Use and economics of ELISA in the prevention of disease

The use of Enzyme-Linked Immuno Sorbent Assay (ELISA) testing in broilers is widely accepted. Basically, this serological test is used in different ways.

A lot of viral as well as bacterial pathogens will create an antibody response in chickens after challenge. By measuring the antibody response, ELISA can be a good method to come to the correct diagnosis of the disease challenge the birds are facing.

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For certain types of birds and/or certain pathogens it is not as much the antibodies you want to detect, but the lack of presence of these antibodies. ELISA can be a very useful tool in screening and monitoring for absence of disease challenge. A good example is Mycoplasma gallisepticum.

For a lot of pathogens birds are being vaccinated. Also vaccines will evoke a certain antibody response. 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 you 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, you cannot expect to improve, optimise and maintain the efficiency of vaccination programs. Therefore you need to have in mind that building the right monitoring program for your type of operation is not the end of the process.

The next step in the process is interpretation. Although this is easy when monitoring for absence of disease, interpretation can be more difficult for example when evaluating vaccination responses. Building your own baselines based on the vaccination program used and the local disease challenge is key. But often underestimated is that the right way of analysing and processing results as well as getting these results to the right people quick and accurate is at least as important. This can only be achieved, when the software built around the ELISA test is capable of doing this.

Setting up a good monitoring program for your operation depends on the type of bird you are designing it for, but local disease challenges as well as governmental and export regulations need to be taken into account too. And the financial benefit of your monitoring program has to outweigh the investment done.

The next examples shown are actual field cases where calculations have been made based upon market prices prevailing in that specific area at the moment.

Age (days)	IBD	NDV	IBV	REO
1-6	✔	✔	✔	✔
45	✔	✔	✔	✔

Table 1. A basic monitoring program.

Broilers

The benefit of monitoring broilers is often underestimated. The main goal is to help decrease production costs of broilers by lowering mortality and condemnation rates and improving feed conversion as well as meat quality at processing.

Practical applications can be quality control check of day-old chicks, vaccination date prediction for Infectious Bursal Disease (IBD), vaccination response check, measuring change of disease pressure and/or early detection and diagnosis of disease.

The next two examples are cases from the field that show the value monitoring in broilers could bring you. The costs were calculated based upon a basic monitoring program as described in Table 1.

Per 10 million broilers assuming 20% of the flocks will be tested, the cost of monitoring is €0.002 per bird based upon 30,000 birds per house. Per sample moment, a total of 23 samples are taken.

- **Case 1**

A broiler farm (half million broilers per month) suffered during a four month production period from respiratory clinical symptoms and loss of performance (increased FCR, condemnation rate, and mortality).

The normal production parameters per house of 30,000 birds is as follows:

- Birds grown to 2.2kg live weight.
- FCR 1.8.
- Feed cost €370 per tonne.
- Broiler LW price €1.20/kg.
- Condemnation rate 0.5%.
- Mortality rate 3%.

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Fig. 1. BioChek ELISA assay showing a mixed IBV infection on a broiler farm. *Assay: IBV, Lot FS 4712, Bleeding date: 06/02/08, Test date: 07/02/08.*

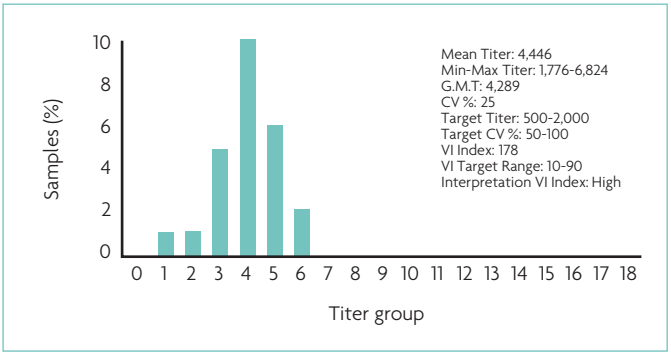
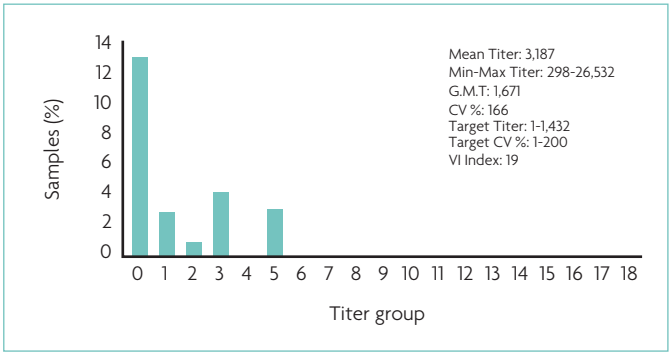


Fig. 2. BioChek ELISA assay showing an ORT infection on a broiler farm. *Assay: O.r, Lot FS 4701, Bleeding date: 06/02/08, Test date: 07/02/08.*



