

Infectious Salmon Anaemia



Infectious Salmon Anaemia (ISA) is a viral disease affecting the Atlantic Salmon (*Salmo salar*), causing severe losses on fish farms in Norway, Scotland, Canada and Chile. The virus is called infectious salmon anaemia virus β (ISAV), belonging to the Isavirus genus in the Orthomyxoviridae family. It is a RNA virus causing severe anaemia of the infected fish. The virus infects the erythrocytes of the fish, and they develop pale gills, often swimming closer to the water surface gulping for air. It is obvious that the oxygen supply is insufficient, even though the fish may show no external signs of illness, still having normal appetite. This viral

disease can slowly progress through the infected farms, and in worst-case scenarios the death rate might approach 100%. I have chosen to focus on the consequences of this serious viral disease affecting the salmon farms along the Norwegian coastline.

The ISA virus was first observed in Atlantic salmon along the southwestern coast of Norway in 1984. In 1988 the disease had become severe and widespread enough to be declared a notifiable disease by the Norwegian Ministry of Agriculture, Fisheries and Food. During the following years the virus was observed in both Canada and Scotland as well. In Canada it was called "hemorrhagic kidney syndrome", and both Norwegian and Canadian scientists concluded that the same virus was responsible for both ISA and hemorrhagic kidney syndrome. Post-mortem examination of the fish shows that the liver and spleen may be swollen, congested or partially already dead. The circulatory system stops working, and dead blood cells contaminate the blood. There is an increased number of immature and damaged blood cells, and the red blood cells easily burst. The virus is attached to the red blood cells that will get a shorter lifetime, making the anaemia more severe. Cells from the spleen and kidneys may also die, most probably according to bad oxygen supply due to the lack of oxygen from the blood. It has been concluded that the ISA virus agglutinates the erythrocytes of salmon. After being incubated with the virus for 4 hours, the Atlantic salmon erythrocytes showed endocytosis of the virus particles, which is consistent with virus infection.

Transmission occurs by contact with infected fish or their secretion, as well as contact with people or equipment that have been in contact with the fish. As the virus can survive in seawater, it is not a big surprise that any infected fish farm serves as a major risk for the still uninfected farms in their proximity. The outbreaks of infectious salmon anaemia happen almost exclusively in Atlantic salmon in seawater farms. Usually the virus attacks one farm, spreading during weeks or months to neighboring breeding farms. Studies show that often less than half of the salmon in one breeding unit are infected, and the daily mortality is low, usually between 0,5 to 1 per thousand fish. However, in early summer and

winter time the mortality is slightly higher. In Norway, ISA is a so-called B group disease, meaning that there is an active program to fight against and prevent the virus from spreading. All farms having fish positive for the disease must slaughter all the fish belonging to the farm within 80 days, regardless if the rest of them are infected or not. Even though the control measures is a bigger strain for the industry than the disease itself, earlier experiences clearly show that without such control measures the problems will enhance towards a bigger threat against the whole industry itself. In Norway, the whole fish industry is a valuable trade that we cannot afford to lose. The Norwegian organization "Mattilsynet", which is responsible for food safety in Norway, administrates the fight against ISA in Norway.

The Atlantic salmon farming has in Norway been a rapidly growing industry since the beginning of the 1970s, producing 582 000 tons of fish with a first hand value of \$1.8 billion in 2005. Norway is definitely a leading producer of Atlantic salmon. The ISA virus has, since its first outbreak in 1984, caused large economic damage in the salmon farming industry. Since eradication of ISAV has not been a success so far, it is extremely important to identify the factors affecting the transmission of the ISA virus. Epidemiological studies conducted in Norway identified proximity to other farm sites with ISA outbreaks as a significant risk factor. Seawater constitutes a major pathway for the transmission of ISAV. In Norway it is quite common that different farm sites share common ownership. Shared staff and boats, often from a shared wharf, enhancing the risk of transmission of the virus if one farm unit is affected, often operate the different farm sites. Epidemiological studies have identified a number of risk factors related to the management and husbandry, including shared staff between the farm sites, divers visiting multiple farm sites, low frequencies of dead fish removal and treatment against sea lice. All of this is important to take into consideration when trying to fight the ISA virus and prevent it from spreading.

Early diagnostics and detection of the illness is extremely important in order to prevent huge losses. The observation of the behavior of the fish and the mortality rate make the foundation in detecting the virus. The first line of defense is made

up by the general hygienic measures against infection, while the second line of defense consists of the rapid diagnostics. When looking for changes according to the ISA virus, the characteristic black liver is often a trademark, even though it is not present in all cases. However, the thin, anaemic blood is much more reliable, which is constantly found in all infected salmons. Together with circulatory disorders, the serious anaemia is a certain indication on ISA.

Immunohistochemistry from cells affected by the virus show a characteristic red colour, and the diagnosis is assured by several other viral tests like IFAT, RT-PCR and cell culturing. Other very characteristic clinical signs of this viral infestation are signs of exophthalmia, pale gills, enlarged liver, congestion of gut, ascites, and petechial hemorrhages in visceral organs.

To sum up, it is extremely important to take the ISA virus seriously to prevent it from spreading. As it is such a big industry here in Norway, and the consequences of the losses can be really extensive, it is best to avoid it as far as is possible.

Once it has infected a farm, it is much harder to get rid of the virus than trying to prevent it in the first place.

References:

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