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Ichthyophthirius multifiliis is a ciliated protozoan which causes "Ich" or "white spot disease." This disease is a major problem to aquarists and commercial fish producers world wide. Ichthyophthirius is an important disease of tropical fish, goldfish, and food fish. The disease is highly contagious and spreads rapidly from one fish to another. It can be particularly severe when fish are crowded. While many protozoans reproduce by simple division, a single "Ich" organism can multiply into hundreds of new parasites. This organism is an obligate parasite which means that it cannot survive unless live fish are present. It is capable of causing massive mortality within a short time. An outbreak of "Ich" is an emergency situation which requires immediate treatment: if left untreated, this disease may result in 100% mortality.

The Parasite

"Ich" is the largest known parasitic protozoan found on fishes. Adult organisms are oval to round and measure 0.5 to 1.0 mm in size. The adult is uniformly ciliated and contains a horseshoe-shaped nucleus which can be seen in older individuals.

The breeding stage of the parasite encysts between the layers of the host skin. When mature, it leaves the fish and produces large numbers of free swimming young. These must find a host within 48 hours (at water temperatures of 75-79°F) or they will die. The life cycle of "Ich" is shown in Figure 1 .

Disease Signs

The classic sign of an "Ich" infection is the presence of small white spots on the skin or gills. These lesions look like small blisters on the skin or fins of the fish. Prior to the appearance of white spots, fish may show signs of irritation, flashing, weakness, loss of appetite, and decreased activity. If the parasite is only present on the gills, white spots will not be seen at all, but fish will die in large numbers. In these fish, gills will be pale and very swollen. White spots should not be used as the only means of diagnosis because other diseases may have a similar appearance. Gill and skin scrapings should be taken when the first signs of illness are observed. If the "Ich" organism is seen, fish should be medicated immediately because fish which are severely infected may not survive treatment.

Diagnosis of "Ich"

Diagnosis of "Ich" is easily confirmed by microscopic examination of skin and gills. Remove several white spots from an infected fish, then mount them on a microscope slide with a few drops of water and a cover glass. The mature parasite is large, dark in color (due to the thick cilia covering the entire cell), and has a horseshoe-shaped nucleus which is sometimes visible under 100 x magnification. The adult parasite moves slowly in a tumbling manner and, with practice, is easily recognized. The immature forms (tomites) are smaller, translucent, and move quickly. The tomites closely resemble another protozoan parasite called Tetrahymina. Tetrahymina usually does not require treatment, so it is important to recognize the difference between the two parasites. If only tomites are seen, prepare a second slide and examine it closely for the adult parasite to confirm the diagnosis. Observation of a single organism is sufficient to make treatment necessary.

Prevention of "Ich"

Prevention of "Ich" is preferable to treating fish after a disease outbreak is in progress. All incoming fish should be quarantined for at least three days when temperatures are 75 to 83°F. At cooler temperatures a 3-day quarantine will be inadequate for "Ich" because of its lengthened life cycle. For this reason, and to prevent introduction of other diseases which have incubation periods greater than 3 days, a longer quarantine is strongly recommended. Three weeks is generally considered a minimum period for adequate quarantine of new fish.

Treatment of "Ich"

Control of "Ich" outbreaks can be difficult because of the parasites' unusual life cycle and the effect of water temperature on its life cycle. Review the life cycle of L multifiliis presented in Figure 1 . Of the life stages shown, only the free-swimming tomites are susceptible to chemical treatment. This means that application of a single treatment will kill tomites which have emerged from cysts and have not yet burrowed into the skin of host fish. This single treatment will not affect organisms which emerge after the chemical has broken down or been flushed from the system. Repeated treatments, however, will continually kill the juvenile tomites, preventing continuation of the infection. The epizootic will be controlled as more adult parasites drop off the sick fish, encyst, and produce young which cannot survive because of the repeated application of chemicals. This process will be greatly accelerated if organic debris can be removed from the tank or vat following treatment. This will remove many cysts from the environment, decreasing the number of emergent tomites.

