Mere 'Science Fiction' Now, New Poultry Vaccine Research Proceeds

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The development of vaccines prove a challenge, even for some of the less challenging, more commonly known, less changeable form of poultry diseases such as pullorum and Newcastle.

Some vaccines, Donahoe said, can be made out of bacteria or viruses. For vaccines made from viruses, the key to making them work is to create antibodies which coat the virus, to prevent it from dividing, and rendering it harmless to the bird by preventing it from replicating. The virus is transferred through the air and enters the bird's upper respiratory passage. There, the virus can be taken into the body by swallowing, which spreads through the reproductive and gastrointestinal system.

Eventually, the virus can escape into the bloodstream, known as "viremia," said Donahoe. The virus goes into the liver and spleen, and this is when the bird can show early signs of disease — it goes off feed, it doesn't drink the water, and it becomes "quieter," Donahoe said.

When viremia occurs, the bird mounts a large immune response. At this time, clinical signs develop, including swelling eye tissues, the bird is off feed, egg production down, and there are any number of "economic parameters" that show the producer the bird is infected, he noted.

A live virus vaccination allows the bird to develop the large immune response quickly, though the virus can't replicate.

But the response is a shorter period of time (only eight weeks, if dealing with influenza) compared to 25 weeks for the killed vaccine. The killed vaccines use water-in-oil emulsions along with the chemically killed, inactive virus. The killed vaccine continues to generate a very high immune response in the bird, Donahoe noted.

Donahoe reviewed the early history of developing vaccines, which began in southeastern Pennsylvania and New Jersey in the late 1800s. In 1971, one groundbreaking event occurred — the first license against cancer, for Marek's Disease, was obtained. An IBD vaccine was obtained in 1980, and new companies and new products have continue to proliferate in the decades since.

Now, the industry has to deal with mergers and acquisitions on almost a weekly basis, with technology being traded and transferred. And companies are developing vaccines in a wide variety of ways. The use of biologicals, now at 15 percent of the share, are growing. "Biologics are on the rise," said Donahoe.

Possibilities for future vaccines were discussed Monday by Dr. John P. Donahoe, president of Maine Biological Laboratories, Waterville, Maine, left. Donahoe spoke to about 30 poultry producers and agri-industry representatives at the Poultry Health and Management Seminar at Kreider's Restaurant near Manheim. At right is John Schwartz, Lancaster County extension director.

In the past, 11 companies were making vaccines. Now it's down to eight. Some are "casualties" of mergers, and they will continue, Donahoe said. "There are rumors about every one of them right now."

Donahoe outlined several major developments in the forefront of vaccination development:

• Recombinant DNA vaccines. The technology focuses in on what genes are "bad" in live viruses and takes them out. This includes engineering the genes to add antigens to more formidably tackle Newcastle and bronchitis. "Other recombinant vaccines are coming," he said.

• Competitive exclusion for biologicals. Using other, less threatening bacteria can block the attachments of salmonella and more threatening bacteria. Duration and delivery of the bacteria is a problem today, a "goal for researchers to improve on," Donahoe said.

• Vaccines that can address the food safety issues that are consuming the industry, in light of salmonella and e. coli outbreaks. A lot more work needs to be done on producing live and killed salmonella vaccines. But early research has not been good for campylobacter control, noted Donahoe.

• In ovo vaccines, which involve highly sophisticated equipment. Vaccines for Malik's and IBD could be licensed in ovo, and many more are under development.

• DNA vaccines. Instead of shooting the entire virus into the bird, take the gene for the antigen and inoculate the bird. The gene could be carefully coated for and correctly implanted in the bird, with no risk of developing the disease or fear of endotixins. "But this technology is a long way off," he said. "It's science fiction today."

Many immunosuppressive diseases — which cause the bird's natural immunities to be jeopardized — includes bursal, Marek's, chicken anemia, leukosis, and others. The immunosuppression is permanent — which makes other pathogens a lot worse to the bird.

• Retroviruses and others, including J leukosis, where eradication is needed. Vaccines will be difficult to develop because of the changeability of the virus. "Don't look for it anytime soon," Donahoe said.

• Protozoan vaccines. Vaccines for coccidiosis and other diseases are becoming important because the standard drugs are disappearing from use. Availability will be determined on economic viability, including safety, cross-protection, and low cost to develop and use.

• Antibody therapy. The idea "once held great promise," said Donahoe. But how to administer them and not cause allergic reactions? There could be a way to blend the treatment with other health measures for the bird, including feed.

• Adjuvants and immune modulation. Researchers are looking for a way to generate a fast, long-lasting immune response with a reasonable antigen load.

• Cross-protection, developing vaccines that can handle so many different strains of infection, such as bronchitis, coccidiosis, influenza, bursal disease, and others. Researchers must find a way to develop a cross-protective antigen. All the labs are working on it, he noted.

• Vaccines for emerging diseases. Exotic diseases and diseases never present before in poultry will develop over time and companies must be prepared.

• Mucosal immunity. Finding ways to line the gut and reproductive tract with strong mucosal immunity, a good local cell-mediated immunity, will take more research. The use of antibodies in the digestive tract can be useful to controlling harmful bacteria, but the material must be present on a constant basis. Work to apply human research in this area can help.

• Gene insertion. Take the gene dominant for Newcastle, for instance, and put it in chicken's genes. This gene insertion technique "sounds good in theory," said Donahoe, but there are problems. It must be near some type of "regulator" that can allow the gene to be "turned off and turned on later," he said. The gene must be turned on when the chick can handle it correctly.

"This is big-time science fiction," he said. "We're a long way from it, but we're working on it."

In the U.S., food safety is a high priority because of life- threatening outbreaks of diseases such as salmonella. But in other countries, salmonella has little if no priority, because it doesn't cause problems with the chickens themselves.

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