UMaine Researchers to Develop Enhanced Fish Vaccines with Nanocellulose

2021-08-23

In an effort to support Maine and the nation's growing finfish aquaculture industry, University of Maine scientists seek to develop more effective, safe, sustainable and affordable fish vaccines using nanocellulose produced from Maine's renewable wood pulp industry.

The U.S. Department of Agriculture's National Institute of Food and Agriculture (NIFA) awarded a team of UMaine aquaculture and engineering experts $495,000 to investigate if novel nanocellulose vaccines protect Atlantic salmon against lethal pathogens. The project will target vaccine development to combat Infectious Salmon Anemia Virus and Vibrio ordalii, two globally significant Atlantic salmon pathogens. Researchers hope this project will lay the groundwork for using nanocellulose in future vaccine formulations to protect against many other types of diseases impacting aquaculture and agriculture.

UMaine researchers say injectable vaccines are presently the most effective form for protecting aquacultured fish species, but current vaccines made with adjuvants that are water and oil based are expensive to make and can cause undesired side effects resulting in decreased growth rates and adhesions and pigmentation around the injection site.

Nanocellulose is a biologically derived natural polymer found in the cell walls of wood and plants and may offer several benefits as a vaccine component. Nanocellulose is considered to be biocompatible, meaning it has no known harmful effects to tissue and is unlikely to cause cellular damage. Vaccines developed with nanocellulose may also be less expensive to manufacture than their oil-based counterparts, researchers say. Its chemical properties allow it to be easily modified and could help increase the effectiveness and longevity of the vaccine without the associated undesired side effects of traditional fish vaccine adjuvants, according to UMaine researchers.

“Nanocellulose could potentially be a sustainable option for aquatic animal vaccines providing an economic solution for managing disease in commercially important species,” says project lead Deborah Bouchard, director of the Aquaculture Research Institute (ARI) at UMaine.

Disease among fish stocks can be costly for finfish producers, with the Food and Agriculture Organization of the United Nations reporting in 2018 that the global aquaculture industry loses more than $6 billion per year to outbreaks. As the aquaculture industry grows, so does the risk of disease, UMaine researchers say, prompting the demand for more effective and less expensive vaccines.

Infectious Salmon Anemia Virus causes Infectious Salmon Anemia, which can kill up to 90% of a producer’s Atlantic salmon during an outbreak, according to researchers. Annually occurring outbreaks of Infectious Salmon Anemia have cost producers millions of dollars. Vibrio ordalii causes vibriosis, which can also cause 90% mortality in salmon farms and cost the global aquaculture industry more than $1 billion in losses each year, researchers say.

“The market demand for Atlantic salmon continues to rise. The future sustainability of the Atlantic salmon aquaculture industry will rely on our ability to maintain healthy cultured populations and effective vaccines are a critical tool for achieving this,” says Bouchard, also division lead for University of Maine Cooperative Extension Diagnostic and Research Laboratory’s Aquatic Animal Health Lab.

Bouchard will be joined by other researchers from the Aquaculture Research Institute (ARI) and UMaine Chemical and Biomedical Engineering Department to develop the nanocellulose vaccines. They include Michael Mason, professor of chemical and biomedical engineering, Ian Bricknell, a professor of aquaculture biology, and Sarah Turner, a research professional with UMaine Extension’s Aquatic Animal Health lab.

The team will prepare and characterize nanocellulose vaccine formulations, examine the antibody response of Atlantic salmon with the new vaccines and evaluate their effectiveness against the Infectious Salmon Anemia Virus and Vibrio ordalii pathogens, particularly in

comparison to commercially available vaccines.

Researchers will conduct their work at the wet and dry labs at the UMaine Extension Diagnostic and Research Laboratory in Orono, at Mason's wet chemistry and spectroscopy and imaging labs, and at the Forest Bioproducts Research Institute's Process Development Center in Jenness Hall.

"This research capitalizes upon strengths of the University of Maine's research expertise, facilities, and industry partnerships in two complementary areas: aquaculture/fish health and cellulose nanomaterial science and engineering" says Bouchard.

Read the original article on University of Maine.