# Merial Forum highlights why Gumboro vaccination should be in the hatchery

**The Merial Avian Forum 2014 was recently held in Paris and among the many interesting papers were three on Gumboro or infectious bursal disease.**

In the first of the three Gumboro papers, Merial's Michel Bublot looked at the evolution of infectious bursal disease vaccinology.

Gumboro disease was first seen in the early 1960s and since then has acquired a global distribution and caused major losses.

Gumboro disease virus multiplies in, and therefore damages, the bursa of Fabricius which plays a key role in the development of the bird's humoral immune response.

Chicks hatched from vaccinated breeders have high levels of maternal antibodies which decline with chick age.

## Difficult to eradicate

The Gumboro disease virus is very resistant and difficult to totally eradicate from a poultry house by the terminal cleaning and disinfection programme, so the young chicks often encounter the virus on placement.

In the first weeks of the chick's life this is not a big issue since the maternal antibodies are protective and neutralise the Gumboro disease virus before it can reach and damage the bursa of Fabricius.

Once maternal antibodies have fallen below their 'protective level', the challenging Gumboro disease virus escapes from being neutralised by the maternal antibodies and this virus then starts to multiply in the B-cell progenitors of the bursa and those bursal cells which become infected are destroyed.

## Cytokine storm

The virus also multiplies in other cells of the bursa and this, coupled with a severe inflammatory response characterised by a 'cytokine storm', causes clinical signs and deaths, which can be 20% or higher with very virulent strains of Gumboro disease virus. Some variant strains do not produce obvious clinical signs.

All Gumboro disease viruses will induce B-cell depletion and bursal atrophy which leads to immunosuppression, the extent of which is dependent on several factors, including viral strain, bird type (layers being more sensitive than broilers) and age at infection.

Immunosuppressive effects of Gumboro disease virus infection at three to four weeks of age include a lower percentage of B-cells, a reduced serological response to antigens, reduction of plasma cells in the Harderian gland, a hyporesponsiveness of lymphoid cells to mitogenic stimulation and a higher sensitivity to E. coli challenge.

## First generation vaccines

The first generation of Gumboro disease vaccines to be used were modified live ones. These were administered by the water and vaccination failures were not uncommon due to cold chain failure, time of vaccination and poor water quality.

These vaccines had to be administered at a time when the level of maternal antibodies was such that they did not interfere with vaccination.

These levels varied for different vaccine types such as intermediate or intermediate plus.

If the timing is right the 'immunity gap' – the time between loss of protective maternal immunity and the development of vaccinal immunity is minimised. With some of these vaccines significant bursal damage also occurred.

## Second generation vaccines

The second generation of vaccines were the immune complex vaccines. These were developed in the 1980s and were composed of a live intermediate plus vaccine strain bound to antibodies.

This type of vaccine could be administered at the hatchery and once the level of maternally antibody has fallen to a level at which the intermediate plus vaccine is not neutralised the virus starts to replicate in the bursa of Fabricius and to induce a vaccinal antibody response.

With this type of vaccine the 'immunity gap' can still be an issue and the preferred strain of Gumboro disease virus for this type of vaccine can induce bursal damage.

## Third generation vaccines

The third generation of Gumboro disease vaccines, the HVT-vectored vaccines, necessitated the use of the new technology of vector vaccines.

In this the gene coding for the VP2 protein of the Gumboro disease virus was cloned and inserted into the HVT virus' genome. This type of vaccine is also administered at the hatchery.

After vaccination, the HVT vector will infect and replicate in the vaccinated (host) chick's cells without being affected by the maternal antibodies in that chick.

During the replication of the HVT, Gumboro VP2 protein is produced in the cytoplasm of infected cells which then lyse and release the VP2 protein which then activates the B-cells.

These activated B-cells multiply and become plasmocytes which secrete anti-VP2 antibodies that progressively replace the declining maternal antibodies. This prevents the creation of an 'immunity gap' and keeps the overall level of antibodies above the threshold level at all times.

As the HVT replicates in other cells the bursa of Fabricius remains intact, thereby maximising the diversity and quantity of B-cells throughout the body. The bird's immune system is therefore able to offer an optimal response to external antigens (infections or vaccines).

## Evaluating safety and efficacy

Sjaak de Wit from GD Deventer, part of the Dutch Animal Health Service, considered how the safety and efficacy of Gumboro vaccines could be evaluated. In particular he highlighted bursa:body weight ratio and bursa lesion scoring.

In the former the ratio is defined as:

$$\frac{\text{Bursa weight} \times 1{,}000}{\text{Body weight}}$$

A high ratio is desired as this reflects less bursal atrophy. Bursa lesion scoring is a standardised histological method of determining the level of bursal damage and in it lymphoid depletion is scored using a Muskett score which, ideally wants to be as low as possible.

The Muskett score is determined as follows:

- 0 – No lesions.
- 1 – Minor lymphoid depletion.
- 2 – Moderate lymphoid depletion.
- 3 – Lymphoid depletion.
- 4 – Severe lymphoid depletion.
- 5 – Very severe lymphoid depletion.

Sjaak then went on to consider some challenge studies.

The first compared Vaxxitek administered subcutaneously at the hatchery with an intermediate plus Gumboro disease vaccine given on day 21.

It was found that both gave a full clinical protection against a very virulent Gumboro disease challenge on day 28. In addition, the Vaxxitek vaccinated birds had no bursal lesions, whereas there were serious bursal lesions in the pullets receiving the intermediate plus vaccine.

In addition, the Vaxxitek vaccinated birds were significantly heavier at 28 and 38 days when compared to those birds vaccinated with the intermediate plus vaccine.

## Muskett scores

When it came to the Muskett scores the Vaxxitek vaccinated birds had a score of almost zero, whereas those receiving the intermediate plus vaccine scored at about 3.9. In work recently completed in broilers, Vaxxitek was compared with an antigen/antibody complex vaccine when the birds were challenged with a very virulent Gumboro disease virus on day 28.

The Muskett scores are shown in Table 1 below.

In summary, Sjaak concluded that both Vaxxitek and antigen/antibody complex vaccines gave full clinical protection but that the latter vaccine was associated with serious bursal lesions.

***Table 1. Muskett scores at day of challenge (Day 28) in the recent broiler study.***

| Vaccine type | Mean Muskett score at 28 days |
|---|---|
| Vaxxitek | 0 |
| Antigen/antibody complex vaccine | 4.2 |
| Negative control | 0 |

## Use of vectored vaccine

In the third presentation on Gumboro disease vaccination, David D. Smith from Merial in the USA spoke on the use of the vectored HVT+IBD vaccine in his country.

He again highlighted the reliance on maternal immunity and coupled this to the reuse of litter in US broiler production as factors impacting Gumboro disease vaccination. These two factors allow for a build up of Gumboro disease virus numbers in the environment to infect subsequent flocks. The introduction of vectored HVT+IBD vaccines has moved control to focus on the active immunisation of broilers against Gumboro disease and this has resulted in a reduction in the virus being shed in the broiler house and a subsequent reduction in the impact of the disease in the broilers. A series of studies was undertaken that showed fewer Vaxxitek vaccinated birds shed Gumboro virus compared to chickens that just had maternal immunity and that birds that were shedding virus shed less virus. Now researchers are looking at replacing cloacal swabs with environmental swabs and creating an IBD Burden Index from the results as an indicator of Gumboro disease risk. ■