Evaluation of a Herpes Virus of Turkey vector vaccine inducing protection against Infectious Bursal and Marek’s Diseases (VAXXITEK® HVT+IBD) under Philippines field conditions

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Abstract

A field study was conducted to evaluate the safety and efficacy of a Herpesvirus of Turkey (HVT) vector vaccine inducing protection against Infectious Bursal Disease (IBD) and Marek’s disease (MD) (VAXXITEK® HVT+IBD) when administered to day-old broiler chickens under Philippines field conditions. 75,000 birds from 3 broiler farms were observed. Each farm had two groups: one vaccinated with VAXXITEK HVT+IBD and the other kept as the control group. Vaccinated group received 0.2mL of VAXXITEK HVT+IBD by subcutaneous injection at the back of the neck at day-old. Control group received the IBD vaccines specified in current vaccination programs. Safety was assessed by evaluation of the overall health condition and mortality rate. Efficacy was assessed by the absence of clinical IBD and clinical MD, IBD-ELISA titres and flock production performances. Safety and efficacy of VAXXITEK HVT + IBD were demonstrated in this study.
1. Introduction

MD is a lymphoproliferative disease characterized by a mononuclear infiltration of one or more of the following organs: peripheral nerves, gonad, iris, various viscera, muscle and skin. It is one of the most ubiquitous avian infections. IBD is an acute, highly contagious viral infection of young chickens that targets lymphoid tissue with a special predilection for the bursa of Fabricius. The disease is economically important. Virus strains may cause up to 20% mortality in chickens of 3 weeks of age and older and, more importantly, a prolonged immunosuppression of chickens infected at an early age.

Vaccination programs for young chickens should take into consideration parental immunity passed on by immunized breeders. Maternally derived antibodies (MDA) would normally protect chicks for 1 to 3 weeks and may stretch up to 4 to 5 weeks in progeny of breeders boosted with oil-adjuvanted killed vaccines. The presence of MDA in young chickens plays a major factor in determining the proper timing of vaccination, as it neutralizes actively administered vaccine antigens [1].

VAXXITEK® HVT + IBD is a frozen vaccine to be diluted into an aqueous diluent. The active ingredient is the production-cell associated vHVT13-69 virus vaccine strain expressing the VP2 coding sequence of IBD virus. The parental strain of VAXXITEK HVT + IBD FC-126 belongs to the serotype 3 of MD and is widely used in classical vaccination against MD. HVT strains are apathogenic in all species and do not replicate in mammalian cells. The VP2 protein is the only protein of IBD virus that induces protection against IBD. It is indicated for active immunization of day-old chicks to prevent mortality and reduce clinical signs and lesions of IBD and MD. Onset of protection for IBD is from 2 weeks and may extend up to 9 weeks; while for MD, protection is from 4 days and a single vaccination provides sufficient protection during the risk period of rearing [2], [3]. It was registered and widely used in field conditions in the United States, the European Union [4] and other parts of the world including Latin America [5].

The study aimed to assess safety and efficacy of a recommended dose administration of VAXXITEK HVT + IBD when administered to day-old broiler chicks under Philippines field conditions.

2. Methods

Three broiler farms located in three different geographical districts were selected. All three farms, Farm 1, Farm 2 and Farm 3, were validated for suitability by a representative of the Philippines Bureau of Animal Industry based on history of disease challenge, particularly of MD and IBD. The starting population was determined by subtracting the number of rejected chicks and dead on arrival from the quantity brought from the hatchery. A total
of 75,291 COBB® 500 day-old broilers were used in the study. Each farm had two groups, one vaccinated with VAXXITEK HVT+IBD and one control group in which classical IBD vaccines were used. Identification of animals was facilitated by house placement and rearing methods followed management implemented in each farm.

VAXXITEK HVT+IBD vaccine was reconstituted according to the manufacturer’s recommendation. The vaccinated group was administered VAXXITEK HVT+IBD by subcutaneous route at 0.2mL per bird at the back of the neck using the ACCUVAC® injector. The control group was vaccinated following the farms’ current IBD vaccination program.

The study groups were observed for 28 days post-vaccination for adverse reactions to vaccinations such as, but not limited to: severe depression, neurological signs/paralysis, increased mortality (>2% at Day 7) and signs of IBD (swelling of the bursa, gelatinous transudate covering the bursa, bursal haemorrhages). Five birds were randomly selected per group at day 1, day 7, day 14, day 21, day 28, and at harvest. The birds were weighed and sacrificed for bursa collection to determine the bursa to body weight ratio. Bursal size and weight was determined using a bursa scale and digital weighing scale respectively. Bursa to body weight ratio between the vaccinated and control group were compared. Bursal samples collected were fixed in 10% buffered formalin solution and were processed for histopathologic examination. Bursa lesion scoring was done to assign numerical values for cellular changes observed in the vaccinated and control group (Auburn University, AL, USA).

