Recombinant Vaccines for Poultry: An Overview of the Basics

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An application with the United States Patent and Trademark Office (USPTO) for one of the first recombinant vaccines for use in poultry was filed in 1985 under the trademark Vectorvax™, by Syntro Animal Health, Inc. This vaccine, vectored in Avipoxvirus and expressing an immunogenic protein of Newcastle disease virus, became a trademark later owned by Schering Plough Animal Health Corporation, but was never used in a commercial setting. After a long hiatus, Ceva-Biomune introduced the first commercially produced Fowlpox-vectored recombinant vaccine against infectious laryngotracheitis (ILT) (rFP-LT) in or around 2006. Approximately a year later, Merck Sharpe and Dohme (MSD or Merck) introduced its first Meleagrid Herpesvirus 1 (MeHV-1, rHVT)-vectored vaccine (rHVT-LT) against ILT. Both vaccines were not originally intended for use in broiler chickens, but an industry fatigued of the inconveniences derived from the mass application of chicken embryo origin (CEO) ILT vaccines, quickly embraced rather successfully the use of in ovo vaccinations for broiler chickens with either the FP-LT or the HVT-LT vaccine, and in some cases, with both vaccines as it has been done in commercial layer pullets in some areas. In approximately 2008, the Brazilian industry began the intensive use of recombinant rHVT-IBD vaccines, a practice that was later expanded to dozens of countries. In many cases, the use of live attenuated vaccines against IBDV was replaced partially or completely in commercial layer pullets. Billions or broiler chickens would eventually receive a dose of rHVT-IBD alone or in combination with a live attenuated IBD vaccine.

These events marked the beginning of an era of fast growth in the use of recombinant vaccines by the poultry industry worldwide. The biologicals industry quickly responded with a renewed interest and commitment for the development of further recombinant vaccines, including rHVT-IBD, rFP-MG, and several additional vaccines. The list of recombinant vaccines available to the poultry industry continues to grow, and there is also a growing number of vaccine companies entering the recombinant vaccine business. Although Fowlpox virus has proven to be an excellent vector expressing immunogenic proteins against ILT, NDV, MG, and AIV, HVT is probably the most used vector today for the construction of recombinant vaccines. Other viruses such as Newcastle disease virus (NDV) are used as vectors for commercially produced vaccines against H5 and H7 subtypes of avian influenza in other countries. NDV has also been used experimentally as a vector to produce constructs expressing immunogenic proteins against at least infectious bronchitis, infectious laryngotracheitis, and Marek's disease viruses. Today there are multiple commercially produced recombinant vaccines intended to protect chickens against the vectors involved (HVT, FP, and NDV), and against disease agents represented in the form of immunogenic proteins expressed by the vector viruses (NDV, IBDV, ILTV, MG, AIV-H5, and AIV-H7).

Little is known about the immune responses generated by recombinant vaccines against the foreign proteins expressed by the vectors. However, there is a growing body of knowledge derived from academic research. We are starting to gain insight on the genes that are

upregulated and downregulated upon vaccination with some recombinant vaccines. We have also gained some knowledge and understanding of the cell types participating in cellular immune responses against some recombinant vaccines and their foreign proteins. This type of research will be crucial for possible modulation of the immune response against recombinant products in the future, and to overcome at least partially some of the disadvantages of recombinant vaccines.

Some of these disadvantages include (not exclusively), a relatively late onset of protection, inability to prevent field infection and virus excretion, and perhaps a relatively short duration of immunity in some cases. An additional challenge is represented by difficulties in validating the quality of vaccination itself, and assessment of immune responses against vaccination with recombinant products, since there seems to be some limitation for the proper evaluation of immune responses such as serology.

On the other hand, recombinant vaccines are convenient, easy to apply in the hatchery under better control and hygiene than in the field, are safe and effective, and lack the proclivity that some attenuated vaccines have for reversion to virulence, recombinations, and adverse vaccine reactions. Whether the recombinant vaccines are vectored in Fowlpox virus, Newcastle disease virus, or Meleagrid herpesvirus 1, they have already made very positive contributions for disease control in many countries and will continue to be a very useful tool for disease prevention and control worldwide.