MERCK ANIMAL HEALTH
TECHNICAL SERVICES BULLETIN

Development of Intussusception in Young Broilers Vaccinated with Coccivac®-D2 and Subjected to Feed Restriction

INTRODUCTION

Among the many perils faced by broiler-breeder producers attempting to profitably manage their flocks, death losses due to intussusception of the lower gastrointestinal tract has emerged as another common obstacle. Intussusception involves an invagination of the distal thin-walled portion of the intestine (colon and rectum), whereby an inflamed segment telescopes or folds over itself. This serious condition may lead to necrosis of the surrounding intestinal tissue, prolapse, and death of the affected bird.

Several predisposing factors are thought to possibly contribute to the initiation of the syndrome, including coccidiosis, overgrowth of pathogenic bacteria (e.g. necrotic enteritis), enteric viruses, and helminths (worms).[2-4] However, severe feed restriction, a routine management practice for pullet production, can also be a primary cause of intussusception.[2] Targeted feed restriction is an important strategy for moderating the genetic growth potential of pullets, to produce efficient breeding stock with good livability and fertility. Thus, an elevated incidence of intussusception is often encountered in young replacement birds, especially during the early growth and developmental periods.

A university research study explored the development of intussusception in young broiler chickens (primarily pullets) vaccinated for coccidiosis with Coccivac®-D2 (Merck Animal Health) and subjected to feed restriction, simulating a typical pullet production program.[1]

KEY POINTS

- A university research study1 investigated the scope of intussusception and coccidiosis in a simulated pullet production system involving feed restriction.
- An early feed restriction protocol starting at 14 days of age appeared to be a driver in the development of intussusception.
- Early vaccination with Coccivac-D2 at 1 day of age successfully presented homologous coccidial antigens to the immune system regardless of subsequent feeding protocol, with all birds generating effective immune responses to coccidiosis challenge at 28 or 35 days of age.

COCCIVAC®-D2

Coccivac-D2 is a live oocyst vaccine approved for use in healthy chickens, and it has shown to be effective against coccidiosis. A controlled dose stimulates early, mild, predictable, and uniform immune responses to 6 species of Eimeria parasites important in chicken production (*E. tenella, E. mivati, E. acervulina, E. maxima, E. brunetti, E. necatrix*) using strains sensitive to anticoccidial drugs. Coccivac-D2 may be administered to chickens via spray cabinet at 1 day of age or orally on the feed at 4 days of age.

DESIGN

The 6-week study involved 850 day-old chicks (H x C500, 85% females) obtained from a commercial hatchery. A single dose of Coccivac-D2 vaccine was applied at the hatchery to 800 of the chicks via spray (Spraycox® II cabinet). After transport to a study site, the 800 vaccinated birds were randomly assigned to 16 pens (50 birds/pen), and those pens allotted to 3 treatment groups for different feeding regimens as follows (Figure 1):

- Normal (unrestricted) feeding (n=400, 8 pens): typical commercial non-medicated pullet ration offered ad libitum;
- 14-day restricted fed (n=200, 4 pens): same ration but limited to 0.06 lb/bird/day starting at 14 days of age until study end, to simulate skip-a-day feeding restriction;
- 21-day restricted fed (n=200, 4 pens): same ration but limited to 0.06 lb/bird/day starting at 21 days of age until study end.

The remaining 50 hatch-mate chicks served as negative (non-vaccinated) controls and were kept separate from vaccinates to avoid cross contamination.

Figure 1: Summary of study design.