Water temperature has a tremendous influence on how fast the life cycle for "Ich" (Figure 1) is completed. At warm temperatures (75-79°F), the life cycle is completed in about 48 hours, which means that chemical treatments should be applied every other day. At cooler temperatures the life cycle is prolonged and treatments should be spaced further apart. For example, at a water temperature of 60°F, treatments should be spaced 4 or 5 days apart. In warm water, a minimum of three treatments applied 2 to 3 days apart is required. In cooler water, a minimum of five treatments should be applied 3 to 5 days apart. Treatments should never be discontinued until all mortality from "Ich" has stopped. Fish should be closely watched during recovery; the weakened fish may be susceptible to a secondary bacterial infection. The choice of chemical used to treat "Ich" will be based upon water quality conditions, species of fish to be treated, and the type of system fish are housed in. In general, copper sulfate, formalin, and potassium permanganate are all effective against "Ich" when applied at the correct concentration in a repetitive manner as described above.

Special Considerations for Treatment of Food Fish

Most channel catfish, raised in the southeast, are reared in ponds. For these fish, the treatment of choice for "Ich" is copper sulfate. The chemical is effective and relatively inexpensive, an important consideration when large volumes of water are treated. The disadvantage of copper sulfate is that it is extremely toxic, particularly in water of low alkalinity. NEVER use copper sulfate without testing the total alkalinity of the water, carefully measuring the dimensions of the pond to be treated, and weighing the amount of chemical to be applied.

The concentration of copper sulfate to apply is often calculated by determining the total alkalinity of the water and dividing that number by 100. For example, if the total alkalinity of the pond is 100 mg/L, then 100/100 = 1 mg/L copper sulfate. Do not use copper sulfate if the total

alkalinity is less than 50 mg/L. If you have never used copper sulfate, contact an IFAS extension aquaculture specialist for assistance. Use of copper sulfate may lead to severe oxygen depletions, therefore, emergency aeration should always be available. Use of copper sulfate during hot weather, or when algae blooms are dense, is strongly discouraged. Remember, if you do not know the alkalinity of your water and can not measure it then DO NOT USE COPPER SULFATE.

If you are unable to use copper in your pond because of low alkalinity, lack of aeration, or you are not comfortable using it, potassium permanganate can be used instead. The primary disadvantage of potassium permanganate is its high cost. However, it is equally effective and safer to use than copper sulfate. Potassium permanganate can be applied at a concentration of 2 mg/L which will result in a purple-pink color of the water. If the water turns yellow or brown in less than 8 to 10 hours, then the treatment should be repeated. Usually, a maximum of three applications (2 mg/L each) is recommended during any one treatment (maximum concentration of 6 mg/L).

If fish are maintained indoors in a tank system, formalin can be used to treat "Ich". Formalin is not the ideal treatment for ponds, but works nicely in tanks with vigorous aeration. Formalin should not be run through a biofilter, however, as it will kill the bacteria in the filter and ammonia levels may increase to lethal levels. A short-term bath of 250 mg/L for 30 to 60 minutes can be followed by a water change. Cleaning the tank will also decrease the number of parasites. When applying a concentrated treatment such as formalin, NEVER leave the fish in the treated water longer than recommended, and NEVER leave them unattended. Sick fish may be unable to tolerate a full treatment. If they appear stressed or try to jump out of the tank, flush the chemical from the system immediately. A long term bath of formalin can be used in a tank system at a concentration of 15 mg/L and does not need to be flushed out.

Salt can also be used to control "Ich" infections in small volumes of water. This is not practical in ponds because even a light salt solution of 0.01% (100 mg/L), would require large quantities of salt (272 lbs/acre-foot). In small volumes (i.e. tanks or vats), however, salt can be useful. Fish can be dipped in a 3% (30,000 mg/L) solution for thirty seconds to several minutes, or they can be treated in a prolonged bath at a lower concentration (0.05% = 500 mg/L). Salt at low concentrations (0.01 to 0.05% solution) is an excellent means of controlling "Ich" in recirculating systems without harming the biofilter. An ultraviolet filter is recommended as an aid in preventing the spread of the parasite in a recirculating system.

