Exposing the secrets of costly viruses

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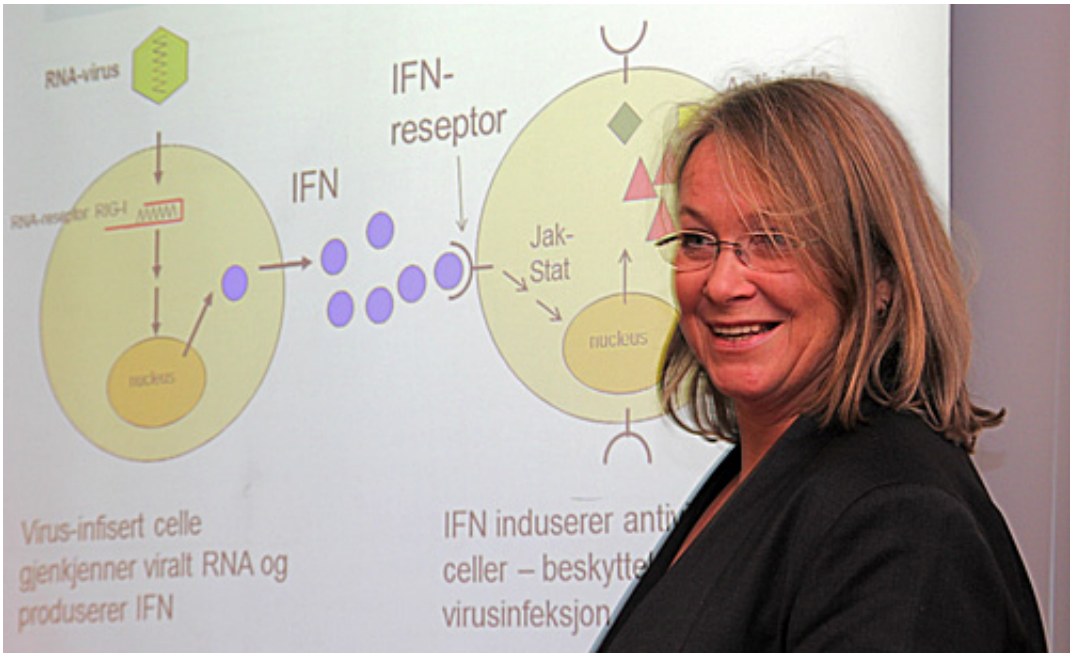

"Using the knowledge we now have about the salmon immune system and ISAV infection strategies, we can customise vaccines to produce the most effective immune mechanisms," explains Siri Mjaaland. Credit: Torkil Marsdal Hanssen

Researchers are making headway in discovering how two harmful viruses – ISAV and IPNV – sidestep the salmon immune system. Effective viral vaccines are now in sight.

Viral diseases continue to plague Norwegian aquaculture. Current vaccines are either non-existent or mostly ineffective because not enough is known about how salmon react to viral infections. The

Research Council of Norway's Platform for Viral Aquamedicine has filled many of these knowledge gaps and has revived hopes for effective viral vaccines for the fish farming industry.

For the past five years, Siri Mjaaland has been coordinating the basic research activities of four Norwegian specialist environments; together the groups have enhanced the understanding of how viruses – particularly the infectious salmon anaemia virus (ISAV) and infectious pancreatic necrosis virus (IPNV) – bypass the salmon's innate immune system. The researchers are also studying which immune responses may protect the fish from these viruses.

Secret uncovered

In order to maximise the effectiveness of a future viral vaccine, it is critical to identify how the salmon immune system works.

The innate immune system of salmon also develops immune responses to be deployed later in life. Interferons (host-cell proteins that combat pathogens) play a pivotal part in the salmon's innate immune system. Børre Robertsen's research team succeeded in cloning all the interferons found in salmon in order to discover each one's role in fighting viral infection. Unni Grimholt of the University of Oslo has identified unique aspects of acquired immunity in salmon.

Just as important to this vaccine research has been solving the longstanding mystery of how these viruses manage to avoid interferon attack, the first line of defence in salmon. Jorunn Jørgensen's research team has focused primarily on the IPNV, while Dr Mjaaland's team concentrated on the ISAV.

"Using the knowledge we now have about the salmon immune system and ISAV infection strategies," explains Siri Mjaaland, "we can

customise vaccines to produce the most effective immune mechanisms. We know the basics of how to design the ISAV vaccine, but there are still many challenges remaining before an effective vaccine will be commercially available."

Customisable vaccine

The ISAV vaccine design for salmon is based on dramatic research findings from the University of Oslo and uses the same principles considered promising for future human vaccines.

The principle of vaccibodies makes it possible to customise vaccine molecules depending on the virus to be combatted and the immune response to be triggered. Simply put, a vaccibody is something like a triple CD cover with room for a chain of three types of genes, each of which has an important function in the immune system.

The first unit of a vaccibody is the targeting gene, which determines where in the immune system the vaccine will go. The second unit acts as a hinge that binds with the first unit and with the vaccibody's third, antigenic unit, which determines which virus the fish is being vaccinated against.

"The antigenic unit makes up only a small portion of a virus – in this case, the ISAV or IPNV," continues Dr Mjaaland. "The targeting gene has to be identified and cloned from salmon."

The research group at the University of Oslo is headed by Unni Grimholt and collaborated with Dr Mjaaland's team on identifying the targeting gene.

"So far the vaccibody has only been tested experimentally on mice," says Dr Mjaaland, "but we are confident that the principle will work on fish

as well."

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