Fifteen serum samples were collected from each group at day 1, day 21 and at terminal age for IBD, Newcastle Disease (ND), and Infectious Bronchitis (IB) ELISA titer determination (Rizal Poultry & Livestock Association, Inc. Animal Disease Diagnostic Laboratory, Philippines). IBD VP2-specific ELISA antibody titre changes in the vaccinated group and control group were compared. Clinical ND and IB challenges were determined based on ND and IB titers. Respiratory disease incidence was also observed for all replicates and compared between vaccinated and control groups. Flock efficiency, mortality, and feed conversion ratio (FCR) were monitored on a weekly basis. The average live weight (ALW) and average daily gain (ADG) were computed for 2.5% of the population per group. ALW was also monitored on a weekly basis. FCR was calculated based on actual feed consumption and computed ALW. Final efficiencies were determined and presented as European Production Index (EPI) computed using the formula: EPI = Livability % * Weight/ Age * FC * 100. Cost advantage per bird was computed for each farm. Data gathered were statistically analyzed using T-test.

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3. Results

A lower mortality rate was observed across all sampling ages of the vaccinated group in Farm 1. The control group showed a generally lower mortality rate from day 7 to day 28 in Farm 2 and farm 3, but was reversed at terminal age (Figure 1).

Bursa size was greater in the VAXXITEK HVT+IBD vaccinated group in all three farms except for day 7 samples where the control group showed a slightly higher bursal size when compared to the vaccinated group (Figure 2). Bursa weight was greater in the VAXXITEK HVT+IBD vaccinated group. Day 7 results were superior in the control group in Farm 1 and Farm 3 and at days 14 and 28 in Farm 2. Day 21 bursa weight in farm 2 was greater in the VAXXITEK HVT+IBD vaccinated group at 5% level of significance (Figure 3). Comparison of the bursa to body weight ratio between the VAXXITEK HVT+IBD vaccinated and control groups of the trial farms showed variations on the first 4 sampling ages but were all superior in the vaccinated group at terminal age. In Farm 1, bursa to body weight ratio was consistently greater in the VAXXITEK HVT+IBD vaccinated group starting day 14 until terminal age. Day 14 and 28 sampling revealed higher values for the control group in Farm 2, as well as day 14 to day 28 in Farm 3 (Figure 4). Day 28 and terminal age sampling demonstrated a lower lesion score for the VAXXITEK HVT+IBD vaccinated group across all trial farms. Control groups for Farm 1 and Farm 3 had higher lesion scores on day 14 and days 7 and 21, respectively. Bursa lesion score was generally lower in the VAXXITEK HVT+IBD vaccinated group in all farms (Figure 5).

IBD ELISA titers were at an almost similar level at day 0 in both vaccinated and control groups of all three trial farms. Vaccinated group exhibited a higher reading starting day 21 until terminal age (Figure 6). All IBD titer readings were consistently higher in the vaccinated group and uniformity across the samples was observed as demonstrated by the lower coefficient of variances. ND and IB titers of the vaccinated and control groups of Farm 2 and Farm 3 were high while relatively low titers for both diseases were observed in Farm 1. The vaccinated group of the trial farms had higher IB titer readings and better uniformity.

Computed average live weight (ALW) was highly comparable in the vaccinated and control groups of all 3 farms from day 7 to day 14. Favorable results for the vaccinated group started to show at day 21 to terminal age (Figure 7). Feed conversion ratio was consistently encouraging across all sampling ages in all trial farms, especially observed starting day 14 up to terminal age (Figure 8). Computed cost advantage per bird was highest in Farm 3 at 14.10 Philippines Peso (Php) per bird followed by Farm 2 at 8.89 Php per bird. Farm 1 had a computed cost of advantage of 6.10 Php per bird (Table 1).
4. Discussion

Commercially available vaccines have gone through thorough studies, primarily to ensure their safety when used in the field. The absence or low incidence of adverse reactions in both the vaccinated and control groups is an expected result as both groups received vaccines that have gone through their manufacturer’s rigid tests. The generally low mortality picture of the vaccinated group can be attributed to several factors, one of which is the safety of the vaccine in study. The insertion of the gene coding for the IBD VP2 protein in the HVT parental strain in VAXXITEK HVT+IBD allows it to be administered to day-old chickens without presenting any safety problems or immunosuppressive effects. The level of stress brought about by numerous vaccines administered to the control group is also a factor worth considering when looking at the poor performance of the group in terms of mortality when compared to the vaccinated group. Other notable causes of mortalities at day 7 and day 14 were omphalitis and yolk infection, mechanical injuries, cat infestation, and small and weak chicks at the time of placement. Respiratory problems experienced by Farm 2 were more severe in the control group. This, paired with the feed-related problem the farm had in the early days of rearing, resulted in the mortality rate for this farm being significantly higher in the control group.