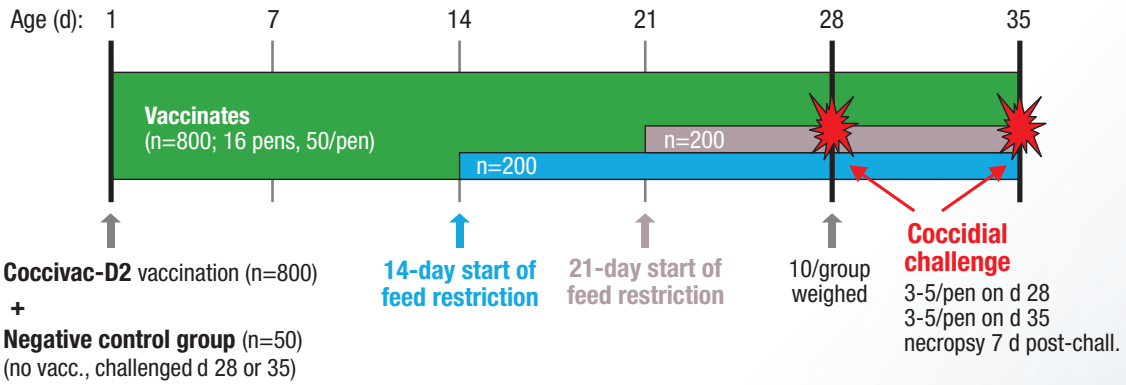
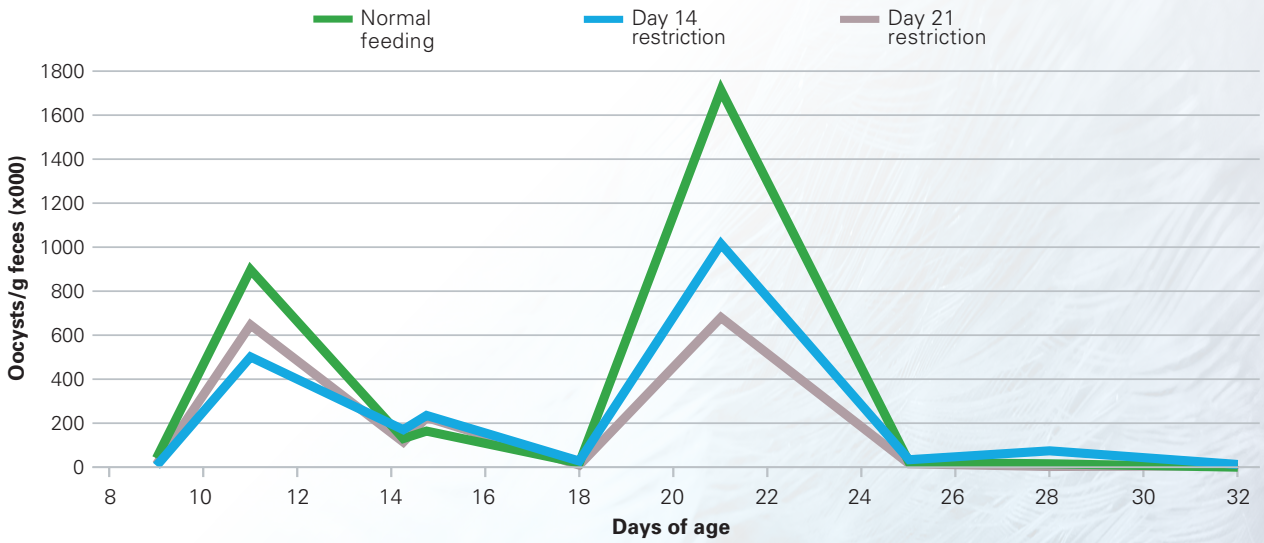


Figure 2: Coccidial oocyst shedding by treatment group during study course.



Coccidial shedding by vaccinated birds was monitored by collecting 10 to 15 fresh fecal droppings from each pen twice a week from 9 days through 32 days of age. The samples were subsequently evaluated to determine coccidial species and oocyst counts. Mortalities occurring during the study were investigated to determine the cause of death. Average body weights were assessed for 10 randomly selected birds from each vaccinated group at 28 days of age.

