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Research Update

Effect of Original XPC™ on *Clostridium perfringens* induced necrotic enteritis in broilers

Clostridium perfringens (CP) is an extremely hardy, spore-forming bacteria often isolated from poultry feed and the poultry house environment. Since CP is a common bacteria in broiler chicken intestines, it is often found in the litter. The broiler disease, necrotic enteritis (NE), is a result of broiler intestinal damage usually occurring from *Eimeria maxima* and the presence of a toxigenic CP strain.

Currently, the international poultry industry is experiencing an increase in NE as a result of bans on the use of growth-promoting antibiotics in some countries as well as consumer preferences for decreased antibiotic use in food production.

Diamond V's Original XPC™ (XPC) has been shown to have an impact on pathogenic intestinal bacteria in poultry. Previous work with a CP challenge in broiler chickens has shown that feeding XPC can reduce intestinal lesions and mortality associated with NE (Broomhead et al., 2014). Improved body weight gains and feed conversion were also observed when XPC was fed, as compared to control CP challenged birds (Broomhead et al., 2014).

Furthermore, the inclusion of XPC in poultry diets has been reported to improve innate immunity by increasing natural killer cell activity (Jensen et al., 2008) and lysozyme activity (Gao et al., 2008; Gao et al., 2009) while dampening IFN-gamma production (Jensen et al., 2008). Adaptive immunity also has been impacted as shown by higher levels of secretory IgA (Gao et al., 2008; Gao et al., 2009) and increased antibody titers following Newcastle disease vaccination (Gao et al., 2009).

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Objective

The objective of this experiment was to determine the effects of feeding Diamond V XPC during a necrotic enteritis (NE) challenge in broiler chickens with a toxigenic *Clostridium perfringens* (CP).

Experimental design and treatments

- Male Cobb broiler chickens (n = 2,250)
- 5 treatments
- 9 replicate floor pens per treatment
- 50 birds per pen

Upon arrival at the farm, all birds were vaccinated by spray cabinet with Merck Coccivac-B at 2 times (double) the normal recommended dosage (Merck, Inc.) to help initiate the NE challenge model. All birds and feeders were weighed by pen on 0, 21, 35, and 42 days of age.

Treatment description

- T1 – Negative Control (NC), in which birds were not challenged with CP and did not receive medicated feed or XPC (benchmark treatment for this study, Table 1)
- T2 – Positive Control (PC), in which birds were challenged with CP and did not receive medicated feed (Table 1)
- T3 – Birds were challenged with CP and received XPC (2.5 lb/ton) in the feed from 0 to 42 days of age (XPC, Table 1)
- T4 – Birds were challenged with CP and virginiamycin (20 g/ton) was added to the feed from 0 to 42 days of age (VM, Table 1)
- T5 – Birds were challenged with CP and fed the combination of XPC (2.5 lb/ton) and VM (20 g/ton) from 0 to 42 days of age (VMX, Table 1)

Table 1. Experimental treatment design

Treatment	Feed Description (0 – 42 days of age)	Cocci-Vaccine[3]	CP Challenge[4]
T1-NC	Unchallenged; non-medicated	0 d	No
T2-PC	Challenged; non-medicated	0 d	19, 20 & 21 d
T3-XPC	Original XPC[1] 2.5 lb/ton	0 d	19, 20 & 21 d
T4-VM	Virginiamycin[2] 20 g/ton	0 d	19, 20 & 21 d
T5-VMX	XPC[1] 2.5 lb/ton + VM [2] 20 g/ton	0 d	19, 20 & 21 d

[1]Diamond V Original XPC™ (XPC), Diamond V, Cedar Rapids, IA
[2]Stafac20, Phibro Animal Health, Teaneck, NJ
[3]Coccivac-B, Merck Animal Health, Millsboro, DE
[4]*Clostridium perfringens* added to the complete feed at a dose of approximately $1x10^8$ CFU/mL/bird

Challenge administration, sample collection, and NE scoring

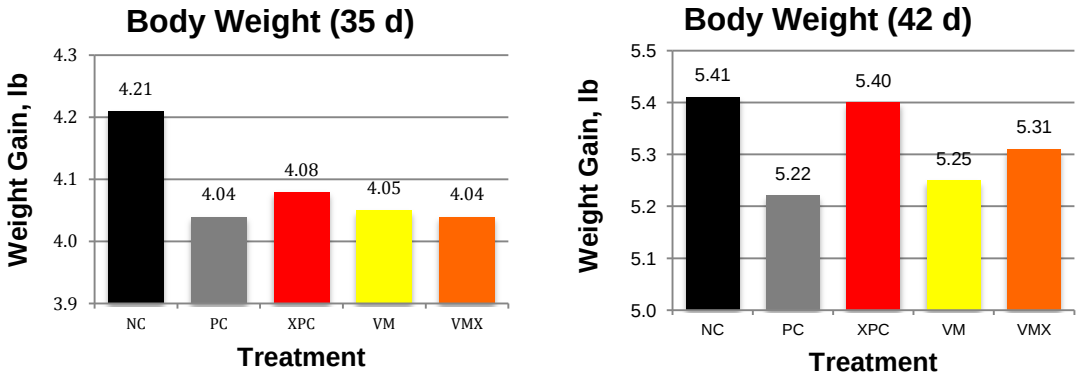
All birds except those in the NC group were challenged with *C. perfringens* (Table 1) . Samples collected from the intestine and scored for NE as described below.

