Infectious Salmon Anemia

Infectious salmon anemia (ISA) is a foreign disease of Atlantic salmon caused by an orthomyxovirus. This virus appears to cause disease only in Atlantic salmon, both wild and farmed (*Salmo salar*); however, other wild fish are also susceptible to infection, including sea run brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), and herring. ISA was first discovered in Norway in 1984. Since then, ISA has also been found in New Brunswick, Canada, in 1996; Nova Scotia in 1998; Scotland in 1998; Chile in 1999; Faroe Island in 2000; and the United States in 2001.

The ISA virus is an emerging viral pathogen. Based on biochemical, physical, chemical, and structural characterization, ISA virus is very similar to members of the "flu" family (influenza or orthomyxovirus family). Some basic flu virus family principles can be applied when trying to understand the ISA virus. The first general characteristic is that the ISA virus can mutate and evolve. The second is that the virus can change rapidly by recombination of ISA virus genetic elements. There is a significant molecular difference that exists between the "Norwegian," "Scottish," and "North American" ISA virus isolations.

Clinical signs

Clinical signs of ISA generally appear 2 to 4 weeks after the initial infection. Fish are most frequently affected after being in sea water for 1 year. Signs of the disease include but are not limited to:

- lethargy
- swelling and hemorrhaging in the kidney and other organs
- swelling of the spleen
- protruding eyes
- pale gills
- darkening of the posterior gut
- fluid in the body cavity
- severe anemia.

All parts of the fish are infected, the most prevalent being body fluids, especially blood and mucus, muscle, internal organs, trimming, and feces. The liver is identified as a primary target organ. Hematocrit values are extremely low due to hemolysis with an increase in white blood cells, similar to that of a fish under stress from being handled.

Mortality is highly variable and ranges from 2-50 percent over one production cycle and can affect an entire farm in a matter of months. The mortality depends on stocking density, sea lice (*Lepeophtheirus salmonis*) status, etc. Uninfected fish exposed to sea lice from carrier fish incurred high mortalities upon exposure. The variation in severity of the ISA disease depends upon, but is not limited to, virus strain, virus dose, method of exposure, fish strain and species, fish age class, and water temperature.

Identification of ISA Virus

Initially, positive identification of an isolated virus as ISA virus was possible only by indirect fluorescent antibody tests using a monoclonal antibody developed by Norwegian scientists. Subsequently, Norwegian investigators developed a reverse-transcriptase polymersase chain reaction (RT-PCR) assay for identification of the Norwegian ISA virus. Recently, two RT-PCR assays were developed using primer sets specific for two different ISA virus genes: the PB1 polymeraes gene and the NS gene. It has been demonstrated that these RT-PCR assays can be used to detect and identify the North American ISA virus strain in both cell cultures and in fish tissue homogenates. The protocols for these new PCR assays must be verified and the sensitivity of the assays determined.

Transmission

ISA can be transmitted and spread between and through wild and farmed fish populations and geographic areas from direct contact between infected and uninfected fish. Fish handlers and equipment contaminated with the ISA virus can introduce the disease to uninfected sites and fish. ISA is not zoonotic (i.e., virus does not have ability to replicate in mammalian tissue cells) and has no effect on humans. Sea lice appears to enhance transmission of the ISA virus from infected to susceptible fish. Salmon pens and facilities without adequate water intake treatment within three miles of an infected farm or processing plant have a risk up to 13 times higher of becoming infected with ISA.

Treatment and Prevention

There is currently no cure for the ISA virus. As a result, regulations based on general hygienic measures are being drafted in an effort to stop the spread of ISA. These include compulsory veterinary health control in smolt plants, mandatory health certification for each stage of life and on sale of fish, and regula-

tions concerning the transport of live fish and on slaughterhouses. Other requirements put into action include the disinfection of wastewater from salmonid processing plants, slaughter of fish upon detection of ISA, and disinfection of all infected biological material and equipment. Seawater in smolt farms and movement of fish already in net cages have been banned,and special ISA-virus-free farm site zones have been established. The disease occurs when smolt are transferred from freshwater to seawater. Movement of infected fish from netpens can serve as a vector that can transmit the virus and cause the disease. In an effort to eliminate the disease, demands have been made to slaughter all fish in net-pens showing increased mortalities because of ISA virus. Additionally, protective zones have been set up around infected aquaculture facilities. In many cases the disease can be stabilized so that no additional mortalities occur in the remaining fish in other pens in the facility. In a situation such as this, the fish can continue to be fed until they are slaughtered without the occurrence of serious outbreaks of clinical ISA.

For More Information

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