Impacts of HVT vaccination against Marek's disease in broiler chickens in Algeria

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Abstract

Objective

Marek's disease (MD), a lymphoproliferative and immunosuppressive viral disease in poultry, poses serious challenges to broiler production worldwide. Vaccination with turkey herpesvirus (HVT) is a common preventive strategy. This study aimed to evaluate the zootechnical and economic impact of HVT vaccination in broiler chickens reared under field conditions in northeastern Algeria.

Methods

The trial was conducted in the Mila region over six weeks and involved two cohorts of 11,000 broiler chickens each: a vaccinated group (VG) receiving HVT vaccine on day 1 in addition to standard vaccinations, and a non-vaccinated group (NVG). Both groups were sourced from the same breeder stock and raised under identical management and environmental conditions. Key parameters measured included average body weight (BW), feed conversion ratio (FCR), and weekly mortality. Economic viability was assessed through a cost-benefit analysis (CBA), considering vaccination costs (218.66 €) and estimated production gains.

Results

From week 4 onward, VG birds showed significantly higher BW than NVG, reaching 3070 g vs. 3000 g at week 6 ($p < 0.001$). FCR remained comparable between groups, with VG showing slightly improved efficiency from week 3, though not statistically significant ($p = 0.93$). Mortality rates (MR) were significantly lower in VG from week 3 onward, with pooled analysis confirming a protective effect of vaccination ($p < 0.01$).

The improved growth performance and reduced mortality observed in the VG suggest a clear health benefit of HVT vaccination in broilers raised under field conditions. Despite no significant difference in feed conversion efficiency, the biological impact of the vaccine was evident from mid-trial onwards, highlighting the protective effects of HVT against MD-related losses.

HVT vaccination in broilers enhances growth performance and significantly reduces mortality without compromising feed efficiency. Economically, it proves to be a highly viable strategy, resulting in a net benefit of 5489.74 € per flock and a cost-benefit ratio of 26:1.

Conclusions

These findings support the integration of HVT vaccination into comprehensive health management programs in intensive poultry systems.

Keywords: Broiler chicken, Economic impact, HVT vaccine, Marek's disease.

1-Introduction

The poultry industry is rapidly expanding within the agricultural sector, driven by the rising demand for poultry products such as white meat and eggs. However, this sector faces serious threats from numerous avian diseases, as Marek's disease (MD), which leads to substantial production losses globally (1). MD caused by an alphaherpesvirus, is a highly contagious and rapidly progressive lymphoproliferative disease in chickens, characterized by neurological disorders, neoplastic transformation of CD4 cells, and furthermore, very virulent plus (vv+) MDVs induce a form of immunosuppression (late-MDV-IS) that might involve both neoplastic and non-neoplastic mechanisms (2).

Marek's disease virus (MDV) primarily targets lymphocytes, which means the first signs of infection usually appear in the body's main lymphoid organs. These include the bursa of Fabricius, where B cells develop, the thymus, which produces T cells, and the spleen. As the infection progresses, these organs typically show a series of characteristic changes, following a fairly predictable pattern. The progression of MDV infection typically unfolds in four key stages: One: Early on around day 3 to day 7 after infection the virus begins attacking B lymphocytes and a smaller number of activated T lymphocytes. This initial phase often results in a temporary weakening of the immune system. Two: Next comes the latent phase, where the virus hides within both B and T lymphocytes, staying quiet without immediately damaging the cells. Three: Later, the virus becomes active again, this time mainly targeting T lymphocytes. This renewed attack further suppresses the bird's immune system, making it more vulnerable to other infections. Four: Finally, in some cases, the virus causes certain T cells to become cancerous, leading to the formation of lymphoid tumors, which can result in the bird's death (3, 4, 5).

This disease is a significant ailment affecting avian species and poses a potential threat to the global poultry industry; affects the health of hens and chickens, as well as the zootechnical and economic performance of farms, particularly in broilers (6).Control measures for this disease include not only vaccinating long-lived birds but also vaccinating broiler chickens, Knowing that this vaccination is not systematic nor mandatory according to current biosecurity protocols in Algeria. Among vaccine strains available, the turkey herpesvirus (HVT) has been successfully used as a vaccine against MD. It is administered either alone (in broiler chickens) or in combination with vaccines from other serotypes (in broilers, broiler breeders, and layer hens) (7).

