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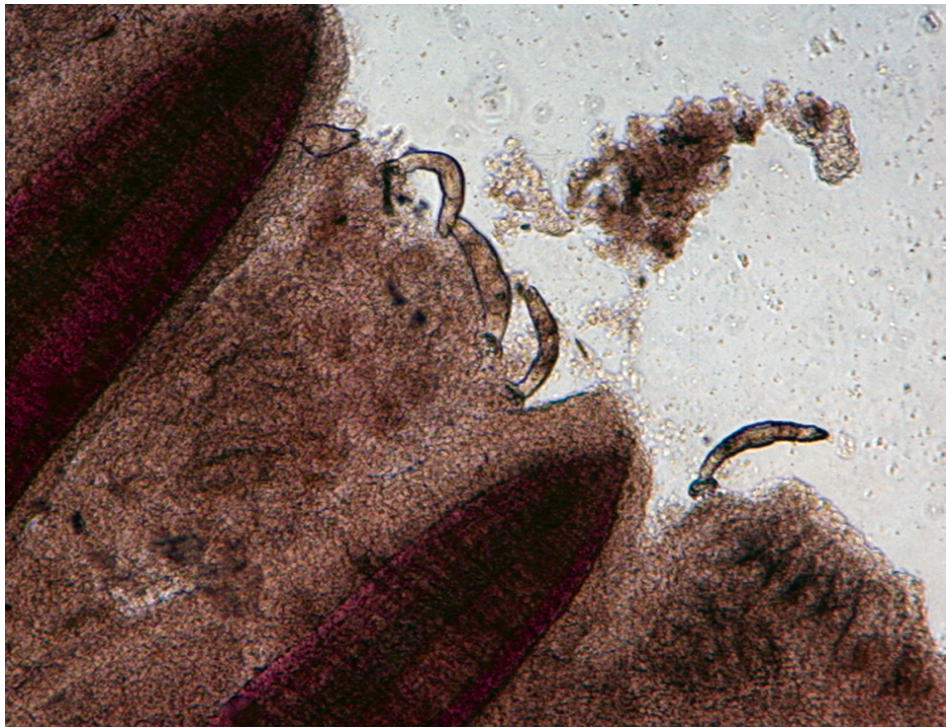
Health &
Welfare

Parasitism enhances susceptibility to bacterial infection in tilapia

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Mortality increased significantly under conditions of co-infection



Gyrodactylus mainly live on the skin and gills of freshwater fish.

Diseases are a major problem for tilapia farming. They cause high fish mortality, increase production costs and decrease profits. Parasites, bacteria and fungi are potential pathogens for tilapia.

Gyrodactylus, for example, is a monogenetic trematode that appears on fish fins, body surfaces and gills, and has the ability to expand rapidly within a relatively short time due to high reproduction rates and direct transmission between fish. *Streptococcus iniae* is a severe bacterial pathogen that has caused production losses in most regions of the world where tilapia are cultured.

Since fish are constantly exposed to pathogens in water, tilapia can be co-infected with two or more pathogens. Both *Gyrodactylus* and *S. iniae* have been observed in tilapia from ponds, tanks and recirculating aquaculture systems. However, no study had been conducted to determine the association of the two pathogens in tilapia. The authors therefore conducted a study to evaluate whether tilapia infected with *Gyrodactylus* were more susceptible to *S. iniae*.

***Streptococcus* infection trial**

The authors used Nile tilapia as experimental fish. After tilapia spawned in a pond, the fry were collected and reared in tanks using filtered, recirculated water. When the tilapia reached 9 cm in length and 12 g in weight, the fish were parasitized at an intensity of less than 10 *Gyrodactylus* per fish.

The tilapia were divided into two groups. In one group, the parasite intensity was allowed to increase by holding 50 or more fish in 57-liter aquariums without treatment for two weeks. The other group of tilapia was treated with formalin and potassium permanganate to eliminate parasite infection. After treatment, flowing water was provided, and the treated fish were allowed one week to recover.

Two hundred tilapia infected with *Gyrodactylus* and 200 fish free from the parasite were used in the infection trial. These fish were divided into four, 90-fish groups and received one of the following treatments: parasite infection and bacteria challenge, no parasite infection and bacteria challenge,

parasite infection and no bacteria challenge, and no parasite or bacteria challenge. Each group was split evenly among three tanks.

The remaining fish – 20 infected with *Gyrodactylus* and 20 free of parasites – were examined for parasite load and bacterial infection prior to the trial. For fish challenged with *S. iniae*, the bacterial suspension was added to the tanks and fish exposed to the bacteria for one hour. The mortality of fish was recorded, and dead fish were examined for *S. iniae* daily for two weeks.

Results

The 20 *Gyrodactylus*-infected fish and 20 non-infected fish were cultured to verify their *S. iniae*-free status prior to the infection trial. None of the fish was positive for *S. iniae* prior to the trial.

