Marek's Disease in Poultry: Understanding the Role of Vaccination

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Marek's Disease (MDV) is a highly contagious viral disease posing a significant threat to poultry health and productivity worldwide. The genus includes three species (serotypes) designated as Gallid alphaherpesvirus 2 (serotype 1), Gallid alphaherpesvirus 3 (serotype 2), and herpesvirus of turkeys (HVT) (serotype 3). Serotype 1 includes all the virulent strains, which are further divided into pathotypes that include mild MDV (mMDV), virulent MDV (vMDV), very virulent MDV (vvMDV), and very virulent plus MDV (vv+MDV). The disease primarily affects chickens and is characterised by the formation of T-cell lymphomas, enlargement of peripheral nerves, and a variety of clinical manifestations. This article explores the nature of the disease, its transmission, evolution, and the critical role of vaccination in controlling its spread.

Understanding Marek's Disease

Under field conditions, most chickens become infected with MDV during the first few weeks of life. The clinical disease is typically seen between 6 weeks and 30 weeks of age. But Marek's Disease can develop in older birds as well. Clinical signs include paralysis, weight loss, and immunosuppression.

The virus is shed from feather follicles and spreads through inhalation of contaminated dust and dander. Once infected, birds carry the virus for life and can transmit it to others.

Transmission and pathogenesis

The primary route of transmission is via inhalation of virus-laden particles. The virus targets lymphoid tissues and peripheral nerves, leading to tumours and neurological symptoms. The disease can manifest in several forms: classical (nerve), acute (visceral tumours), ocular (iris discolouration), and cutaneous (skin lesions).

Economic impact

Marek's Disease causes significant economic losses due to mortality, reduced productivity, and increased management costs. The disease affects both broilers and long-lived birds, with losses caused by decreased growth rates, a drop in egg production, and increased mortality. The estimated worldwide economic losses from Marek's disease exceed $2 billion due to poultry meat condemnation, reduced egg production, and vaccination costs.

Evolution of the virus and control challenges

Over time, MDV has evolved into more virulent strains, making control increasingly difficult. The emergence of very virulent (vvMDV) and very virulent plus (vv+MDV) strains has stressed the importance of reviewing existing vaccination strategies.

Continuous monitoring and adaptation of control measures are essential to manage this evolving threat.

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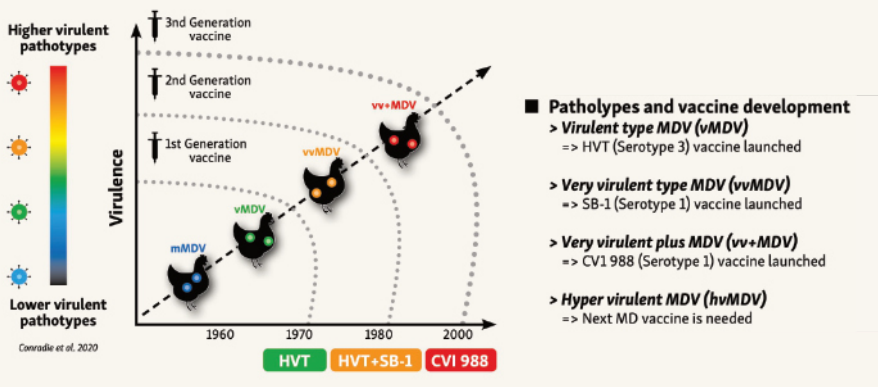
Fig. 1. Evolution of MDV and MD vaccines.



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The role of vaccination

Vaccination remains the cornerstone of Marek's Disease control. Live attenuated vaccines, particularly those based on HVT (Herpesvirus of Turkey) and Rispens strains, have been widely used. These vaccines do not prevent infection but significantly reduce clinical signs, mortality, tumour formation and virus shedding, thereby limiting disease spread. Because Marek's Disease is widespread in the environment, it can infect chicks shortly after hatching. It is critical to establish immunity as early as possible. For this reason, vaccines are typically administered either in-ovo or to day-old chicks. This early intervention is essential to initiate the build-up of immunity before exposure occurs, setting the stage for the next generation of vaccines designed to offer even earlier and more robust protection.