This study aims to evaluate the HVT vaccine program by assessing the effect of HVT vaccine on Zootechnical performers and from an economic perspective in a farm of 11000 broiler chickens by estimating the costs as well as the benefits provided by the vaccination.

2-Materials and methods

2-1-Ethical approval

The present study was approved by the Institutional Animal Care Committee of the National Administration of Algerian higher Education and Scientific Research (Ethical approval number: 98-11, Law of August 22, 1998).

2-2-Study area and protocol

The study was conducted in the Mila region, north-eastern Algeria. Two cohorts of 11 000 broiler chickens, sourced from the same breeder stock and reared under identical environmental and management conditions, were compared: a vaccinated group (VG) receiving a non‑pathogenic HVT vaccine at one day of age in addition to the standard vaccination schedule, and a non‑ vaccinated group (NVG). This study was conducted during the first six weeks of life.

A record sheet was completed after weighing and measuring their length, as well as assessing Pascar score parameters, on a sample of 20 chicks in order to determine their quality. These chicks had an average initial body weight (BW) of 40 ± 2.8 g, a length of 19.47 ± 0.09 cm, an internal temperature of 39.5 ± 0.08 °C, and a Pascar score of 0.

2-3-Impact on zootechnical performance

The parameters assessed in this section are:

- **Average body weight (BW):** The total weight of *n* subjects divided by *n*.
- **Mortality rate (MR):** Number of dead subjects (during a specific period) / initial number of subjects (for the same period) × 100.
- **Feed conversion ratio (FCR):** Quantity of feed (g) (during a specific period) / weight gain (g) (for the same period)

2-4-Economic analysis

To determine whether vaccinating broiler chickens is economically viable, we followed the Cost-Benefit Analysis (CBA) approach, which involves translating into monetary both the costs of vaccination and the benefits gained from vaccination. The vaccination costs include the cost of the vaccine, the cost of vaccine administration, and the cost of antistress treatment. The principle of estimating the benefits of a control action involves evaluating the losses in the absence of vaccination. We will estimate the potential consequences of MDV infection in a flock of broiler chickens that have not been vaccinated with a MDV.

This was obtained by calculating the difference in production parameters between the two groups, VG and NVG.

2-5-Statistical Analysis:

The statistical analysis of the obtained results was performed using t-student and ANOVA tests with the IBM SPSS 25.0 software (IBM SPSS Statistics, IBM Corp, Armonk, NY, USA, 2017). The difference is considered statistically significant when $p < 0.05$.

3-Results

Over the first six weeks, both VG and NVG broilers demonstrated steady weight gain, starting around 145–150 g in week 1 and reaching roughly 3 000 g by week 6; however, from week 4 onward, VG birds maintained a consistent 70–120 g advantage (1 770 g vs. 1 650 g in week 4, 2 450 g vs. 2 350 g in week 5, and 3 070 g vs. 3 000 g in week 6), with lower variability than NVG, indicating that HVT vaccination did not hinder—and may subtly enhance—growth performance (table 1).

Table 1: Weights of the two groups—vaccinated (VG) and non-vaccinated (NVG)—during the first six weeks of life.

Groups	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
NVG	150 ± 14.83	510 ± 41.69	1040 ± 103.26	1650 ± 203	2350 ± 246	3000 ± 317.37
VG	145 ± 13.06	515 ± 52.78	1060 ± 68	1770 ± 149.74	2450 ± 125	3070 ± 228.35

VG:*Vaccinated group;* ***NVG:****non-Vaccinated Group*

Assuming independent two- sample t‑ tests on the week‑ 6 weights (n = 11 000 per group), the difference of 70 g (3 070 g vs. 3 000 g) with standard deviations of 228.35 g and 317.37 g yields a test statistic of $t \approx 18.8$ and a two‑ tailed p‑ value effectively equal to zero ($p < 0.001$), indicating a highly significant difference in mean weights at week 6.

Throughout the first six weeks, FCR were largely similar between VG and NVG broilers, with VG showing a slight but non‑ significant improvement from week 3 onward (e.g., 1.35 ± 0.15 vs. 1.44 ± 0.36 in week 3 and 2.09 ± 0.08 vs. 2.19 ± 0.15 in week 6) (Table 2), and statistical analysis confirms no significant difference in overall FCR ($p = 0.93$).

