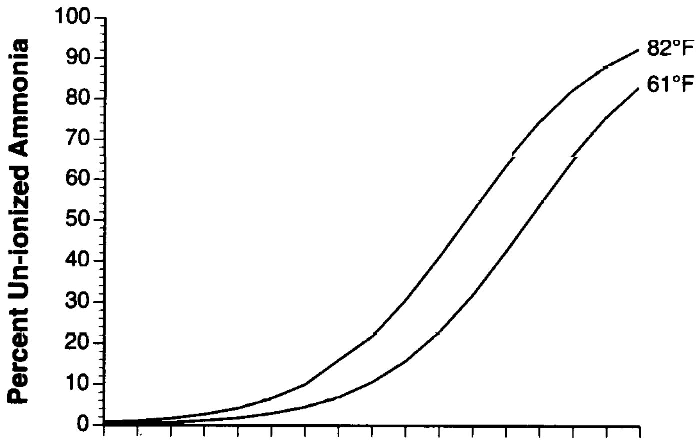
An Introduction to Water Chemistry in Freshwater Aquaculture

freshwater aquaculture systems and methods to monitor them are described in this publication. Water quality determines not only how well fish will grow in an aquaculture operation, but whether or not they survive. Fish influence water quality through processes like nitrogen metabolism and respiration. Knowledge of testing procedures and interpretation of results are important to the fish

farmer.

Some water quality factors are more likely to be involved with fish losses such as dissolved oxygen, temperature, and ammonia. Others, such as pH, alkalinity, hardness and clarity affect fish, but usually are not directly

When fish are cultured intensively and fed protein-rich feeds they can produce high concentrations of ammonia in the water. Ammonia and other metabolic wastes are gradually removed by natural processes in ponds or through the use of biological filters in recirculating and reuse systems. Ammonia is removed by bacteria that initially convert it into nitrite and subsequently into nitrate. Nitrite is toxic to fish and causes "brown blood" disease.



Iron

Many groundwaters contain elevated levels of dissolved iron. When exposed to the air, this iron interacts with oxygen, becomes insoluble, and forms a red deposit. Small clumps of iron are produced that can settle on fish gills, causing irritation and stress. Problems can be avoided if the iron-bearing water is exposed to air and the resultant clumps of iron removed by settling or filtration before the water enters the culture system.

Chlorine

To control bacteria, municipal water supplies are typically treated with chlorine at 1.0 ppm. If municipal waters are used to culture fish, residual chlorine must be removed by aeration, with chemicals such as sodium thiosulfate, or filtration through activated charcoal. Chlorine levels as low as 0.02 ppm can stress fish.

Hydrogen Sulfide

Ponds with oxygen-poor bottoms and accumulated organic material can release hydrogen sulfide when seined or disturbed. Substratum beneath heavily fed cages/net pens can accumulate wastes (e.g., uneaten food, feces) and produce hydrogen sulfide gas if oxygen becomes deficient. Hydrogen sulfide gas has a rotten egg odor and is extremely toxic to fish. Any detectable odors or levels should be avoided and extreme care should be taken when handling fish in an afflicted pond. Ponds can be drained, exposed to air and/or excavated to correct the problem.

Water Clarity

In pond and cage culture, water clarity can affect fish. If fish that prefer turbid waters (e.g., bullhead, catfish, walleye) are cultured in relatively clear water they will experience stress; survival and growth will be adversely affected. Accumulation of suspended solids and discoloration of culture water occur in recirculating systems which can irritate fish and precipitate disease. Some suspended and dissolved materials can cause off-flavor in fish. Filtration and flocculent can be used to remove solids and reduce discoloration.

Monitoring Methods

A variety of methods are available to monitor water quality (see Table 1). In pond, cage, and low intensity culture, the high precision of sophisticated analytical methods (e.g., APHA 1989) is not needed to make informed management decisions (see Boyd 1990). However, intensive culture in recirculating and reuse systems requires frequent and sophisticated monitoring.

If fish are maintained at high densities, then temperature, dissolved oxygen, ammonia, nitrite, and pH should be monitored daily or more frequently (e.g., continuous monitoring of dissolved oxygen in recirculating systems). Water clarity, alkalinity, and hardness can be measured less frequently, perhaps one or two times per week, as they do not fluctuate as rapidly. Salinity, iron, and chlorine should be determined when a potential water source is first examined so corrective measures may be incorporated into the production system during the design or planning stage. Carbon dioxide should be measured when first using a new groundwater source and routinely in recirculating systems. When hydrogen sulfide and carbon dioxide problems are likely, systems should be monitored closely and the means to correct problems should be readily available.

At lower stocking densities, water quality parameters can be monitored less frequently or not at all. Regardless of the frequency, monitoring should be conducted at a standard time and depth where fish are located. Time of measurement and observed values should be recorded; good record keeping is essential to successful aquaculture. In pond and cage culture it is preferable to monitor dissolved oxygen early in the morning, when conditions stressful to fish are most likely to occur (e.g., low oxygen). Conversely, temperature and pH in ponds are best measured during the late afternoon.

Sources of Supplies and Equipment

Several suppliers produce kits and materials to monitor water quality. Suppliers frequently have displays at trade shows and sources are listed in several trade journals including the Annual Buyer's Guide published by Aquaculture Magazine, P.O. Box 2329, Ashville, NC 28802.

References

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