Are Fungi Involved in Coinfections?

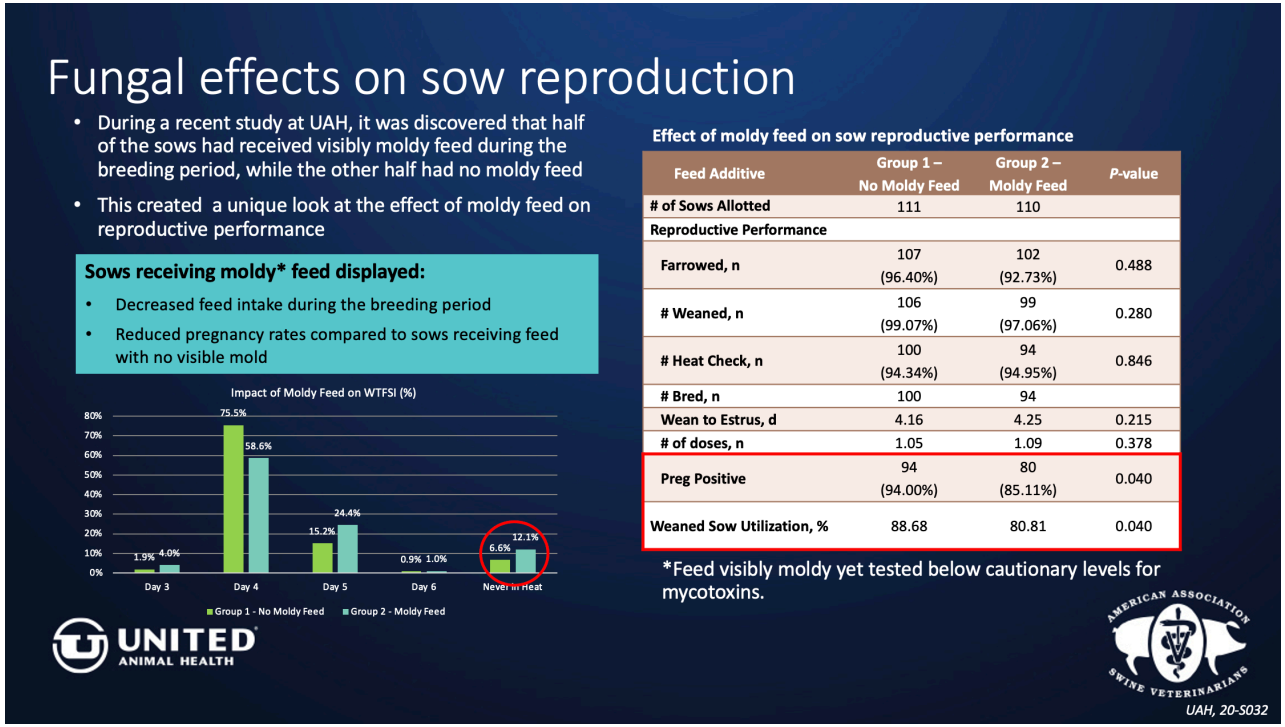
Recent PathKinex™ data shows the potential connections between fungi and pathogenic bacteria in animals' GI tracts.

Microscopic fungi are ever-present in the environment, living on plants and in soil and spreading airborne spores for miles. A particular type of these fungi, called mycotoxigenic fungi, can produce and spread mycotoxins, poisonous compounds that harm animals or humans when consumed. The prevalence of fungi depends on weather and climate factors, as different weather conditions may favor the growth of

different species. It is possible to forecast which mycotoxins are likely to affect a region based on the weather during a growing season (1). If a season is bad across several regions, many producers will be affected, and they will all need solutions for the downstream effects.

Although some mycotoxin-contaminated feedstuffs have visible mold or other signs of spoilage, even "clean corn" and other feedstuffs may contain high levels of unseen mycotoxic fungi, which can produce mycotoxins during storage if the grain is damaged or if environmental conditions support additional fungal growth. When the contaminated feedstuffs are consumed, the mycotoxins may cause immune suppression or inflammation in an animal's GI tract, opening the door for other opportunistic pathogens present in the gut.

While some fungi are mycotoxin producers, certain non-mycotoxigenic fungi in diets can also compromise feed hygiene, reduce feed consumption, and potentially alter microbial populations in the gut, leading to challenges with dysbiosis. In swine, these factors can translate into losses in production, with pregnancy rates decreasing significantly in sows consuming moldy feed.



