AUTUMNAL FISH HEALTH MANAGEMENT

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Of the four seasons, many fish farmers prefer autumn because of the following characteristics of autumn:

1. The water temperatures are decreasing, thus reducing the infectious disease potential and the required amount of daily feed.

2. With the decrease in water temperature, the oxygen carrying capacity of the ponds increases and the amount of free ammonia (NH_3) decreases.

3. The migratory, fish-eating birds have departed for warmer climates.

To present the changes in the system quantitatively, the following occur with a decrease of water temperature from 15^0C to 9^0C:

1. Fish-associated changes: (based upon 100 g rainbow trout)

- The metabolic rate decreases 67.5%
- The growth rate potential decreases 97.8%
- The daily weight gain potential decreases 66.7%
- The ammonia generation potential decreases 98.6%

2. Water-associated changes:

- The dissolved oxygen concentration increases 12.8%
- The oxygen-carrying capacity increases 33.1%
- The environmental unionized ammonia (NH_3) decreases 58.8%

So, all things considered, the situation fish-wise is pretty rosy. There is another autumnal consideration, I think, which should be attended. The fish have come through the summer water temperatures and the associated episodes, seen and unseen, of infectious and noninfectious diseases. In the majority of cases of external protozoan and metazoan parasitisms, there are some "hangers on" into the autumn and winter months. Specifically, *Trichodina*, *Gyrodactylus*, and *Ichthyophthirius* are most common among the "hangers on". In late winter and early spring, when water temperatures begin to increase, these organisms frequently emerge from their winter hibernation and cause problems for their fish hosts. The problems are often quite serious because the defensive mechanisms of the fish are still quite depressed because of the as yet low water temperatures. In addition, the nutritional status of the fish, in many cases, is also compromised from the winter conditions. Thus, both conditions favor the reproductive cause(s) of the organisms. In many cases, to administer a chemical such as formalin at this time could cause more problems than it would cure because of the reduced capability of the fish to withstand such an activity. The point to be considered is to remove the "hangers on" in the early autumn when the fish are physiologically capable of handling the rigors of an hour of formalin treatment.

At this point, it could be prudent to recite an oft-heard saying about treating fish diseases with a chemical administered in the water; to wit: "More fish have been killed than cured with formalin." In my experience, this statement has quite a history to confirm it.

When considering the use of formalin or any other medicament to remove external protozoa, metazoa, or bacteria, the following process should be followed to insure optimum safety for the fish and optimum efficiency in removing the offending organisms:

1. Do not feed the fish during 24-36 hours prior to the treatment.

2. Conduct a bioassay to determine the safe and effective concentration of chemical. This process is usually not done because of its perceived complexity. However, its omission from the treatment process is probably the chief reason for the chemical-related fish kills.

   Examine the gills and pectoral fins of a few (2-3) fish for external organisms. This step may be omitted if one assumes that organisms are present because clinical episodes have occurred in the past.

   Prepare at least 3 concentrations of the candidate chemical in 15-20 l of water. For example, if formalin is to be used, prepare concentrations of 1:4,000; 1:5,000; and 1:6,000 in water from the pond to be treated. Provide aeration using airstones and an aquarium pump.

   Place 2-3 clinically healthy fish and 2-3 not-so-healthy ("screen-hangers") fish into each container. During the ensuing 60 minutes, observe the fish for signs of distress.

   At the end of 60 minutes, examine the gills and pectoral fins of the fish for organisms. This step is often omitted, but it should not be.

   The resultant concentration of chemical to administer is that which does not compromise the well-being of the fish and does kill the resident organisms.

3. While the bioassay is in progress, the dimensions of the water volume and the water inflow of the pond to be treated should be determined with as much accuracy as possible.

Obtaining the water dimensions of most ponds is quite straightforward. In cases where the pond has an irregular shape, time should be spent in acquiring the proper measurements.

The determination of water inflow can, in many cases, be described as a S.W.I.G. (a Scientifically-Wild Intuitive Guess). There are many methods to determine pond inflow. The simplest, in my opinion is the Filling Time Method.

In this method, the water level is reduced by, for example, 25 cm. At that point, begin recording the time required for the water depth to increase 20 cm. Divide the volume (liters) replaced by the time (minutes or seconds) to determine the LPM or LPS water inflow.

In most raceway systems, the 60-minute continuous drip is the most effective and safe method to administer the majority of water-administered chemicals approved for treating diseases of foodfish. When calculating the correct water volume to be treated, the volume of water displaced by the fish should be considered. In the case of most salmonids, 1.018 kg fish displaces 1.0 l of water. Many fish farmers are often quite surprised to note that, in high density conditions, perhaps 1/3 of the water volume is displaced by fish. To treat such a condition would result in a significant increase in chemical concentration and, perhaps, a significant unnecessary mortality.