Special Considerations for Treatment of Ornamental Fish

Fish which are not intended for human consumption can also be treated with the chemicals described above for food fish. Copper sulfate or potassium permanganate work well in pools, whereas formalin or salt may be easier to use in smaller volumes of water.

Malachite green is another chemical which can be used to treat ornamental fish that are housed indoors. This chemical should NEVER be used to treat food fish. Not only is this illegal and unethical, but it is totally unnecessary. The chemicals listed above (copper sulfate, potassium permanganate, formalin, and salt) are all excellent treatments for "Ich". Malachite green is mentioned for the sake of completion, but is not recommended by the authors. The

chemical is hazardous to handle- it is known to cause cancer, mutations, and is harmful to fetuses. Gloves and a protective mask should always be worn when handling the concentrated powder. Pregnant personnel should NEVER handle this chemical. Despite its toxicity, it is commonly used to control parasitic protozoans on ornamental fish and is quite effective when used at concentrations of 0.05 to 0.10 mg/L as an indefinite bath. This chemical is extremely harsh on fish, particularly on gill tissue, so be careful not to overdose the fish. Malachite green can also be combined with formalin (0.2 mg/L malachite green mixed with 25 mg/L formalin) to treat external protozoan diseases. The two chemicals work well together and are quite effective. Malachite green can be very toxic to scaleless fish and should be avoided on these species.

Special Considerations for Treatment of Pet Fish

Pet fish can be treated with any of the chemicals discussed above to correct "Ich" infections. A number of commercial preparations are available from pet stores which contain one or several of these agents. Temperature manipulation is also an effective way to control "Ich" in home aquariums. This technique is often not practical for commercial fish farms, but is advantageous for the hobbyist because expensive products do not have to be purchased and it is safer for some of the delicate species which are popular in community tanks. Water temperature can be gradually raised to 90°F, maintained there for 24 hours, and then gradually dropped to 70°F for 48 hours. The infective juveniles (tomites) will be killed while the water temperature is at 90°. When the temperature is dropped the adult organisms will fall off the fish and begin to reproduce. As the young begin to emerge 48 hours later, the temperature is again raised to 90°F, causing them to die. Repeating this process continuously (24 hours at 90° F followed by 48 hours at 70° F) for two weeks should control the disease. Cleaning the tank every second day will help remove cysts before they rupture and therefore help to prevent completion of the life cycle. If you decide to use temperature to control "Ich" in your home aquarium be sure that the type of fish in your tank can tolerate the temperature extremes involved.

Summary

"Ich" is a protozoan parasite with the scientific name of Ichthyophthirius multifiliis . It is easily introduced into a fish pond, tank, or home aquarium by new fish or equipment which has been moved from one fish-holding unit to another. Quarantine is an effective way of preventing this disease. Once the organism gets into a large fish culture facility, it is difficult to control due to its fast reproductive cycle and its unique life stages. If not controlled, 100% mortality of fish can be expected. With careful treatment, the disease can be controlled, but the cost will be high, both in terms of lost fish, labor, and the cost of chemicals.

In contrast to most parasitic diseases, where the decision to treat (or not to treat) is based on the degree of infestation and other factors, fish infected with "Ich" (even if only one parasite is seen) should always be treated immediately. This organism can only survive if live fish are present for completion of its life cycle. It can cause massive mortality of fish within a short time. In severe cases, control may be impossible. A single treatment is not sufficient for this disease, as the encysted stage is resistant to chemicals. Repeating the selected treatment will disrupt the life cycle and control the outbreak. Daily cleaning of the tank is also beneficial, as the encysted forms are physically removed from the environment. Ichthyophthirius multifiliis is a common parasite which can cause catastrophic loss in aquaculture facilities. Careful attention to management practices, such as quarantine and multiple treatments when outbreaks occur, will

minimize economic loss from this disease.

Footnotes

1. This document is CIR920, one of a series of the Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date March, 1991. Reviewed July, 2002. Visit the EDIS Web Site at http://edis.ifas.ufl.edu.Please visit the FAIRS Web site at http://hammock.ifas.ufl.edu.
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