Aeromonas hydrophila

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Background

Aeromonads are ubiquitous, oxidase-positive, facultatively anaerobic, glucose-fermenting, Gram-negative bacteria that are native to aquatic environments (Hazen et al., 1978). They have been found in brackish, fresh, estuarine, marine, chlorinated and unchlorinated water supplies worldwide, with highest numbers obtained in the warmer months (Van der Kooj et al., 1988; Kaper et al., 1981; Hazen et al., 1978). Aeromonads have been isolated from diseased cold- and warm-blooded animals for over 100 years, and from humans since the early 1950s (Mathewson and Dupont, 1992).

Aeromonas hydrophila
• motile rod-shaped bacterium
• 0.3-1.0 um in diameter and 1.0-3.5 um in length
• no spore stage; usually unencapsulated
• optimum growth at 28 C, but growth observed at extremes (4 C and 37 C)

Scanning electron micrograph of Aeromonas hydrophila attached to a human intestinal epithelial cell line (photo courtesy of Northwest Fisheries Science Center, NOAA).

The ubiquitous nature of Aeromonas species in aquatic environments provides ample opportunity for animals, particularly fish and amphibians, to come into contact with, and to ingest organisms. Such contact may lead to infection which, depending on the species and the virulence of the strains encountered, may have life-threatening consequences.

Aeromonas hydrophila has been recovered from a wide-range of freshwater fish species worldwide, and occasionally from marine fish—e.g. ulcer disease of cod (Larsen and Jensen, 1977). However, conflicting views have been expressed over the precise role of A. hydrophila as a fish pathogen. Some researchers contend that the organism is only a secondary invader of previously weakened hosts, while others believe that A. hydrophila is a primary pathogen of freshwater fish (Eurell et al., 1978).
The Disease (in Fish)

*A. hydrophila* has been associated with several disease conditions in fish, including tail rot, fin rot, and haemorrhagic septicaemias. Haemorrhagic septicaemia is characterized by the presence of small surface lesions, often leading to sloughing off of the scales, haemorrhaging in the gills and anus, ulcers, abscesses, exophthalmia (bulging eyes), and abdominal swelling (dropsy)—often seen in European carp culture. Internally, there may be the presence of ascitic fluid in the peritoneal cavity, anaemia, and swelling of the kidney and liver (Miyazaki and Kaige, 1985). Another condition caused by *A. hydrophila*, known as red-fin disease, is characterized by the presence of surface haemorrhages and scale erosion.

![Eel (Anguilla japonica) with red-fin disease caused by Aeromonas hydrophila (photo courtesy of Dr. Teruo Miyazaki). During the 1960s, outbreaks of red-fin disease, caused by *A. hydrophila*, occurred frequently in cultured eels in Japan (Hoshina, 1962; Egusa, 1978).](image)

The etiologic agent is transmitted horizontally (between animals other than parents and offspring) but not vertically (from parent to offspring). The bacteria multiply inside the intestine, causing a haemorrhagic mucous-desquamative catarrh (excessive mucous secretion). Toxic metabolites of *A. hydrophila* are absorbed from the intestine and induce poisoning. Capillary haemorrhage occurs in the dermis of fins and trunk and in the submucosa of the stomach. Hepatic cells and epithelia of renal tubules show degeneration. Glomeruli are destroyed and the tissue becomes haemorrhagic, with exudates of serum and fibrin (Miyazaki and Jo, 1985; Miyazaki and Kage, 1985).

*Aeromonas* species produce many products that may be toxic to other cells. Some are released from viable cells in soluble form. Others may remain associated with the cell surface, and still others may be released upon cell death. Three of the extracellular proteins of *Aeromonas* species—that have been implicated in pathogenicity—have been cloned, sequenced, and characterized biochemically. These are aerolysin, GCAT (glycerophospholipid:cholesterol acyltransferase), and a serine protease (Howard and Buckley, 1986; Buckley et al., 1991; Rodriguez et al, 1992).

