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RESEARCH UPDATE

Campylobacter is one of the leading causes of foodborne illness. Traditional methods for controlling *Campylobacter* contamination have been focused within the processing plant, trying to prevent cross contamination through washing and evisceration.

It has been suggested that if colonization of *Campylobacter* could be controlled in the birds' intestinal tract, prior to slaughter, then contamination of processed birds also will be reduced.

The functional metabolites in Diamond V Original XPC™ have been shown to directly impact innate immunity by increasing natural killer cell activity (5) and lysozyme activity (3, 4), while reducing IFN-gamma production (5). Adaptive immunity is also impacted as shown by higher levels of secretory IgA (3,4) and increased antibody titer levels following vaccination (1, 3).

Experimental design

Two independent studies were recently conducted using a *Campylobacter coli* challenge to evaluate the effects of Original XPC on *C. coli* colonization and transmission. A broiler trial (Experiment 1) was conducted by the SPR Group near Nicholson, GA, and Experiment 2 was conducted at North Carolina State University near Raleigh, NC using commercial turkey hens.

Experiment 1: Broiler trial

Cobb chicks (n = 1,200) were housed in 24 floor pens (50 birds/pen) and assigned to one of 3 feed treatments (8 replicates each). Control birds (T1) received an industry standard Starter, Grower, and Finisher dietary regimen with no antibiotics or coccidiostat (Table 1). Treatments T2 and T3 received the control Starter diet with the addition of XPC at 2.5 lb/t from 0-21 d. After 21 d, XPC was reduced to 1.25 lb/t for T2 birds, while T3 birds continued to receive feed with 2.5 lb/t of XPC. All

Feeding Original XPC™ can help reduce *Campylobacter* in broilers and turkeys



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birds and feed were weighed by pen at 0, 21, 35, and 42 d. All birds were vaccinated with Coccivac-B at 0 d.

Table 1. Experiment 1– broiler diets

Feed	Age (d)	Feed Form	C. Protein (%)	ME (kcal/lb)
Starter	0-21	Crumbles	20.96	1,392
Grower	21-35	Pellets	20.03	1,421
Finisher	35-42	Pellets	19.16	1,437

Challenge administration and sample collection

At 14 d, 25-tagged birds per pen were orally gavaged with a gentamicin-resistant strain of *C. coli* containing approximately 10^5 to 10^6 cfu/ml (Table 2). The remaining 25 birds per pen did not receive a tag or *C. coli* challenge, and were used to determine horizontal transmission of *C. coli* from one bird to another.

Fifteen birds per pen (5 tagged and 10 non-tagged) were sampled at 42 d and the ceca removed for *C. coli* colonization evaluation. All samples were transported to the University of Georgia PDRC for *Campylobacter* analysis. The MPN (most probable number) method was used to enumerate *C. coli* (2).

Table 2. Design of broiler *Campylobacter coli* challenge in Experiment 1

ID	Description ¹	Cocci- Vac	<i>C. coli</i> ⁴ challenge	Ceca ⁵	Pens/Trt
T1	Non-medicated, No XPC	DOT 0	DOT 14	DOT 42	8
T2	XPC1 (2.5 & 1.25 lb/t) ²	DOT 0	DOT 14	DOT 42	8
T3	XPC2 (2.5 lb/t) ³	DOT 0	DOT 14	DOT 42	8

¹ Diamond V Original XPC, Diamond V, Cedar Rapids, Iowa.

² Starter and grower/finisher dietary inclusion rates, respectively.

³ Inclusion rate fed through 42 DOT (starter/grower/finisher diets).

⁴ 1 ml/bird *C. coli* broth containing approximately 10^5 to 10^6 .

⁵ Collected from 5 challenged and 10 non-challenged chicks per pen.

DOT = Day of trial.

Experiment 2: Turkey trial

Hybrid hen poults (n = 288) were assigned to one of 2 feed treatments, with 12 replicate floor pens per treatment and 12 birds per pen. Each pen had fresh pine shavings (4 in. thick) as bedding material. Feed and water were available ad libitum throughout the trial. Birds received 24 hours of light for the first 3 days, then natural light for the remainder of the study in a curtain-sided barn.

Four diet phases were fed during the 12-week study: Starter 1 (S1), Starter 2 (S2), Grower 1 (G1), and Grower 2 (G2), (Table 3). Feed treatments consisted of Control

(T1) or XPC (T2). XPC was added to the T2 rations at 2.5 lb/t in the two starter feeds (S1 and S2) and 1.25 lb/t in the two grower feeds (G1 and G2). Feed S1 was crumbled; feed S2 was a small, short pellet; and feeds G1 and G2 were standard pellets. Diets did not contain any antibiotic or coccidiostat.