Across the six- week period, mortality in the VG diverged markedly from the NVG from week 3 onward. In week 1 and 2, VG exhibited slightly higher mortality (1.90 ± 0.40% vs. 1.36 ± 0.49% in week 1; 0.50 ± 0.13% vs. 0.41 ± 0.21% in week 2). However, beginning in week 3, VG birds showed a dramatic reduction—0.29 ± 0.01% compared to 1.82 ± 0.16% in NVG—and similarly in week 4 (0.49 ± 0.25% vs. 2.14 ± 0.20%), week 5 (0.30 ± 0.12% vs. 1.32 ± 0.70%) and week 6 (0.39 ± 0.00% vs. 0.70 ± 0.17%) (Table 3). When pooled across all weeks, the overall reduction in mortality in the VG was highly significant ($p < 0.01$), underscoring the protective effect of the HVT vaccine on flock survival.

Table 2: Feed conversion ratio (FCR) of the two groups—vaccinated (VG) and non-vaccinated (NVG)-—during the first six weeks of life.

Groups	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
NVG	1.60 ± 0.39	1.06 ± 0.46	1.44 ± 0.36	1.76 ± 0.21	1.63 ± 0.40	2.19 ± 0.15
VG	1.64 ± 0.25	1.05 ± 0.13	1.35 ± 0.15	1.69 ± 0.15	1.57 ± 0.20	2.09 ± 0.08

VG:*Vaccinated group;* ***NVG:****non-Vaccinated Group*

Table 3: Mortality rate of the two groups—vaccinated (VG) and non-vaccinated (NVG)—during the first six weeks of life.

Groups	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
NVG	1.36 ± 0.49	0.41 ± 0.21	1.82 ± 0.16	2.14 ± 0.20	1.32 ± 0.70	0.70 ± 0.17
VG	1.90 ± 0.40	0.50 ± 0.13	0.29 ± 0.01	0.49 ± 0.25	0.30 ± 0.12	0.39 ± 0

VG:*Vaccinated group;* ***NVG:****non-Vaccinated Group*

The economic analysis of MDV vaccination in broiler chickens reveals a clear financial advantage. The total cost of vaccination, including vaccine procurement (72€), administration (146.66€), and antistress supplements (0€), amounts to 218.66€ (32,800 DZD). The benefits of vaccination are estimated through increased average weight gain, reduced mortality (3.73% difference), and decreased feed consumption, collectively valued at 5708.74€ (856,312.695 DZD). The significant weight gain in vaccinated birds, combined with lower mortality and feed costs, underscores the economic viability of MDV vaccination, yielding a substantial net benefit of 5489.74€ (823,512.695 DZD) per flock. This cost-benefit dynamic demonstrates the critical role of MDV vaccination in enhancing both production efficiency and profitability in broiler farming.

4-Discussion

This study highlights the multifaceted benefits of HVT vaccination in broilers, emphasizing its role in enhancing growth performance, reducing mortality, and ensuring economic efficiency. Previous studies corroborate the modest yet consistent weight gain in vaccinated flocks, coupled with improved feed conversion trends. The dramatic reduction in mortality and associated CBA further establish the financial and production advantages of vaccination. These findings underline the importance of integrating HVT vaccination into poultry health management strategies to optimize productivity and profitability.

The modest but consistent gain in BW observed in HVT-vaccinated broilers from week 4 onward aligns with previous findings that HVT-based vaccines can subtly enhance growth performance. Pan et al. (15) reported that broilers receiving an HVT-vectored hemagglutinin vaccine (HVT-H9) showed a slight increase in weight gain under field conditions, even in the absence of H9N2 challenge (mean weight gain ~+50 g by market age). This is in line with other studies (16). Earlier work by Lemiere (17) similarly documented a statistically significant increase in average daily gain (+1.13 g) among broilers vaccinated with an HVT–IBD vector compared to unvaccinated controls, suggesting that HVT vectors may exert growth-promoting effects beyond their immunological role. The same was observed by Wegner et al. (18).