Bursa weight and size are a good indication of the immune status of young birds. The bursa size follows the growth rate of the birds and regresses towards the fifth week of life. Immunosuppressive diseases cause regression or bursal atrophy at a young age which renders the animal unable to respond well against disease challenges. Vaccinated groups showed better bursa size and weight results which translated into a better bursa to body weight ratio. Consequently, any physical damage to the bursa will have a corresponding effect at the cellular level. In the lesion scoring performed, the vaccinated group performed better than the control group such that the vaccinated group had relatively lower lesion scores than the control group. The positive results observed from bursal samples of the vaccinated group may be attributed to the technology employed to manufacture VAXXITEK HVT+IBD which allows the vaccine to be administered at an early age without interference with MDA. This allowed the birds to actively mount a high immune response at an earlier age as demonstrated, thereby reducing the window of susceptibility to disease challenges particularly brought about by IBD. The titer levels for the vaccinated group also illustrated better uniformity over the control group wherein the vaccinated group had a lower coefficient of variation across all sampling age in all 3 farms. This uniformity may be a gauge of how well the vaccine was taken in by the animals and how widely the flock has been protected.

In broilers, terminal titers for ND and IB generally show a picture of the severity of the disease challenge. The results gathered
from Farm 2 and Farm 3 suggest a high level of challenge for both ND and IB while Farm 1 results were suggestive of low incidence of said diseases. It can be noted that ND and IB titers for the vaccinated group were higher than that of the control group. The data gathered in this study may not be appropriate to substantiate a positive direct correlation between VAXITEK HVT+IBD vaccination and high ND and IB titers.

MD-related observations were not carried out since the birds were harvested at an early age before clinical signs of MD are not feasibly observable. Aside from protection against MD and IBD, VAXITEK HVT+IBD contributes to the development of a strong immune integrity that leads to better response to other vaccines and lowers the risk of respiratory problems. It follows that with better immune integrity, the production performance of the flock will also improve as energy from the feed is utilized for growth rather than fighting off diseases. This was exhibited by the vaccinated groups whose ALW and FCR were consistently better than the control group. In broiler production, an improvement in production performance is always sought after as this will translate into a higher economic benefit for the raiser.

5. Conclusion

The safety and efficacy of VAXXITEK HVT+IBD have been shown in the study conducted in 3 farms located in 3 different geographical districts in the Philippines. The absence of vaccination reactions as revealed in the study and low mortality rate of less than 2% at day 7 suggests the safety of the vaccine. The absence of clinical IBD in these historically positive farms, together with the serological picture of the IBD titer and bursa evaluation accomplished in this study demonstrated the efficacy of the vaccine in protecting the flock against IBD with a single dose. The economic impact of the improvements delivered by VAXXITEK HVT+IBD is noteworthy and may be one of the most important factors that poultry raisers will consider.

References

[4] VAXXITEK® HVT+IBD, live vector vaccine against infectious bursal disease and Marek’s disease was registered in the European Union on August 9th, 2002 under the reference number EU/2/02/032/001.

Figure 1. Observed percentage of mortality in VAXXITEK® HVT+IBD & conventional IBD vaccinates for Farms 1, 2 & 3.

Figure 2. Observed average bursa size (mm) in VAXXITEK HVT+IBD & conventional IBD vaccinates for Farms 1, 2 & 3.

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Figure 3. Observed average bursa weight (g) in VAXXITEK HVT+IBD & conventional IBD vaccinates for Farms 1, 2 & 3.

Figure 4. Observed average bursa to body weight ratio in VAXXITEK HVT+IBD & conventional IBD vaccinates for Farms 1, 2 & 3.
Figure 5. Observed average bursa scoring in VAXXITEK HVT+IBD & conventional IBD vaccinates for Farms 1, 2 & 3.

Figure 6. Observed IBD ELISA titre geometric means in VAXXITEK HVT+IBD & conventional IBD vaccinates for Farms 1, 2 & 3.
**Figure 7.** Observed average live weight (g) in VAXXITEK HVT+IBD & conventional IBD vaccinates for Farms 1, 2 & 3.

**Figure 8.** Observed feed conversion index in VAXXITEK HVT+IBD & conventional IBD vaccinates for Farms 1, 2 & 3.
Table 1. Cost advantage per bird farm per farm of the vaccinated with VAXXITEK HVT+IBD birds over the control groups.

* EPI = European Performance Index = Livability % * Weight/ Age * FC * 100.

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<th>Difference Farm 1</th>
<th>Vaccinates Farm 2</th>
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<th>Vaccinates Farm 3</th>
<th>Controls Farm 3</th>
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