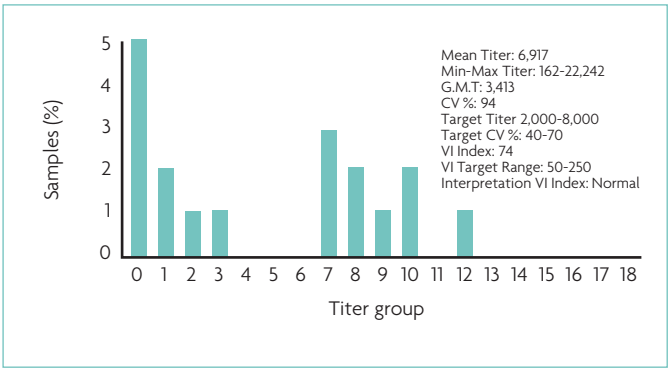


Fig. 3. BioChek ELISA assay.
Assay: NDV, Lot FS 4829, Bleeding date: 22/04/09, Test date: 15/05/10.

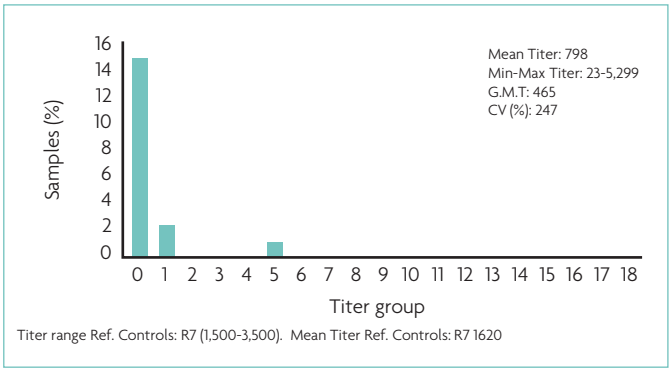


Fig. 4. BioChek ELISA assays.
Assay: ILT, Lot FS 4858, Bleeding date: 22/04/09, Test date: 15/05/10

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After four months of persisting problems, blood samples were taken and analysed for different diseases.

ELISA analysis showed the affected houses on the farm to suffer from a mixed IBV and ORT infection (Figs. 1 and 2 respectively).

The standard vaccination program for this farm was a two time Mass vaccination day old and around three weeks. Because ORT is often a secondary infection, first action based on these results, was to include a IBV variant vaccine in the program. Here it solved the problem. Per 30,000 birds the financial losses due to live weight reduction of 200g were €7,200.

Increased FCR from 1.80 to 1.90 increased the feed costs with €2,400 and the increased condemnation rate from 0.2% to 2% and rise in mortality up to 11% brought additional losses of €1,426 and €6,336 respectively.

This brings the total losses of this mixed IBV and ORT infection to a total of €17,362 or €0.58 per bird. If vaccine monitoring had been implemented (€0.002 per bird) and corrective actions in the form of including an IB variant strain in the program next to the Massachusetts vaccination taken place from the beginning (€0.014 per bird), the extra costs would have been €0.016 per bird, thus saving €0.56 per bird.

This represents a 35-fold return on investment.

Case 2

A broiler farm (a million broilers per month) suffered for over six months production period from respiratory clinical symptoms and loss of performance (increased FCR, condemnation rate, and mortality).

Based upon the clinical picture and a one-time NDV ELISA result (Fig. 3) that was misinterpreted as field infection instead of rolling vaccine reaction, the infection was misdiagnosed as Newcastle disease (NDV).

Implementation of an alternative vaccination program including additional ND vaccinations did not have any effect. ELISA testing showed normal NDV serology, but abnormal positive serology for ILT (Fig. 3).

One or more positives in the BioChek ILT ELISA in non-vaccinated flocks is suspicious for infection. ILT diagnosis was confirmed by subsequent PCR and histology testing.

Increased FCR from 1.80 to 2.05 increased the feed costs with €6,000 and the increased condemnation rate from 0.2% to 3.0% plus rise in mortality up to 6% brought additional losses of €2,218 and €2,376 respectively.

This brings the total losses per flock of 30,000 birds to €10,534 or €0.35 per bird.

If vaccine monitoring had been implemented (€0.002 per bird), misdiagnosis would have been prevented and ILT diagnosis could have been made from the beginning.

Including corrective actions in the form of, in this case, a recombinant ILT vaccine (€0.024 per bird) the extra costs would have been €0.026 per bird, thus saving €0.32 per bird.

This represents a potential 12-fold return on investment.

Conclusion

These examples are clear cases of good return on investment. In the field, not everything is so clear cut. Is there always a need for a comprehensive monitoring program? Things can go well for years without monitoring, so why make the investment? First, when investing in a good vaccination program, why would you choose not to check if the vaccines applied give the response needed for a good protection? Often the costs of monitoring are just a fraction of the costs of the vaccine applied.

Second, for broilers, a basic monitoring program as mentioned above will be around 0.091 eurocents per kg live weight, which is 0.086% of the cost price of a kg live weight (LEI Wageningen Economic Research). Is this worth the potential risk of a disease outbreak? In summary, setting up a good monitoring system for ELISA along with taking actions based upon results, should give you a higher profitability in your broiler operation. ■