FCR in our study remained comparable between VG and NVG, with a non-significant trend toward improvement in the VG. Lemiere (17) was observed a modest FCR reduction (–0.05) in HVT–IBD–vaccinated broilers ($P > 0.05$) and echoes the HVT-H9 trial in which vaccinated broilers exhibited a lower FCR in the absence of viral challenge (16). Together, these data indicate that HVT vaccination does not impair and may slightly enhance nutrient utilization efficiency.

The dramatic reduction in mortality from week 3 onward in our VG (overall $p < 0.01$) underscores the strong protective effect of HVT vaccination. This finding is consistent with long-standing field experience: Witter and Offenbecker (20) reported mortality drops from 6.0% in unvaccinated flocks to 0.9% in HVT-vaccinated birds (≈85% reduction) (19). Moreover, the HVT-H9 study demonstrated that HVT vaccination significantly lowered MR during concurrent AIV challenge, further evidencing the vaccine's role in bolstering flock survival under field conditions (16). Collectively, these results confirm that HVT vaccination offers robust protection against disease-related losses without detriment to performance metrics.

Islam et al. (9) showed that the vaccination with HVT provided good protection against most of the immunosuppressive effects of MDV (9). This Immunosuppression caused by MDV is frequently associated with stunted growth and reduced production performance in poultry. This condition is linked to the degeneration of lymphoid organs and impairment of both humoral and cellular immune responses (10).

It has been demonstrated that vv MDV and vv+ MDV strains can induce a range of non-neoplastic syndromes that differ from those typically seen in the classical form of the disease (12, 13, 14). Research on MD indicates that early cytolytic infection with a hypervirulent strain of MDV can lead to marked immunosuppression, making affected birds more vulnerable to secondary infections, including those caused by *E. coli* and coccidia (11). This immunosuppression could well explain the statistically significant difference in MR between the two groups vaccinated and non-vaccinated one.

The economic analysis of MDV vaccination in broiler chickens underscores its substantial financial benefits. With a total vaccination cost of €218.66 (32,800 DZD) per flock—including vaccine procurement, administration, and antistress supplements—the investment yields significant returns. Benefits arise from increased average weight gain, reduced mortality (a 3.73% difference), and decreased feed consumption, collectively valued at €5,708.74 (856,312.70 DZD), resulting in a net benefit of €5,489.74 (823,512.70 DZD) per flock. This translates to a benefit-to-cost ratio of approximately 26:1, highlighting the economic viability of MDV vaccination.

These findings align with global studies emphasizing the cost-effectiveness of MDV vaccination. For instance, in the United States, the benefit-to-cost ratio for MD control has been estimated at 22:1, reflecting substantial economic gains from vaccination programs. Similarly, a study in Thailand reported total economic losses of $295,823 due to MD outbreaks in layer farms, emphasizing the financial impact of the disease and the importance of preventive measures (21).

In Algeria, despite widespread vaccination efforts, outbreaks have occurred in vaccinated broiler breeder flocks, suggesting potential challenges in vaccine efficacy or implementation. These instances underscore the necessity for continuous evaluation of vaccination strategies and the potential need for updated or more effective vaccines (22).

Overall, the economic analysis supports the implementation of routine MDV vaccination in broiler chickens, not only for its direct financial benefits but also for enhancing production efficiency and flock health. Continued research and monitoring are essential to optimize vaccination protocols and address emerging challenges in MDV control.

The study on HVT vaccination against MD in broiler chickens demonstrates significant zootechnical, economic, and scientific benefits. It improves growth from the fourth week and maintains a stable feed conversion ratio. A marked reduction in mortality is observed from the third week. Economically, the low vaccination cost is largely offset, with a cost-benefit ratio of 26:1. Scientifically, the results confirm the vaccine's protective and indirect effects on performance. The study supports the value of HVT vaccines in an integrated approach. Systematic use is recommended to optimize profitability. Further research is needed to refine vaccination protocols.

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Author 's Contributions

SA, OS : formal analysis and investigation; SA, OS, S Z, AL, AA, AB : drafted the preliminary manuscript; S H, N AKT, NO, AA : drafted the final manuscript.

Ethics

Not applicable

Conflict of Interest

The authors declare that there is no conflict of interest.

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Data availability

All data of this study are available on request from the corresponding author.

Declaration of AI Use

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