Modern vaccine solutions: a brief look

Recent advancements have led to the development of vaccines, updated to meet the protection required in the battle against further evolving pathogenicity of the field virus. These vaccines are designed to provide the earliest onset of immunity, combined with high immunogenicity through back-passage of the Rispens strain, and proven safety with no reversion to virulence.

Evidence from laboratory trials: early protection and vaccine replication

All vaccines evaluated in the trials below, in the laboratory and the field, are commercially available vaccines. Vaccine A is the same vaccine in all trials. To further evaluate the performance of modern Marek's Disease vaccines, a series of laboratory trials were conducted comparing three commercially available CVI988 (Rispens) vaccines, referred to as Vaccine A, Vaccine B, and Vaccine C.

Prompt activation of the immune system is essential for effective protection, particularly in environments where early exposure to field viruses is likely. A vaccine's ability to rapidly reach key lymphoid organs and initiate replication plays a critical role in triggering a timely and robust immune response.

Early immune activation through targeted replication

In a controlled study, day-old chicks were vaccinated either in-ovo or subcutaneously and monitored for viral replication in primary immune organs—spleen, thymus, bursa, and peripheral blood mononuclear cells. The three commercially available vaccines evaluated in this study demonstrated notable differences in immunity buildup.

Vaccine A exhibited faster replication across all target organs, with significantly higher levels of viral genome detected as early as 3 days post-vaccination. In both in-ovo and subcutaneous groups, Vaccine A also showed higher viral loads, suggesting a more rapid onset of immune activation compared to Vaccines B and C.

These observations highlight that not all vaccines perform identical in terms of early tissue targeting and speed of replication. The data above underscores the importance of these early-phase virus dynamics in achieving the earliest protection.

Protective efficacy under high-challenge conditions

In environments where exposure to highly virulent MDV is likely, the ability of a vaccine to prevent disease and reduce mortality is crucial. A challenge study was conducted to evaluate the protective performance of three commercially available vaccines against a very virulent plus (vv+) strain of Marek's Disease Virus (MDV). Efficacy was assessed based on mortality, morbidity, and protective index.

- Vaccine A achieved a protective index of 77%, with only 23% mortality and no morbidity among surviving birds.
- Vaccines B and C showed lower protective indices (27% and 50%, respectively), accompanied by higher rates of mortality and morbidity.
- All unvaccinated control birds succumbed to the disease, confirming the severity of the challenge.

These findings illustrate that the vaccines differ in their ability to confer protection under extreme challenge conditions. While Vaccine A demonstrated higher efficacy in this study, the choice of vaccine and its implications should always be based on the specific needs and risk environments. It is important to stress that a vaccine that performs well even under high field challenge conditions can offer peace of mind under varying challenge environments, ensuring robust protection when it is needed most.

Monitoring and adapting marek's disease vaccination strategies: insights from field data

Feather pulp qPCR as an indicator of early vaccine performance

Quantitative PCR (qPCR) analysis of feather pulp has been established as a valuable method for assessing Marek's Disease (MD) vaccine performance by measuring viral load in feather follicles. This method enables evaluation of both early challenge and vaccine virus replication, particularly within the first 7–10 days post-vaccination.

A field trial was conducted on a commercial layer farm in Asia, known for recurrent Marek's Disease (MDV) outbreaks, to evaluate the efficacy of two vaccination strategies under high challenge conditions. Ninety-six commercial layer chicks were divided into three groups: Vaccine A, Vaccine B, and non-vaccinated controls. Feather pulp samples were collected at 10 and 21 days of age for qPCR analysis to assess vaccine virus replication and field virus presence.

Key findings:

- Early Onset of Immunity: At 10 days of age, 93% of birds in the Vaccine A group had vaccine virus levels ≥132 genome copies 10,000 cells, a threshold associated with 90% protection. In contrast, only 53% of Vaccine B

birds reached this level, indicating a slower onset of immunity.

- Vaccine Replication: Vaccine A demonstrated significantly higher replication in feather pulp at 10 days, suggesting a more robust early immune response (Fig. 2).
- Field Virus Detection:
  - At 10 days, field MDV was detected in 37.5% of control birds, 9.4% of Vaccine B birds, and only 3.1% of Vaccine A birds (Fig. 4).
  - At 21 days, 71.8% of control birds were positive for field MDV, compared to 34.3% in Vaccine B and just 3.1% in Vaccine A.

