# Reducing pre-harvest pathogens to optimise poultry performance

Human illnesses attributed to foodborne pathogens are not decreasing. Rather, the data suggest an increase over the past decade. Pathogenic bacteria such as salmonella, campylobacter, and Escherichia coli are frequently associated with consumption of animal protein products, and are often cited among the top five pathogens causing foodborne illness in the US. Companies producing poultry, eggs and other foods of animal origin need effective food safety programs.

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Consumer awareness of food safety issues is greater than ever and continues to rise. As a result, food retailers are marketing products based upon consumer perceptions of food safety attributes. Product labelling now includes statements regarding restricted use of antibiotics, hormones, and GMOs (genetically modified organisms).

Further, some products qualify animal housing conditions – such as 'free-range chicken' – because consumers are increasingly interested in where their food comes from and how it is produced.

## Direct correlation: pre-harvest and post-harvest contamination

Most efforts to reduce pathogen load in food animals and products, including chemicals applied during processing, are not completely effective. Research shows that the pre-harvest pathogen contamination of animals, especially poultry, correlates directly with the post-harvest presence of pathogens in food products.

Responsibility for foodborne pathogen control lies within each segment of the food chain, from farm to fork, in order to produce a safe, sustainable, and abundant food supply. Pre-harvest actions are important for food safety, as the prevalence and numbers of pathogens entering the processing plant correlate directly with pathogen levels found in the plant. Thus, control of foodborne pathogens at the farm level leads to safer product entering food processing and delivery of safer food to the consumer.

Therefore, food companies and the farmers who supply them should consider effective pre-harvest, on-farm interventions to significantly minimise pathogen prevalence (percent positive occurrence) and contamination load (number of pathogenic organisms) coming into the food processing plant. A multi-step food safety program, including pre-harvest pathogen reduction, would result in a larger margin of safety by increasing the number of steps used against foodborne pathogens.

## Protect your brand

Responsibility for producing a safe food supply begins at the farm and continues throughout the food chain. Diamond V's proprietary fermentation technologies, the result of more than 70 years of scientific research and on-farm development, offer unmatched benefits and solutions for food animal production. The pre-harvest technologies of Diamond V products promote animal health and human food safety while helping to optimise poultry performance.

Diamond V Original XPC (XPC) is recommended for dietary inclusion throughout all production stages, across all species. It is an all-natural nutritional product that includes functional metabolites from a proprietary fermentation process with Saccharomyces cerevisiae. Extensive controlled research shows that XPC, when added to animal feeds, including poultry feeds, reduces the colonisation and shedding of foodborne pathogens pre-harvest.

Research detailed in the pending patent has demonstrated that feeding XPC to egg laying hens, meat-type chickens, and turkeys reduced percent positive occurrence (prevalence) of salmonella and campylobacter isolated from birds and their environment. In addition to reducing the prevalence, there also was a reduction in the number (load) of salmonella and campylobacter organisms isolated from the reduced number of positive birds.

Diamond V's pending patent is based on multiple studies conducted at multiple research institutions using several different strains of salmonella and campylobacter.

The resulting body of scientific knowledge on the effects of XPC on foodborne pathogen reduction represents the largest collection of pre-harvest research projects of this type in the world. These projects are the replicable work of leading investigators at multiple research locations using varying methods. The quality and consistency of these multiple sources of reliable data further support Diamond V's unique pending patent.

Research indicates that Original XPC can be technology vital for the food industry today and for the foreseeable future, providing an effective, all-natural approach to improve the safety of poultry and eggs by reducing colonisation and shedding of foodborne pathogens.

Listed below are brief summaries of research studies described in Diamond V's pending patent.

## Reduced salmonella load

The addition of Original XPC results in reduced salmonella numbers in poultry:

- **Rubinelli et al. (2015).** Added XPC significantly reduced ($P<0.05$) S. typhimurium counts by 3.5 $\log^{10}$ compared to the control samples in an in vitro broiler chicken intestinal model system.
- **Rubinelli et al. (2015).** A significant ($P<0.05$) 2 log reduction of S. enteritidis was observed when XPC was added to an in vitro intestinal model utilising caecal contents from layer pullets.
- **Hofacre et al. (2015).** Sixteen houses of commercially grown and processed turkey toms, slaughtered at approximately 20 weeks of age, had a significantly lower ($P=0.014$) salmonella load when XPC was fed (2.5lb per ton). The average numbers of salmonella for XPC-fed toms was 2.0 $\log^{10}$, which was significantly lower than control-fed toms at 2.4 $\log^{10}$ ($P=0.017$).
- **Smith et al. (2015).** Pen-raised turkey hens inoculated with S. typhimurium at one day