A challenge phase of the study was implemented when vaccinates and controls attained 28 and 35 days of age. On each date, 3 or 5 birds were removed from each pen and placed into clean, wire-floored isolation cages and allowed 24 hours to acclimate to the new environment. Each bird was then administered a challenge inoculum of homologous *Eimeria* spp via 100- or 150-fold doses of Coccivac-D2. Birds were euthanized approximately 7 days post-challenge for necropsy and quantification of coccidial burdens by scoring the severity of microscopic lesions.

RESULTS

Coccidial shedding

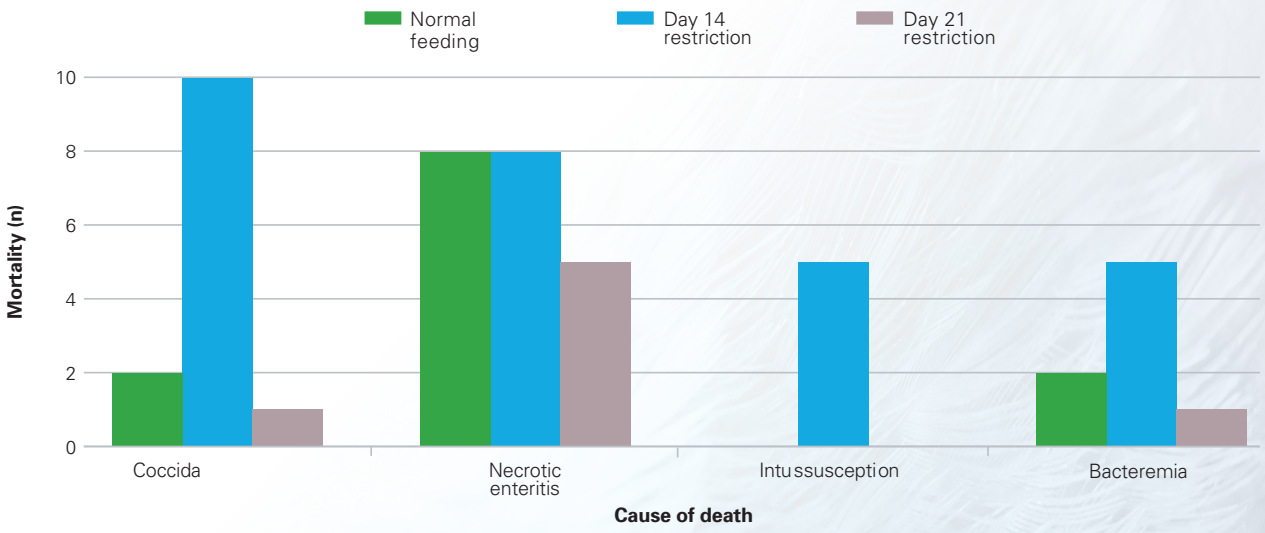
Results summarized in Figure 2 indicate that oocyst shedding peaked around 21 days of age, as is often the case following Coccivac-D2 vaccination of day-old chicks. Shedding declined by 25 days of age and remained low thereafter. While normal-fed birds demonstrated the greatest vaccine response (highest oocyst output), Coccivac-D2 generated substantial oocyst output in all groups, indicative of favorable/desired impacts of the live vaccine for establishing coccidial immunity.

All 6 species of *Eimeria* were detected during the study course (Table 1), including *E. necatrix* (thought to compete poorly by some researchers but was apparent in this study). No overcrowding effect by the different *Eimeria* species was observed as birds developed protective immunity to all species during the same time period.

Table 1: Predominant Eimeria spp detected in fecal sample collected on various study days (bird days of age).

	Fecal collection days (age)							
Eimeria spp	9	11	14	18	21	25	28	32
E. acervulina/mivati	X	X	X		X	X	X	X
E. brunetti	X	X	X				X	X
E. maxima		X	X		X		X	X
E. necatrix			X				X	X
E. tenella	X	X	X	X	X		X	X

Figure 3: Causes of mortality during study course.