Clinical Outcomes: MD-related mortality at 8–20 weeks was 56.25% in the control group, 25% in Vaccine B, and only 6.25% in Vaccine A.

These findings reinforce that not all vaccines perform equally under field conditions and that early replication and immune activation are key factors in effective protection.

As a final consideration, these results highlight the importance of continuously reviewing and updating vaccination strategies, guided by ongoing diagnostic monitoring.

This approach ensures that vaccination programs remain aligned with evolving field challenges and provide optimal protection. Continued innovation in vaccine development offers promising tools to combat this persistent, evolving threat. ■

References are available from the author on request

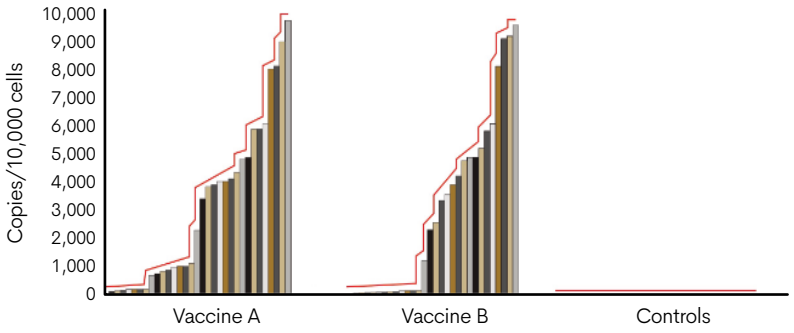

Fig. 2. Vaccine replication rate (Baigent et al., 2007).

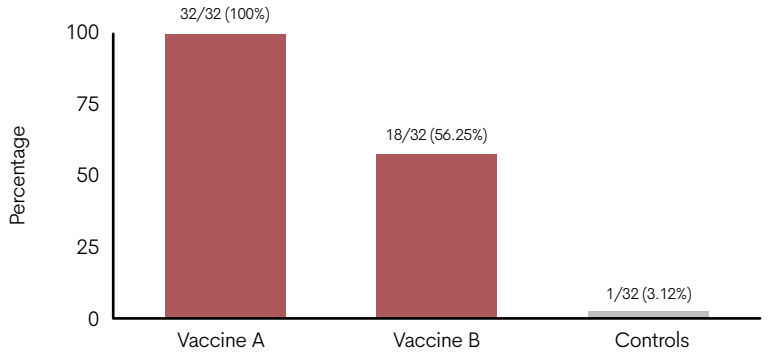

Fig. 3. Birds positive for CVI988 (Rispens) at 10 days of age.
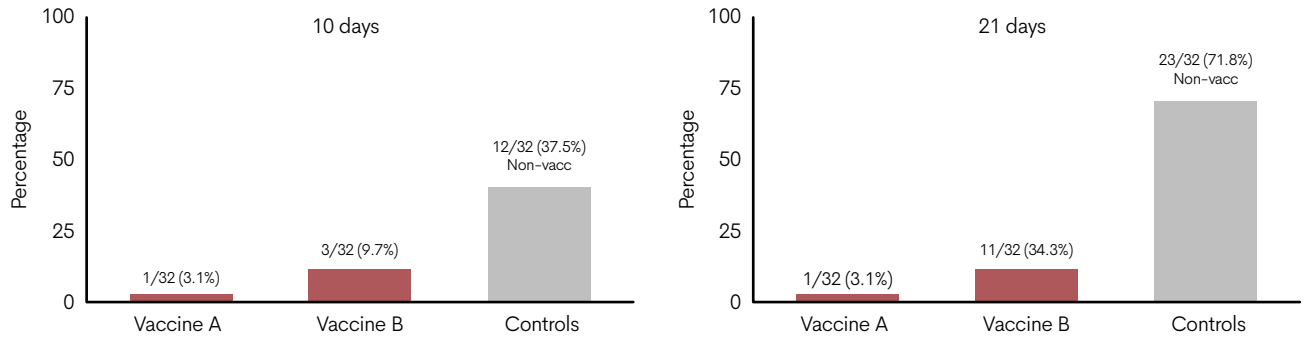
Fig. 4. Birds positive for field MDV (serotype 01) at 10 days of age and 21 days of age.