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of age and S. heidelberg at 56 days of age had significantly lower (P<0.05) average MPN (most probable number) of salmonella compared to hens fed control diets (1.1 vs. 2.9, respectively) when processed at 84 days.
- **Nsereko et al. (2013).** S. heidelberg growth was significantly suppressed by XPC (P<0.001) by 0.4 log in an in vitro poultry model compared to the control treatment without XPC inclusion.
- **Nsereko et al. (2013).** XPC significantly suppressed (P<0.001) the growth of S. Arizonae in turkeys by 0.5 $\log^{10}$ compared to the control.
- **Ibukic et al. (2012).** Floor pen-raised pullets fed XPC had significantly lower S. enteritidis numbers in the caeca at 34 days compared to control pullets (3.6 vs. 4.5 $\log^{10}$ CFU, respectively; P<0.0001).
- **Broomhead, et al. (2012).** S. enteritidis growth was suppressed by 1 log (90%) by the addition of XPC to faecal inoculant derived from hen excreta (P<0.001) in an in vitro poultry intestinal model.

## Carcase rinse

The addition of Original XPC also results in reduced salmonella prevalence (occurrence through natural challenge), as measured in the poultry processing plant:
- **Hofacre et al. (2015)** reported that commercial broiler chickens fed XPC (2.5lb per ton) had lower prevalence of salmonella than broilers fed a diet without XPC. Methodology: Broilers were raised in 16 houses on the same farm; broilers in eight adjacent houses were fed XPC and broilers in eight other adjacent houses were fed a control diet (no XPC).

At approximately 46 days of age, broilers were slaughtered at a commercial plant and 25 carcases per house were rinsed at rehang (between defeathering and evisceration) for salmonella evaluation.

Control broiler carcases were 8.5% positive for contamination (17/200), while contamination of XPC-fed birds was significantly lower (P=0.011) with only one bird testing positive (0.5%).

## Caecum

The addition of Original XPC results in reduced salmonella prevalence, as measured in poultry caeca samples:
- **Roto et al. (2015).** Prevalence of caecal salmonella (natural challenge) in XPC-fed broilers raised in floor pens was approximately 8%, which was significantly lower (P<0.05) compared to control-fed broiler caeca (19%) at 42 days of age.
- **Hofacre et al.** (2015). Sixteen houses of commercially grown and processed turkey toms, slaughtered at approximately 20 weeks of age, had a significantly lower (P=0.014) salmonella prevalence when XPC was fed (2.5lb per ton), with a detection of 41.7% positives (83/200), versus the control toms at 66.5% positives (133/200).
- **Ibukic et al. (2012).** Floor pen-raised pullets fed XPC had significantly lower caeca prevalence of S. enteritidis at 34 days compared to control pullets (60% vs. 95%, respectively; P<0.0001).

## Reduced campylobacter

Unprecedented findings suggest pre-harvest use of Original XPC significantly reduces campylobacter prevalence in poultry:
- **McIntyre et al. (2014).** Caecal contents were evaluated from broiler chickens raised in pens 0-42 days and challenged with C. coli on day 14. Caecal contents from broiler chickens challenged with C. coli and fed XPC had significantly lower C. coli prevalence than challenged birds fed a control diet (1.3% vs. 17.5%, respectively; P=0.02). Broiler chickens fed XPC also had a lower MPN than the control birds (0.94 and 37 MPN/g, respectively; P=0.09).
- **Smith et al. (2014).** Turkey hens inoculated with C. coli had significantly (P<0.05) lower prevalence in the caeca at 84 days of age when fed XPC, compared to hens not fed XPC. Pathogen prevalence was significantly (P<0.05) reduced in non-inoculated birds (exposed to horizontal transmission), from 93% to 75%, for XPC-fed turkey hens when compared to control hens. Turkeys inoculated with C. coli also had significantly (P<0.05) lower numbers in the caeca at 84 days of age when fed XPC, compared to hens not fed XPC. C. coli was reduced by one log (from 4.5 to 3.5 $\log^{10}$) for XPC-fed turkey hens when compared to control hens.

## Increased VFA production

Research findings show Original XPC increases volatile fatty acid (VFA) levels, specifically butyrate:
- **Rubinelli et al. (2015).** XPC produced a doubling of short chain fatty acids (acetate and butyrate) at 24 hours, compared to control samples in an in vitro poultry intestinal model challenged with S. typhimurium.
- **Nsereko et al. (2013).** VFA levels, especially butyrate, were increased by 300% (P<0.05) from XPC inclusion compared to controls in an in vitro poultry model challenged with S. heidelberg compared to the model without XPC inclusion.
- **Nsereko et al. (2013).** Turkey inocula treated with XPC had increased (P<0.05) VFA levels and increased butyrate, compared to control samples in an in vitro poultry intestinal model challenged with S. arizonae.
- **Broomhead, et al. (2012).** XPC increased VFA levels, including butyrate, in XPC-treated samples (P<0.001) in an in vitro poultry intestinal model challenged with S. enteritidis. ■