Mortality

Death losses during the study (Figure 3) were greatest in chickens that experienced feed restriction starting at 14 days of age. Notably, these birds were the only group that suffered mortality associated with intussusception, with losses beginning 4 days after initiation of feed restriction (Figure 4).

The single greatest mortality trigger was coccidiosis (*E. tenella*) in the 14-day restriction group, though some coccidiosis mortality was observed across all groups. Bloody droppings were noted in several pens at 12 days of age, with mortalities beginning at day 14, prompting administration of low-level amprolium (via water) for 48 hours beginning on day 16. Excellent coccidiosis control was observed later in the study, once again confirming the reliable efficacy of Coccivax-D2 vaccination of day-old chicks.

The highest rates of mortality were caused by necrotic enteritis beginning at 16 days of age, also observed across all groups. Coccidia found in enteritis-affected birds included *E. brunetti, E. maxima, E. necatrix,* and *E. mivati*.

Figure 4: Example of intussusception mortality in bird with feed restriction starting at 14 days of age.

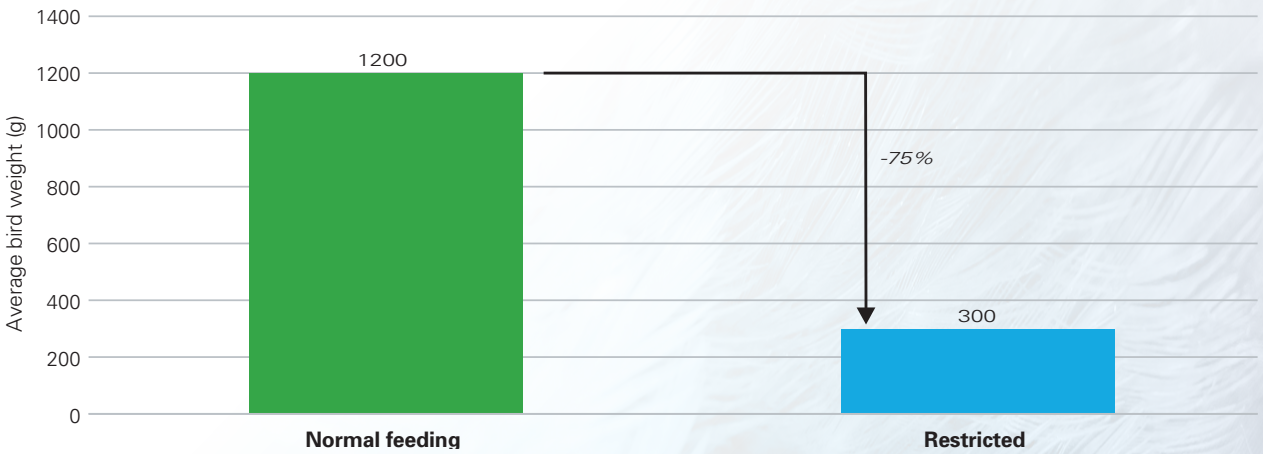
Bird weight

Outcomes regarding the average body weight of birds at 28 days of age (Figure 5) reveal a massive 75% reduction for feed-restricted pullets. The restriction programs were clearly successful in limiting weight gains. Growth rate was not monitored over the entirety of the study due to an elevated number of male chickens in each pen (male:female ratio 10:90 for restricted-fed pens, 20:80 for normal-fed pens). Still, the coefficients of variation between the groups were identical (17.37), demonstrating a high degree of uniformity within groups.