All birds were weighed individually at 10 weeks, and at the end of the study at 12 weeks of age. Feed consumption was measured to calculate feed conversion ratio (FCR) at 12 weeks and during the challenge period (10 to 12 weeks).

Table 3. Experiment 2 – turkey hen diets

Feed	Feed/Bird (lb)	Feed Form	C. Protein (%)	ME (kcal/lb)
Starter 1	2	Crumbles	29.50	1,410
Starter 2	5	Small pellets	26.94	1,443
Grower 1	10	Pellets	25.10	1,511
Grower 2	20	Pellets	22.47	1,543

A gentamicin-resistant strain of *Campylobacter coli* was used to challenge birds, with targeted numbers of at least 10^6 cells per ml dose. At 10 weeks of age, 5 birds from each pen were wing banded and challenged with *C. coli*. The remaining 7 birds per pen were not banded or challenged, and were used to determine horizontal transmission of *Campylobacter* from challenged birds. Hens were given the challenge by gavage (oral inoculation).

At 12 weeks of age, 10 birds per pen (5 gavaged and 5 non-gavaged) were euthanized for sampling. The ceca were removed from each bird then transported to the NC State laboratory for processing.

Results

Experiment 1: Broiler trial

No statistical differences were observed for body weight gain or livability between treatments. Feed conversion was significantly improved ($P < 0.05$) by the addition of Original XPC at both inclusion levels on 35 d and 42 d, respectively (Table 4).

Table 4. Feed conversion ratio (FCR) by treatment at 35 d and 42 d in broilers

ID	XPC Concentration	FCR 35 d ¹	FCR 42 d ¹
T1	Non-medicated, No XPC	1.75 ^a	1.93 ^a
T2	XPC (2.5 & 1.25 lb/ton) ²	1.73 ^b	1.90 ^b
T3	XPC (2.5 lb/ton) ³	1.72 ^b	1.90 ^b

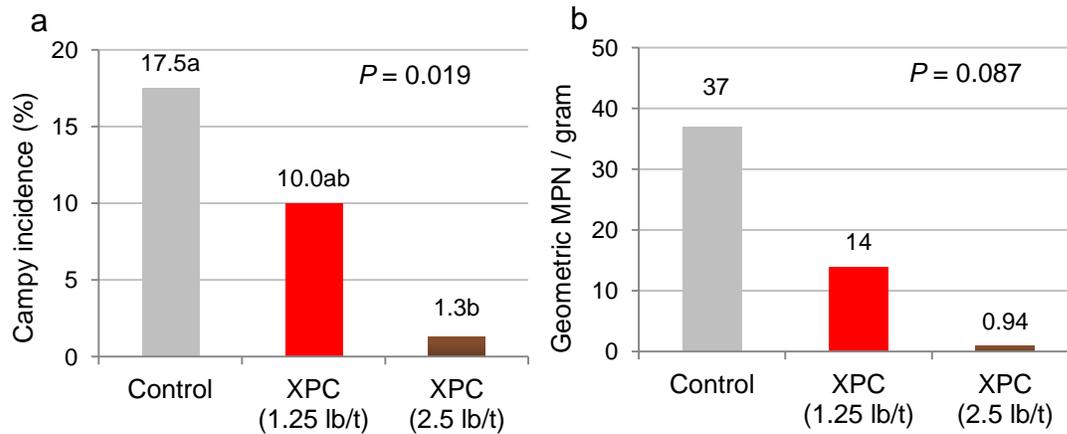
¹ Values within a column with different superscripts are statistically different ($P < 0.05$).

² Starter and grower/finisher dietary inclusion rates, respectively.

³ Inclusion rate fed through 42 DOT (starter/grower/finisher diets).

Campylobacter prevalence (%) in the ceca of 42 d contact challenged birds is shown in Figure 1a. A significant reduction in percentage of positives was observed in the contact challenged birds ($P = 0.019$) between the Control and XPC 2.5 lb/t (T3) groups, with the XPC 1.25 lb/t (T2) group being intermediate.

Figure 1a & b. Broiler cecal *Campylobacter* incidence and MPN (load) at 42 d of age.



Campylobacter MPNs for culture positive samples were only performed on contact-challenged birds. Treatment MPN distributions are illustrated in Figure 1b. Of the three treatments, the birds fed XPC 2.5 lb/t (T3) had the lowest MPN ($P = 0.087$).

Experiment 2: Turkey trial

Body weight gain was not significantly different between treatments at 10 wk or 12 wk of age. Feed conversion was significantly improved ($P < 0.05$) in Original XPC hens both during the challenge period and overall through 12 wk (Table 5).

