How can ELISA monitoring for titers improve your vaccination results?

by Dr Bart van Leerdam,

The use of ELISA serology in poultry health management has been widely accepted as a useful tool to monitor the immune response following vaccination. However, the veterinarian is often left with little or no practical guidelines for the interpretation of ELISA results following vaccinations. Practical questions like “What level of titers and which coefficient of variation (CV) can I expect after vaccination?” and “Can I differentiate between good vaccination and poor vaccination using the ELISA?” and “What are protective titers after vaccination?” are often left unanswered.

This article highlights the use and interpretation of ELISA results following vaccination, and how serology can help in improving the effectiveness of vaccine application. Where possible, serological results from field case histories are discussed.

Justification of ELISA

Disease problems sometimes occur even in vaccinated birds. Is this due to the quality of the vaccine?

Maybe, but more often, vaccine breaks occur because of poor vaccine handling and/or poor vaccine application. Particularly, when dealing with live vaccination against respiratory diseases, like IBV and NDV, evaluating the success of vaccination is important.

This is because successful vaccination is not always imminent, as it is difficult to deliver an effective dose to 100% of the birds when using mass application techniques (drinking water and spray applications).

Furthermore, monitoring vaccination responses help to detect and diagnose vaccine failures, and will allow one to take corrective actions when vaccination has failed.

In this way, vaccination monitoring should be seen as a quality control of the performed vaccinations in the field.

This brings us to a very important point, when conducting ELISA monitoring; one has to be prepared to take proper action on results. Without taking action on results, one cannot expect to improve, optimise and maintain the efficiency of vaccination programs.

Interpretation of results

To be able to successfully interpret ELISA results after serological monitoring of vaccinated flocks, one has to meet the following conditions:

- One must use external reference controls in the laboratory in order to give added assurance on the reproducibility and accuracy of results and allow for correct interpretation of results. Without reference controls one cannot know if abnormal titers, are the result of erroneous test procedures, or an actual reflection of the immune status of birds in the field.
- One must know what result to expect prior to testing (set baselines for successful vaccination and interpret results by comparing obtained results with these baselines).
- One must know what action to take if the results are not as expected.

The actual interpretation of vaccination results is usually done by evaluating the three main key components of an antibody response following vaccination, which are:

- Intensity of the response, as indicated by the mean titer. Do the birds develop titers levels in the expected range for the vaccine used? (=baseline titers).
- Uniformity of response, as indicated by the %CV. Is the vaccine actually getting to all the birds or not? Is the %CV within the required range or is there room for improvement?
- The general guideline for %CV following vaccination is shown in Table 1.

Although these are general guidelines applicable to most live and inactivated vaccine applications, one should keep in mind that application with live vaccines against respiratory disease like IBV and NDV, generate in general variable titer responses.

The spread of respiratory live vaccines among flocks is often limited, and live respiratory vaccines also give a local immunity response, that cannot be measured in ELISA.

So, when one vaccinates with live respiratory vaccines, the expected level of antibodies at the moment of vaccination results is usually done by evaluating the three main key components of an antibody response following vaccination, which are:

- Intensity of the response, as indicated by the mean titer. Do the birds develop titers levels in the expected range for the vaccine used? (=baseline titers).
- Uniformity of response, as indicated by the %CV. Is the vaccine actually getting to all the birds or not? Is the %CV within the required range or is there room for improvement?
- The general guideline for %CV following vaccination is shown in Table 1.
Success or failure?

Indicators of successful vaccination are generally high, uniform and lasting titers that are within the expected range for the type of vaccine. These samples should be 100% positive. Indicators of a poor vaccination result is generally the opposite; i.e., titers lower than expected, non-uniform, and non-persistent. These ‘below the baseline’ titers are usually associated with moderate to high % of negatives.

For some vaccinations, such as AE and CAV, % seroconversion is the only meaningful indicator of success. For instance for AE, if >60-80% test positive after vaccination, vaccination is considered to be successful and re-vaccination is no longer required. The role of IBV monitoring at fixed intervals in layers and breeders is particularly useful for the early detection of failed vaccinations.

Immediate revaccination, after detection of vaccine failure, will consequently help in the prevention of production losses, due to bad handling and/or application errors.

Thus vaccination monitoring has a preventative nature, which is an important economic justification for the use of monitoring programs.

Protective titers or not?

Although the correlation between ELISA titers and protection in challenging trials has been demonstrated for some diseases like NDV and IBD, one has to be very careful when it comes to making predictions on protective titers.

This is in the first place because the degree of protection depends on many variables such as, the vaccine strains used, the virulence of involved field challenge strains, type of bird, vaccination application method and schedule, and local variables such as temperature or feed quality.

A protective ELISA titer of 4000 for NDV for one farm, may not protect birds on the farm next door. One needs to obtain protective titer values, by testing flocks under their own local conditions.

Another reason why one has to be careful in correlating titers with degree of protection is, that for many bacteria (i.e. PM) and mycoplasmas (i.e. MG and MS), immunity is not antibody mediated and antibodies are produced as by-products.

Therefore, titers will not directly indicate immune status. Also titers of some viruses, i.e. fowl pox and ILT, do not reflect immune status. However, ELISA titers of these diseases can be still very useful to monitor success of vaccination.

Conclusions

Poor administration and/or vaccination techniques are the most common cause of vaccine failure in poultry. Results have demonstrated that ELISA monitoring is useful for finding out if a vaccine has been correctly applied or not.

If results are poor, it allows you to re-evaluate your vaccination procedures to find out what went wrong and take corrective action.

In this way, regular vaccination monitoring should improve the effectiveness of vaccine application and, in turn, improve disease control and economic performance of poultry flocks.

Case history: Inactivated vaccination of broiler breeders

Broiler breeder flocks were vaccinated at 18 weeks with inactivated ND+IB+IBD vaccine. ELISA results at 39 weeks revealed some major differences between flocks. Throughout most of the year, the ELISA results were good, until during the summer holiday when the results began to show suddenly very poor and non-uniform titers.

Further investigation revealed that during the summer holiday the regular vaccination crew was replaced by a temporary vaccination crew, which explained the poor quality of vaccination during summer holidays. The flocks vaccinated by the regular vaccination crew had high and uniform (CV < 40%) titers, whereas other flocks vaccinated by a temporary holiday crew, revealed very poor and non-uniform (CV > 65%) titers. The results are shown below.