Response to coccidiosis challenge

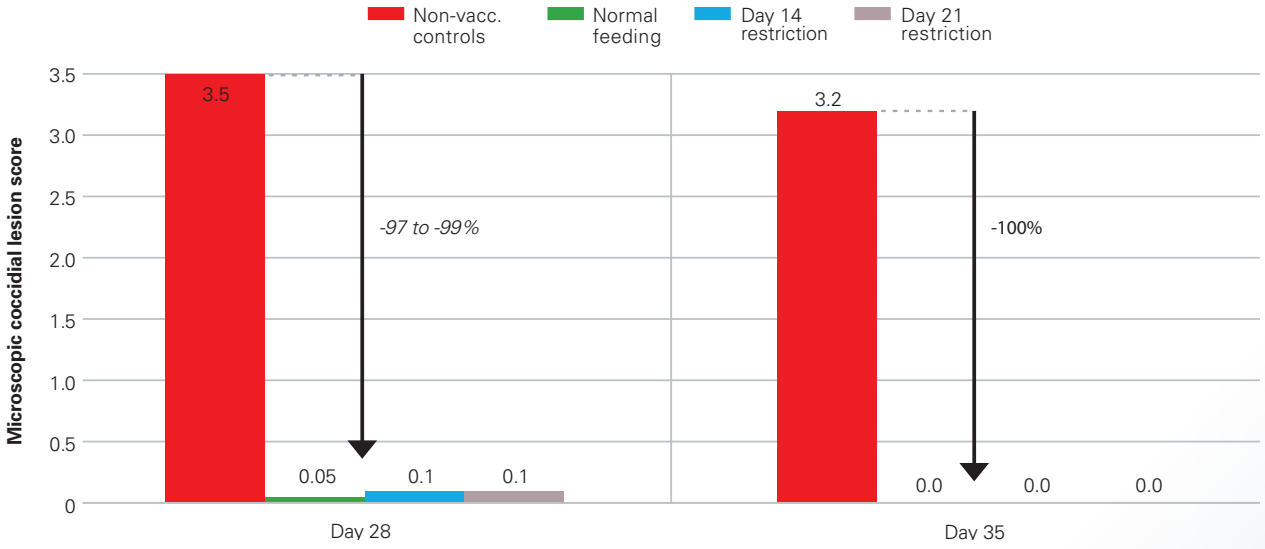
All vaccinated groups, regardless of feeding status, demonstrated high levels of protection against coccidial challenge whether encountered at 28 or 35 days of age. As summarized in Figure 6, 97% to 100% protection from challenge coccidia was generated across the 3 vaccinated groups,

Figure 5: Impact of restricted feeding on average bird weights at 28 days of age.



but the non-vaccinated controls demonstrated high microscopic lesion scores post-challenge. Vaccinates had clearly developed a potent immune response since their day-1 vaccination regardless of feed restriction, while unprotected, non-vaccinated control birds remained highly vulnerable to coccidial exposure and damage. These outcomes again confirmed the excellent efficacy provided by early vaccination with Coccivac-D2.

Figure 6: Coccidial burden (microscopic lesion score) 7 days after challenge at 28 or 35 days of age, non-vaccinated controls vs normal-fed or feed-restricted groups.



CONCLUSIONS

A university study investigated the scope of intussusception and coccidiosis in pullet production systems involving feed restriction. An early feed restriction protocol starting at 14 days of age appeared to be a driver in the development of intussusception.

Outcomes also confirmed the ability of Coccivac-D2 to present homologous coccidial antigens to the immune system of vaccinated chicks regardless of feeding protocol, and subsequently generate effective immune responses capable of protecting birds against coccidiosis when older.

Vaccinates demonstrated a typical oocyst shedding pattern (9 to 32 days of age), a decline in oocyst shedding, and development of protective immunity by 28 and 35 days of age.

Further, no overcrowding effect by the different *Eimeria* species was apparent as birds developed protective immunity to all species during the same time period.

References.

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3. Olasemi GO, Olatunji-Akioye AO. A case report: jejunal intussusceptions associated with necrotic enteritis in a flock of pullets in Nigeria. Asian J Poultry Sci 2011; 5:130-134. doi: 10.3923/ajpsaj.2011.130.134

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