Fungi and their mycotoxins can contribute to dysbiosis and disease

Most major mycotoxins can suppress and damage an animal's immune system in the long term, even if short-term exposure starts out with a burst of immune system activation and inflammation (2). **Figure 1** shows a few common mycotoxins and their effects on an animal's health.

Common mycotoxins	Causes GI distress, low feed intake and slow growth	Causes inflammation in the GI tract lining and damages the intestinal barrier	Is cytotoxic to multiple organ systems including the liver and kidneys	Causes immunosuppression with longer-term exposure	Decreases animals' defenses against pathogenic bacteria
Aflatoxin (produced by Aspergillus flavus and A. paraciticus)				✓	✓
Fumonisin (produced mainly by Fusarium species)		✓	✓	✓	✓
Vomitoxin (produced by Fusarium species)	✓			✓	✓

Figure 1. Common mycotoxins, the fungi that produce them, and their effects.

PathKinex™ data shows us the connection between fungi and pathogenic bacteria in the GI tracts of pigs, chickens, and dairy cows

In monogastric livestock animals, we see a strong connection between the presence of *Aspergillus* marker genes in the GI tract and the presence of pathogenic bacteria. This includes *E. coli*, *Campylobacter*, and *Lawsonia* markers in nursery pigs **(Figure 2)** and avian pathogenic *E. coli* (APEC), *Campylobacter,* and *Enterococcus cecorum* in broiler chickens **(Figure 3)**.

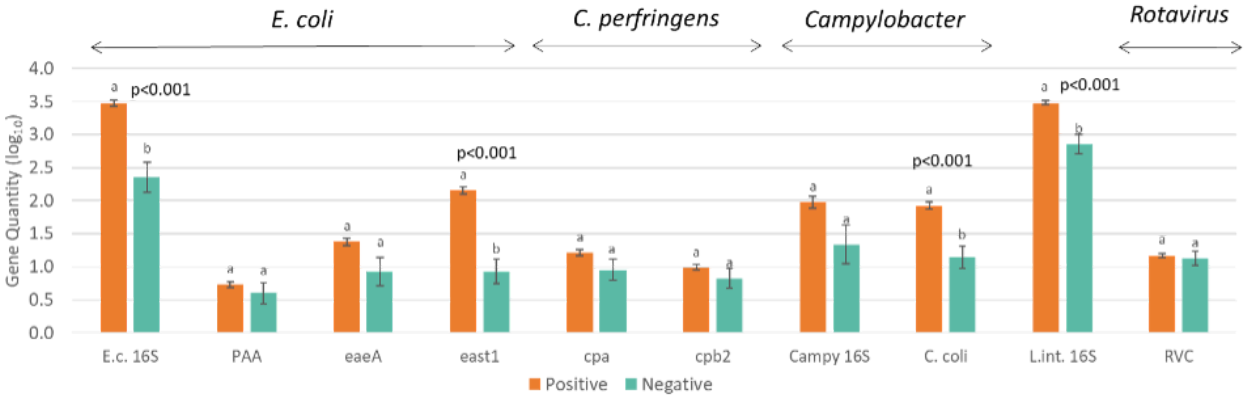


Figure 2. Certain *E. coli*, *Campylobacter*, and *Lawsonia* markers are higher in nursery pigs when *Aspergillus* spp. are present.

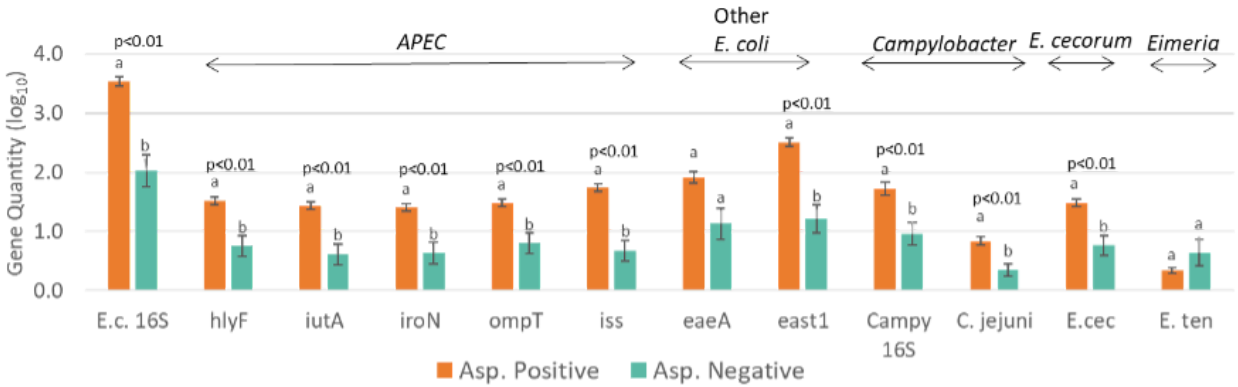


Figure 3. APEC, *Campylobacter*, and *Enterococcus cecorum* markers are higher in broiler chickens when *Aspergillus* ssp. are present.