1. NE challenge on test days 19, 20, and 21:
    a. *Clostridium perfringens* was added to the complete feed at a dose of approximately $1x10^8$ CFU/mL/bird.
    b. Coccidia challenge was from cycling of vaccination (Coccivac-B, Merck) at 0 days of age.
2. NE lesion scoring of the intestine of 5 birds per pen was conducted at 22 days of age, using a 0-3 scale (Hofacre et al., 1998):
    - Lesion score 0 = normal
    - Lesion score 1 = slight mucus covering small intestine
    - Lesion score 2 = necrotic small intestine mucosa
    - Lesion score 3 = sloughed and bloody small intestine mucosa and contents

Results

Body weight gain at 35 days of age was suppressed by the CP challenge in this study (Figure 1). However, by 42 days of age, birds in XPC treated group (T3) had appeared to recover, and were similar to those of the NC group.

Figure 1. Broiler body weight (BW) at 35 and 42 days of age



Following the CP challenge from 19 to 21 days of age, feed conversion ratio (FCR) was similar to NC group at 35 days of age in all feed treatment groups: XPC, VM, and the combination (VMX). By 42 days of age, birds in all 3 feed treatment groups showed statistically improved ($P < 0.05$) FCR compared to the challenged controls (PC) and were similar to the non-challenged group (NC). In the XPC group, FCR was 9 points lower than the PC birds. For the combination treatment (VMX), FCR was 13 points lower than PC birds (Table 2).

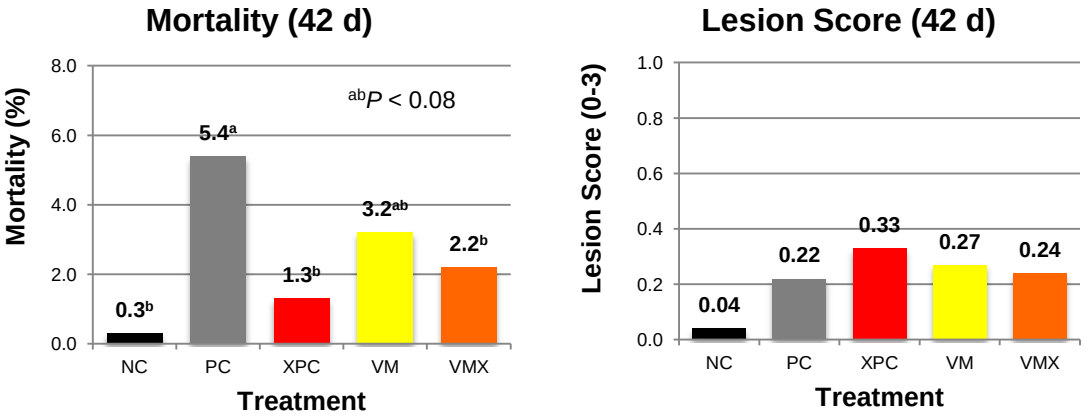
Table 2. Broiler adjusted feed conversion ratio (FCR) at 35 and 42 days of age

Treatment	Feed Description (0-42d)	35d FCR	42d FCR
T1-NC	Unchallenged; non-medicated	1.686^{b}	1.811^{b}
T2-PC	Challenged; non-medicated	1.764^{a}	1.921^{a}
T3-XPC	Original XPC 2.5 lb/ton	1.721^{ab}	1.829^{b}
T4-VM	Virginiamycin 20 g/ton	1.703^{b}	1.808^{b}
T5-VMX	XPC 2.5 lb/ton + VM 20 g/ton	1.686^{b}	1.794^{b}

^{ab} Values, within column, with different superscripts are statistically different ($P < 0.05$).

Mortality of challenged, untreated controls (PC) was higher ($P < 0.08$) than the non-challenged (NC) group (Figure 2). Feeding XPC, VM, and the combination (VMX) reduced ($P < 0.08$) 42 d mortality, similar to the non-challenged birds (NC). No statistical increases in lesion scores were observed in any of the challenged birds (T2-T5), indicating the sub-clinical nature of this floor pen challenge (Figure 2).

Figure 2. Treatment mortality and necrotic enteritis (NE) lesion score



Summary

1. *Clostridium perfringens* (CP) challenge in this study deceased performance and increased mortality of the non-treated controls (PC), indicative of necrotic enteritis (NE) in broilers in floor pens.
2. Feeding Diamond V Original XPC (XPC) restored 42 d body weights following the CP challenge.
3. Adding XPC or virginiamycin (VM) to the feed of challenged broilers in this study improved 42 d FCR by 9 and 11 points, respectively. The combination of virginiamycin and XPC (VMX) improved FCR by 13 points compared to birds in the challenged, untreated controls (PC).
4. Mortality was reduced in CP challenged broilers by feeding XPC, VM, and the combination of products (VMX).

References

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