Protecting Fish Through Vaccines

Just as humans need vaccines to prevent dangerous diseases like polio and measles, fish too can benefit from vaccines against their own set of diseases.

Several researchers at the ARS Aquatic Animal Health Research Unit in Auburn, Alabama—along with one from their laboratory in Chestertown, Maryland—are working mainly with catfish and to a lesser extent with tilapia, hybrid striped bass, and several other species of fish, to develop fish vaccines to protect against diseases. Many of the diseases kill the fish, which means less profit for the producer and higher prices for consumers.

Over the last few years, the laboratory has either patented or applied for patents for several fish vaccines. "It takes about 2 to 4 years of research to get to the point where we can apply for a patent," explains microbiologist Craig A. Shoemaker. He's helped to develop several vaccines in Auburn.

After the vaccine is patented, ARS will license it to a company. Because of the additional testing required by regulatory agencies, it might take another 5 years or more to get the vaccine on the market. Shoemaker says that to cut down on this time, the researchers will often work with companies early on to develop and test the vaccines.

In June 2004, the lab submitted a patent application for a modified live vaccine (meaning the fish are subjected to live bacteria) against *Flavobacterium columnare*. This bacteria causes columnaris disease, which affects many varieties of fish—everything from catfish to goldfish—and thus has a large economic impact. It's the second leading cause of death for catfish. The researchers believe fish producers will save $100 million a year with this vaccine. Currently, fish producers treating for columnaris either apply chemicals to the water or give the fish special food, but this vaccine—given through a bath—is much more effective.

At the laboratory, molecular biologist Joel A. Bader has also applied for a patent for a modified live *F. columnare* vaccine against columnaris disease. The two vaccines were developed independently of each other. "Both vaccines are effective against the disease but work in different ways," Bader says.

Bader's vaccine was modified to prevent the bacteria from attaching to the fish, yet will allow the bacteria to live long enough for the fish to become protected.

While some fish vaccines are injected—just like many human vaccines are—researchers are trying to move away from that, since it's not efficient to hand vaccinate thousands of fish. With either of these two *Flavobacterium* vaccines, both given as a bath at an early age, hundreds of thousands of fish can be vaccinated in as little as 10 minutes. When the fish are moved from a farm to the producer's pond, they'll be protected.

The researchers have also worked on vaccines to fight two strains of *Streptococcus* bacteria, a worldwide disease problem. Antibiotics do not work well against these bacteria. For *Streptococcus iniae,* a disease found in 22 species of cultured and wild fish such as tilapia and rainbow trout, the scientists have developed a successful killed vaccine. "We've found that it's more effective when given by injection," says microbiologist and research leader Phillip H. Klesius. "It's time consuming, but doable." The group received a patent for this vaccine in 2002.

The scientists also developed a killed vaccine for *Streptococcus agalactiae,* a similar bacterium. Klesius believes an immersion vaccine may be possible in the future. This disease can also infect humans and cattle.

The group is working with the Canadian company PerOs Systems Technologies to develop an oral delivery method for killed

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Microbiologist Phillip Klesius gives catfish feed that has been supplemented with vaccine at the Aquatic Animal Health Research Unit in Auburn, Alabama.

vaccines. Initial tests have been positive. An oral vaccine would likely be cheaper and easier to administer than an injection or immersion vaccine.

A lot of work for several of these vaccines was done by ARS aquatic pathologist Joyce J. Evans in Chestertown, Maryland. She says her laboratory is more for conducting vaccine trials on the fish rather than manufacturing the vaccines, since it's a smaller facility. The lab focuses on tilapia.

Evans has also helped to develop a modified live *Edwardsiella tarda* vaccine. Like the other bacteria, this one infects many species of fish. The disease is not just costly; it's also a nuisance. If a producer detects the bacterium, processing lines need to be shut down and disinfected. The disease can also be passed on to humans. Up to this point, some producers use medicated feed to stop the disease from spreading, but it's not very effective. The new vaccine could save producers millions of dollars each year.—By **David Elstein,** formerly with ARS.

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At the Aquatic Animal Health Research Unit's Chestertown, Maryland, site, veterinary medical officer David Pasnik weighs and measures a tilapia fish while aquatic pathologist Joyce Evans injects another one with a vaccine.