Outbreaks of disease are usually associated with a change in environmental conditions. Stressors, including overcrowding, high temperature, a sudden change of temperature, rough handling, transfer of fish, low dissolved oxygen, poor nutritional status, and fungal or parasitic infection, contribute to physiological changes and heighten susceptibility to infection.
Control and Treatment

Prevention in Aquaculture (adapted from Warren, 1991)

1. Avoid hatchery to hatchery transfers of fish. Fish gradually develop resistance to local strains of bacteria but may carry virulent organisms to another hatchery when transferred.

2. Provide optimal environmental conditions for the species being reared, paying special attention to the maintenance of oxygen levels and the gentle handling of fish.

3. Prophylactic treatments are helpful when sorting, handling, or moving broodstock. Intraperitoneal injections of 10–30 mg per pound of body weight of aqueous chloramphenicol has reduced post-handling losses by 80–90 percent in Europe.

Antibiotics or disinfectants should be added to the water as a prophylactic measure when fish are transported in tank trucks or plastic bags. Acriflavin at 2–4 ppm has been used in routine fish transportation operations.

Therapy

Chemotherapeutic agents are used for the treatment of *A. hydrophila* in fish farms. Isolates of *A. hydrophila* in fish have been found to be sensitive to chloramphenicol, florfenicol, tetracycline, sulphonamide, nitrofuran derivatives, and pyrodoinecarboxylic acids (Aoki and Egusa, 1971; Endo et al., 1973; Katae et al. 1979; Fukui et al. 1987). In hatchery operations, terramycin has been effective when incorporated into pelleted fish feed and fed at 3.5 grams of active drug per 100 pounds of fish per day for 10 days (Warren, 1991). [Note: Antibacterial therapy will provide only short-term relief if adverse environmental conditions such as high water temperatures, low water flows, low oxygen levels, or crowding are not promptly corrected].
The Disease (in Humans)

Bacteraemia (bacteria in the blood) is the most common pathogenic manifestation of Aeromonas in humans. Mild symptoms include fever and chills, but patients who become septic (overwhelming bacterial infection) with Aeromonas often exhibit abdominal pain, nausea, vomiting, and diarrhea.

Reports of Aeromonas wound infections have appeared increasingly in the literature. Unlike gastroenteritis, these infections can have fatal or serious debilitating outcomes, such as amputations. Aeromonas wounds fall into three categories, listed in order of increasing severity of damage caused: cellulitis, myonecrosis, and ecthyma gangrenosum.

Cellulitis, the most frequently encountered Aeromonas wound infection, is an acute inflammation of subcutaneous tissue characterized by redness and induration that may arise from injury or secondary to sepsis (Musher, 1980). Myonecrosis and ecthyma, the two less commonly seen types of Aeromonas infections, are typically found in patients that are immunocompromised. Myonecrosis, or bullous lesions, is characterized by the liquefaction of muscles with blackening of the tissue which may be gangrenous with gas formation. These patients require aggressive antimicrobial therapy and debridement; those individuals that fail to respond to these measures may require amputation (Haburchak, 1996). The third type, ecthyma gangrenosum, is a cutaneous necrotic or gangrenous pustule that occurs secondary to sepsis. Lesions have an erythematous border surrounding a vesicle which can progress to necrosis of the soft tissue within 24 h. This type of infection is usually fatal (Musher, 1980).

A. hydrophila infection (cellulitis of forearm) following puncture with fishing hook (photo courtesy of Dr. Haburchak)

Forearm showing bullous lesions as a result of A. hydrophila infection (photo courtesy of Dr. Haburchak)

Leg showing Ecthyma gangrenosum (photo courtesy of Medscape)
Outcomes such as these serve as a sobering reminder to properly attend to wounds with clean water and antiseptics. Never wash a wound with lake or river water!

*A. hydrophila* infections require prompt attention at the first sign of onset. Most infections are treated with fluoroquinolones. Alternative agents include aztreonam, trimethoprim-sulfamethoxazole, third-generation cephalosporins, and/or aminoglycosides (Mani et al., 1995).

**Links to Researchers Investigating *Aeromonas hydrophila***

- [Aquatic Vaccine Unit at the Stirling Institute of Aquaculture](#)
- [Northwest Fisheries Science Center, NOAA](#)
- [Dr. Sin Yoke Min, National University of Singapore](#)
References