The following is an example of using the 60-minute drip method in a raceway system.

Fish: Rainbow trout; 11.3 g/fish; 3,402 kg

Pond: 3.0 m wide, 33 m long, 1.0 m water depth
3.6 m_3 per minute (cms) water inflow

Chemical: 1.75 mg/l for 60 minutes

Water volume minus fish displacement:

$$99.0 \text{ m}^3 - 3.34 \text{ m}^3 = 95.66 \text{ m}^3 \quad (95{,}660 \text{ l})$$

Mix 376 g of the chemical in 10 liters of water and set the drip rate for 167 ml per minute. The dosage was calculated as follows: A water inflow of 3.6 cms generates 2.25 water changes per hour in the pond. Thus, 95,660 l times 2.25 times 1.75 (mg/l chemical for 60 minutes) equals 376 g of chemical. The 10 l volume divided by 60 minutes equals 167 ml per minute.

In circulating water systems; e.g., circular ponds or rectangular circulating ponds, the most effective treatment method is a combination of the bath and drip methods. The proper amount of chemical is spread in diluted form throughout the pond. Also, a 60-minute drip system is set to replace the chemical discharged during the 60-minute period. The calculations for this method are:

For circular ponds:

$$T_d = (-V / R_w) * (-0.69314 / 1.83)$$

Where: T_d = depletion time (minutes) for 50% of the chemical

V = water volume (m^3) minus the volume displaced by the fish

R_w = water inflow (m^3 per minute)

-0.69314 = natural log of 50% reduction of chemical

1.83 = water inflow mixing coefficient

For rectangular circulating ponds:

$$T_d = ((-V / R_w) * -0.69314)$$

Where: T_d = depletion time (minutes) for 50% of the chemical

V = water volume (m^3) minus the volume displaced by the fish.

R_w = water inflow (m^3 per minute)

-0.69314 = natural log of 50% reduction of chemical

The amount of chemical to be replaced (mg/minute) is calculated by dividing the 50% reduction value by the minutes required for such a reduction. The total amount of chemical to be added during the 60-minute drip period is calculated by multiplying the mg/minute lost by 60. A solution is then made, the volume of which is divided by 60 to determine the ml per minute flow.

The following is an example of using a 60-minute bath/drip method in a circular pond system.

Fish: Rainbow trout; 11.3 g/fish; 3,402 kg

Pond: 11 m diameter, 1 m water depth
0.033 m^3 per second (cms) water inflow

Chemical: 1.75 mg/l for 60 minutes

Water volume minus fish displacement:

$$95.0\ m^3 - 3.34\ m^3 = 91.66\ m^3$$

Time for 50% depletion of the chemical is 17.5 minutes

Mix 160.4 g of the chemical in 10-15 l of pond water and mix 275 g of the chemical in 10 l of water. Distribute the 160.4 g solution evenly throughout the pond. Set the 275 g solution to drip at 167 ml per minute.

The following is an example of using a 60-minute bath/drip method in a rectangular circulating system.

Fish: Rainbow trout, 90.8 g/fish, 8,190 kg

Pond: D-End pond with dimensions of 33 m long, 5 m wide, 1 m water depth, and a center wall of 28 m long and 30 cm thick.
0.084 m^3 per second (cms) water inflow

Chemical: 1.75 mg/l for 60 minutes

Water volume minus fish displacement:

$$210.1\ m^3 - 8.1\ m^3 = 202\ m^3$$

Time for 50% depletion of the chemical is 27.8 minutes

Mix 353.5 g of the chemical in 10-15 l of pond water and mix 380 g of the chemical in 10 l of water. Distribute the 353.3 g solution evenly throughout the pond. Set the 380 g solution to drip at 167 ml per minute.

In applying water-administered chemicals to prevent and/or treat diseases in fish, there are a few caveats to be observed. The major consideration is the nature of the chemical. The majority of water-administered chemicals for fish were not developed and marketed for such use and as such the manufacturer of the chemical assumes no liability for problems occurring in such use. Secondly, the margin of safety; i.e., the "distance" between killing the offending organism and negatively affecting the fish, is often minimal. Thirdly, the efficacy and safety of the majority of chemicals used in fish farming are affected by the physical and chemical nature of the water. Thus, dosages recommended in texts and magazine articles may not be suitable for use in all water systems. Fourthly, prior to using a water-administered chemical, all calculations should be validated by a second person.

In summary, to a large degree, the statement is true that water-administered chemicals have killed more fish than the organisms they were supposed to kill. It can be a very hard but unnecessary lesson to learn. Perhaps the foregoing presentation will prevent some future unwanted problems and the fish farmer can spend more time indoors in front of a warm fireplace instead of out in the cold removing morts from the screens.