VM90

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Amyloodinium Infections of Marine Fish[1]

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INTRODUCTION

Amyloodinium ocellatum is a dinoflagellate that infects the gills and skin of both marine and brackish water fishes. The organism may be more closely related to a toxic algae than to the protozoans with which it has been grouped in the past. A similar organism, *Oodinium* spp., is found in freshwater fish. The disease caused by these organisms has been referred to as "velvet," "rust" and "gold dust disease" because of the shiny sheen the parasite imparts to heavily infected fish.

Amyloodinium can cause great losses of aquarium fish or fish held in high-density culture systems and has caused serious problems in public aquaria, mariculture systems and home aquaria. If allowed to become established in high-density recirculating systems, it can be difficult to control. For example, cultured red drum have been shown to be extremely susceptible to this infection. Amyloodinium infects a wide variety of fish and has been reported to occur in more than 100 species in North America.

CLINICAL SIGNS AND EFFECTS

Often, the first indication of an amyloodinium infection is dead or dying fish. Amyloodinium should always be considered as a possible cause of mortality when a disease outbreak involving marine or brackish water fish occurs. Behavioral signs may include a decrease in or complete lack of feeding activity, flashing (rubbing against objects in the tank or on the bottom substrate) and coughing (backflushing water across the gills). The skin of heavily infected fish may have a dull gold or brown sheen. Closer examination of the skin may reveal scale loss and patchy accumulation of mucus.

DIAGNOSIS

The only sure way to diagnose an amyloodinium infestation is by identification of the parasite in infected tissue. Preparations of gill, fin and skin (scrapings of mucus and scales) can be examined with a light microscope. If amyloodinium is present, it is easily seen (Figure 1). The life stage of the parasite that attaches to fish tissue is called the *trophont* (see section on life cycle and Figure 2). The trophont (attached cell) is pear-shaped to spherical with a dark brown to golden color, and is easily seen even with low magnification (40x). The size of the

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organism is variable. Its mean size has been reported as 61 x 50 m, which is about 7 to 8 times larger than a red blood cell. The trophont attaches to the tissue of the fish by means of an attachment plate, which may be visible with a light microscope (Figure 1).

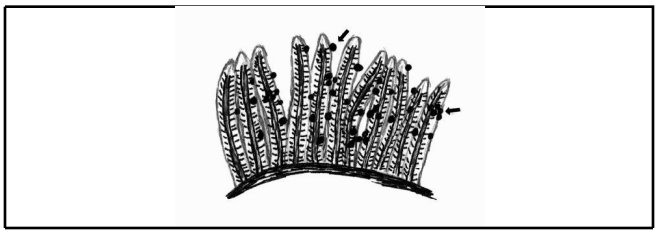

Figure 1.

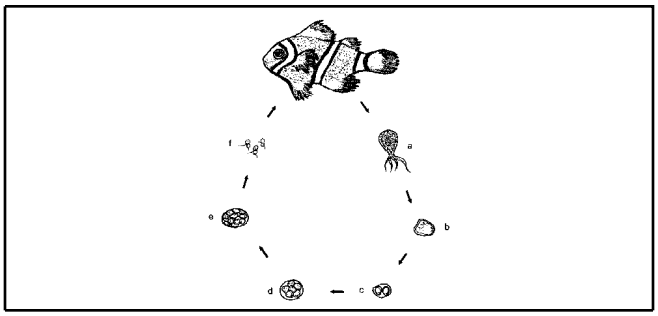

Figure 2.

LIFE CYCLE

The life cycle of amyloodinium is complex compared with those of many other fish parasites. Many single-celled parasites that infect the external surface of fish divide by binary fission. This simply means that an adult organism divides in half and produces two. Those two divide, resulting in four, and so forth. There are two important exceptions to this generalization: the organisms that cause "white spot disease" (*Icthyopthirius multifiliis* in freshwater fish and *Cryptocaryon irritans* in marine fish, described in IFAS Extension Circular 920), and the organisms that cause "velvet" (*Amyloodinium ocellatum* in marine fish and *Oodinium* spp. in freshwater fish).

The life cycle of amyloodinium is shown in Figure 2 . The attached or parasitic stage is the trophont, described above. The trophont detaches from the fish and falls to the bottom substrate, where it forms a protective cyst wall around itself in preparation for cell division. This reproductive stage of the parasite is referred to as the *tomont* (Figure 2). The encysted tomont undergoes repeated division, the rate of which is affected by temperature and salinity. Each tomont may release as many as 256 *dinospores* (Figure 2), which are capable of infecting susceptible fish. Cellular division within the tomont ceases at water temperatures below 10°C (50°F), but can be completed in as little as 3 to 5 days at water temperatures of 22°C (72°F) to 25°C (77°F). The optimal salinity range for maturation of amyloodinium tomonts is reported to be 16.7 to 28.5 ppt.