Wet mount samples were prepared from fish fins and gills to assess parasite intensity under a microscope. The fish showed 20 *Gyrodactylus* in fins and 29 *Gyrodactylus* in gills in the group of fish with parasites prior to the *S. iniae* infection. No *Gyrodactylus* was detected in the group of fish free from the parasite.

Twelve buckets with aeration were each filled with 2 L of tank water and 30 fish. For fish exposed to the bacteria, *S. iniae* suspension was added, and fish were immersed in the water for one hour. The fish from each bucket were then moved to a 57-L aquarium with flowing water and aeration. Fish mortality was recorded, and dead fish were examined for bacterial infection daily for two weeks.

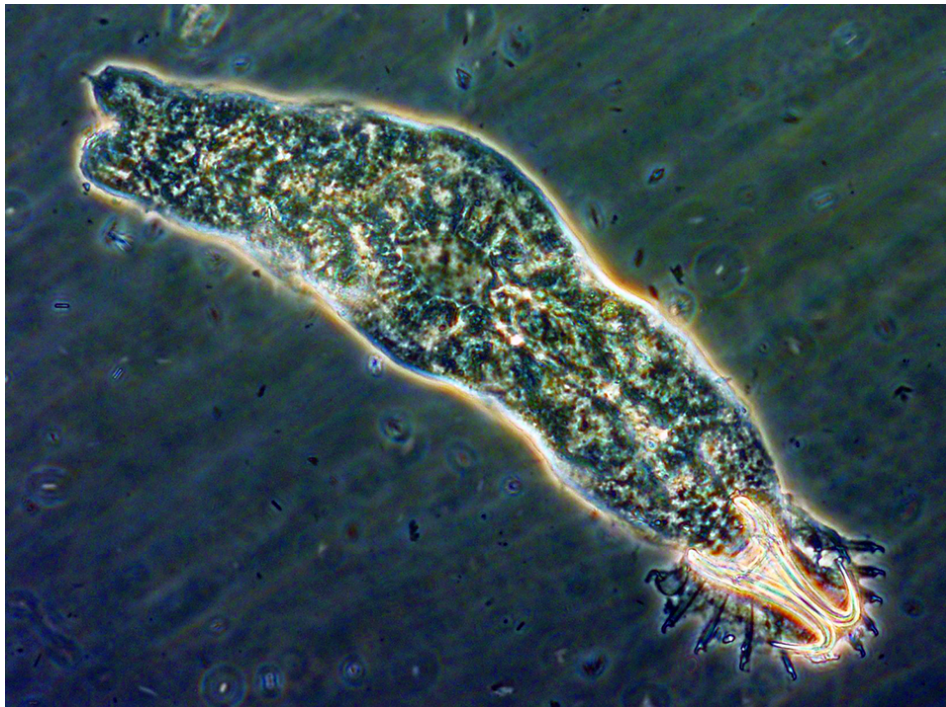
At the end of the infection trial, 38 of the 90 fish died in the group co-infected by *Gyrodactylus* and *S. iniae*, and only six were lost in the non-parasitized group challenged with *S. iniae* (Table 1). Tilapia co-infected by both parasites and bacteria showed 42.2 percent mortality, which was much higher than the 6.7 percent loss in the non-parasitized fish exposed to *S. iniae* challenge. No fish died in the group with only *Gyrodactylus* infection and in the group with no parasites or bacteria.

Xu, Mortality of Nile tilapia, Table 1

Parasite Infection	Bacterial Challenge	Dead/Total Fish	Mortality (%)
<i>Gyrodactylus</i>	<i>S. iniae</i>	38/90	42.2
No parasite	<i>S. iniae</i>	6/90	6.7
<i>Gyrodactylus</i>	0	0/90	0
No parasite	0	0/90	0

Table 1. Mortality of Nile tilapia infected by parasite *Gyrodactylus* after exposure to bacteria *Streptococcus iniae*.

Bacterial samples from the dead tilapia were incubated on agar plates and identified with biochemical tests. *Streptococcus iniae* was isolated from 35 of 38 dead fish from the group infected by *Gyrodactylus* following bacteria challenge. *S. iniae* was also isolated from all six dead fish in the non-parasitized group exposed to bacterial challenge.



Gyrodactylus is a small, elongate parasite with one pair of large anchors and 16 marginal hooklets.

Perspectives

This research demonstrated that tilapia with a solo infection of *Gyrodactylus* or *Streptococcus* had less than 7 percent total mortality. However, the mortality increased significantly under conditions of co-infection. The results confirmed earlier impressions that under farm conditions, diseases from the pathogens can occur together with devastating results.

The invasion and movement of parasites from one location to another on fish cause mechanical injuries to the epitheliums of fish. These injuries can serve as entrances for bacterial invasion, making fish with *Gyrodactylus* infection more susceptible to *Streptococcus*.

Steps such as parasite quarantine, good water quality, reduction of fish density and early diagnosis can be used to prevent the parasite from entering culture facilities or building up in fish. The combined efforts of prevention and treatment not only reduce the direct damage by parasites, but also minimize fish mortality due to bacterial infection.

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