Table 5. Feed conversion ratio (FCR) in turkeys from 10-12 wk and overall 0-12 wk

ID	Description	FCR 10-12 wk ¹	FCR 0-12 wk ¹
T1	Control – No XPC	2.56 ^a	1.95 ^a
T2	XPC (2.5 lb/t; 1.25 lb/t) ²	2.38 ^b	1.90 ^b

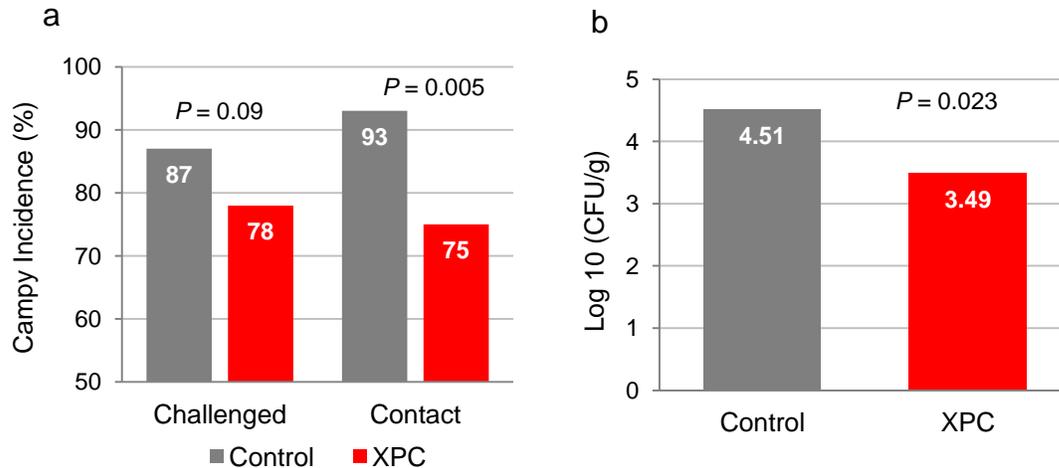
¹ Values within a column with different superscripts are significantly different at $P < 0.05$.

² XPC was added to the Starter diets at 2.5 lb/t then reduced to 1.25 lb/t in Grow/Finish feeds.

Results for *Campylobacter* incidence (% positives) were significant (Figure 2a) as hens fed XPC showed a reduction in numbers ($P = 0.023$). Prevalence was reduced in the non-inoculated birds from 93% to 75% in the XPC group. Turkey hens consuming XPC exhibited a full log reduction in *C. coli* colonization from 4.51 to 3.49 (Figure 2b).

Results from this study support results from Experiment 1 with broiler chickens, where XPC-fed birds had a lower incidence and load of *Campylobacter* at market age.

Figure 2a & b. Turkey cecal *Campylobacter* incidence and Log¹⁰ CFU (load) at 84 d of age.



Conclusions

- Adding Original XPC to the feed of broiler chickens and turkey hens significantly improved feed conversion at market age.
- The addition of XPC to the feed at 2.5 lb/t resulted in a lower incidence of *Campylobacter coli* isolated from commercial broilers at 42 d of age.
- The incidence and load of *Campylobacter coli* were significantly reduced at 12 wk of age in XPC-fed turkeys.
- Feeding XPC to broilers and turkey hens can reduce the load of *Campylobacter* (MPN or cfu) in horizontally challenged birds.

References

1. Al-Homidan A., and M.O. Fahmy. 2007. The effect of dried yeast (*Saccharomyces cerevisiae*) supplementation on growth performance, carcass chemical analysis, immunity, ileum villi heights, and bacterial counts of broiler chickens. *Egypt Poul. Sci.* 27:613-623.
2. Berghaus, R., S. G Thayer, B. F. Law, R. M. Mild, C. L. Hofacre and R. S. Singer, 2013. Enumeration of *Salmonella* and *Campylobacter* in environmental farm samples and processing plant carcass rinses from commercial broiler chicken flocks, *Appl. Environ. Microbiol.* 1-37.
3. Gao, J., H. J. Zhang, S. H. Yu, S. G. Wu, I. Yoon, J. Quigley, Y. P. Gao, and G. H. Qi. 2008. Effects of yeast culture in broiler diets on performance and immune-modulatory functions. *Poult. Sci.* 87:1377-1384.
4. Gao, J., H. J. Zhang, S. G. Wu, S. H. Yu, I. Yoon, D. Moore, Y. P. Gao, H. J. Yan, and G. H. Qi. 2009. Effect of *Saccharomyces cerevisiae* fermentation product on immune functions of broilers challenged with *Eimeria tenella*. *Poult. Sci.* 88:2141-2151.

5. Jensen, G. S., K. M. Patterson, and I. Yoon. 2008. Yeast culture has anti-inflammatory effects and specifically activates NK cells. *Comp. Immun. Microbiol. Infect. Dis.* 31:487–500.



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