Released dinospores are much smaller than mature trophonts, measuring as little as 12 to 15 m in diameter -- about one and one-half to two timesthe size of a red blood cell. The dinospores may remain infective for as long as 15 days in the absence of a fish host. The dinospores swim through the water until they reach and attach themselves to a host. Once attached, they lose their flagella and enter the parasitic stage. Reinfection is a common problem. It is probably related to the life history of the organism as well as to the apparent ability of amyloodinium to infect internal organs, including muscle and intestine, under some circumstances.

TRANSMISSION

Because amyloodinium must go through a developmental phase when it is not attached to a fish host, it does not move directly from fish to fish. Rather, it transmits from the water, which has been seeded with dinospores from infected fish. A common example is introduction of the infection into facilities that use natural seawater. Tomonts or infective dinospores can be introduced directly with incoming seawater, becoming a source of infection for fish in the system. Obviously, introducing fish infected with trophonts into a culture system will serve as a source of infection as soon as the throphonts detach and begin the reproductive process. It is also possible to introduce the infection through food items. The authors are aware of one amyloodinium outbreak that was traced directly to fish caught in the wild and fed to animals in a closed, recirculating system.

MANAGEMENT

Control of amyloodinium outbreaks has been a major constraint on the development of mariculture systems and has challenged marine aquarists for

decades. Although a wide variety of chemical treatments have been used to control amyloodinium outbreaks over the years, none have proven completely effective or safe for target animals.

The most commonly applied treatment for control of amyloodinium in the United States is copper. Because copper chemistry in water is complex, the aquarist should be well educated about the dangers of copper toxicity before applying any copper compound.

In marine recirculating systems, which do not contain invertebrates, copper is added to the system gradually over a period of several days until the free copper ion (Cu^{2+}) is at a concentration of 0.2 mg/l; this level is then maintained for up to 3 weeks. This standard procedure, observed for many years, is moderately effective but requires repeated testing of the copper concentration to ensure that amyloodinium is being controlled without killing fish. This treatment will kill all invertebrates present in the system and certain groups of fish. Sharks and rays do not tolerate it well. Despite the disadvantages of prolonged copper treatment, it is often the only treatment available in the United States. Several copper compounds have been approved for aquatic use as algicides by the Environmental Protection Agency (EPA). No copper compound has been approved by the Food and Drug Administration (FDA) for use as a parasiticide in any aquatic species; however, the FDA is reviewing the status of coppersulfate. Aquaculturists are encouraged to remain informed about FDA rulings on this and other aquaculture drugs.

Freshwater dips are effective in killing free-swimming stages of amyloodinium; however, since encysted stages are protected, a single freshwater dip is not an effective treatment. Decreasing the salinity in a system has been suggested as a method for controlling amyloodinium epizootics, but because the organism flourishes in brackish water, the effectiveness of this strategy is doubtful.

An antimalarial compound, chloroquine, has been used with some success for the control of amyloodinium; however, it has never been approved for this use by the Food and Drug Administration. Unless a registration (Investigational New Animal Drug Application) is pursued for this compound, it will no longer be appropriate for use in U.S. aquaculture industries.

Given the lack of a safe, effective therapeutant for the control of amyloodinium, avoidance is an extremely important means of preventing outbreaks of this parasite. All incoming fish should be quarantined for a minimum of 3 weeks before being introduced into an existing system. Do not feed live or frozen food items that may be infected with amyloodinium. Do not introduce water into a system that may be contaminated with amyloodinium dinospores without using effective filtration or sanitation procedures. (See IFAS Extension Fact Sheet VM-87, *Sanitation Practices for Aquaculture Facilities.*)

SUMMARY

Amyloodinium, a single-celled parasite of marine and brackish water fish, is closely related to the toxic algae that cause "red tide." The organism has a life cycle that allows it to reproduce rapidly in aquaculture systems. Its cyst stage is resistant to chemical treatment and is able to remain infective for at least 2 weeks in the absence of a fish host. The chemical treatment most commonly used in the United States is copper (0.2 mg/l Cu^{2+} for 3 weeks). Copper is toxic to fish and lethal to invertebrates. Because there is no safe, effective treatment for amyloodinium, it is extremely important to avoid introducing it into an aquaculture facility. The three most probable routes through which parasites may be introduced are infected fish, infected food items and contaminated water. Avoidance of this parasite is likely to be far more effective than treatment.