In dairy cows, we did not see the same relationship between mycotoxic fungi and *E. coli*, but we observed higher levels of *Clostridium difficile* and *Clostridium chauvoei* **(Figure 4)**. This could be because dairy cows ferment their feedstuffs for an extended time in the rumen. Ruminants have been thought to be less sensitive to some mycotoxins because the complex rumen microbiota may degrade some mycotoxins. However, there is still a link between mycotoxin consumption, milk and meat safety, and animal health (4).

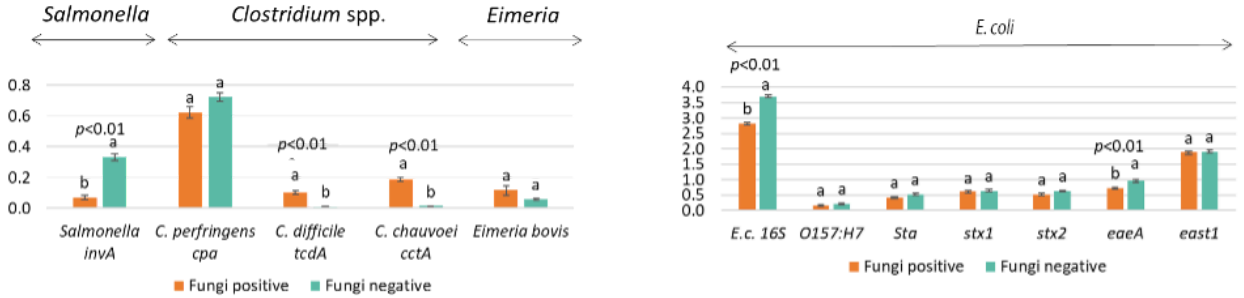


Figure 4. *Clostridium chauvoei* (blackleg) and *Clostridium difficile* are elevated in cows with at least one fungal marker gene.

In PathKinex™ data from all species, pathogenic bacteria were found to "ride along" with fungi, creating a coinfection scenario that may be more severe than we are likely to see from each stressor individually. Mycotoxin exposure can promote the growth and colonization of pathogenic bacteria, but it is these bacteria themselves that can cause acute, severe disease and a crash in an animal's health. Even though it's hard to get away from mycotoxins, we have effective products and tools to reduce their effects and control their partners in crime.

What can we do about mycotoxins and pathogenic bacteria in livestock diets?

Your customers may find the greatest success by selecting products with multiple functions that can attack the problem of fungi, mycotoxins, and pathogenic bacteria from multiple angles.

- **Mycotoxin-adsorbents** can adsorb and decrease exposure to mycotoxins in the digestive tract.
- **Immune-modulating functional ingredients** can help decrease intestinal inflammation, protect barrier function, and adhere to opportunistic pathogenic bacteria, helping to eliminate them from the gastrointestinal tract.
- **Live *Bacillus*** can exert anti-microbial activity directly against mycotoxic fungi and against populations of opportunistic bacteria that thrive in a GI tract under stress. Other *Bacillus* strains may have beneficial immune-modulating effects that can help prevent excessive, damaging inflammation in the GI tract.

For customer-facing Seismic users, consider reviewing the following:

- **Microbial Cross Species Insights:** presented during Coinfection Session at the 2023 Global Sales Meeting
- **M-Mobilize – Sow Focus Contaminated Diets Technote:** Summarizes learnings from feeding sows mold contaminated diets and benefits observed when M-Mobilize was present.
- **Mycotoxin PPT GSM 2023 Update:** Presented by Dr. Adrienne Woodward during swine breakout at 2023 Global Sales Meeting
- **PathKinex Meta Analysis Poster:** Presented by Beth Galbraith at the 2021 AASV Meetings

How are your customers promoting animal health and resilience when mycotoxin challenge is highest?

Interested to Learn More on the Topic of Coinfections?

Respond to MDG

Is there a topic you'd like to learn more about in a future newsletter? We enjoy hearing from you! We welcome your questions, comments, and suggestions on PathKinex updates. Please contact us at AnimalAg@mdgbio.com

References

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