

PATHKINEX UPDATE

Bacillus strains in ProVent® ECL were selected from high performing animals and screened for superior antimicrobial activities, so it is not surprising that these strains can effectively inhibit a wide range of *E. coli* and other important swine pathogens. But what about recent strains of multi-drug resistant F18+ or other highly virulent *E. coli* plaguing swine farms in recent months? How does ProVent® ECL stand up against today's highly pathogenic *E. coli* isolates?

ProVent® ECL is up to the challenge

In this update, we explore the use of ProVent® ECL and its ability to inhibit highly pathogenic *E. coli* isolated from recent commercial outbreaks by veterinary diagnostic labs.

Rising *E. coli* Challenges

Recent reports from the Iowa State University diagnostic laboratory indicate that K88 and F18 strains of *E. coli* have been steadily on the rise since 2010, but due to a dramatic surge in F18 cases in 2020-2021, F18 cases now far outnumber K88 cases¹. While the F18 or K88 fimbrial adhesins are responsible for binding to intestinal receptors, it is the toxins that these strains release that cause the bulk of the intestinal damage. This is what makes the rise in the proportion of isolates harboring Shiga toxin genes¹ also of concern, indicating that the virulence of recent isolates has also increased. Furthermore, increasing resistance of recent *E. coli* diagnostic isolates to multiple antibiotics may reduce treatment options available to veterinary health teams².

Management of enteric challenges often requires a combination of strategies including biosecurity, sanitation, vaccination, dietary modification, and other interventions to promote gut integrity. Amongst these, *Bacillus*-based direct-fed microbials can play a critical role as a tool in a comprehensive approach to promote gut integrity and a healthy microbiota. However, vast differences in capabilities exist across *Bacillus* strains and commercially available products. Here we investigated whether the *Bacillus* strains within ProVent® ECL could inhibit the growth of *E. coli* isolates associated with commercial outbreaks.

Method

For this analysis, 45 pathogenic *E. coli* isolates from 13 different producers were provided by veterinary diagnostic laboratories after culture analysis, genotyping, and/or antibiotic susceptibility testing. All isolates were associated with enteric health challenges, scouring events and/or high mortality. *In vitro* agar cross-streak assays were used to assess the antimicrobial activity of individual *Bacillus* strains in ProVent® ECL against these *E. coli* isolates.

Year Isolated	Percent of Isolates	Virulence Genes**	Percent of Isolates	Antibiotic Resistance*	Percent of Isolates
2018	24%	F18+	81%	Resistant to >4	100%
2019	13%	K88+	16%	Resistant to >5	97%
2020	11%	Stx2e+	56%	Resistant to >7	90%
2021	47%	> 3 toxin genes	78%	Resistant to >8	87%
2022	4%			Resistant to >9	73%
				Resistant to >10	50%

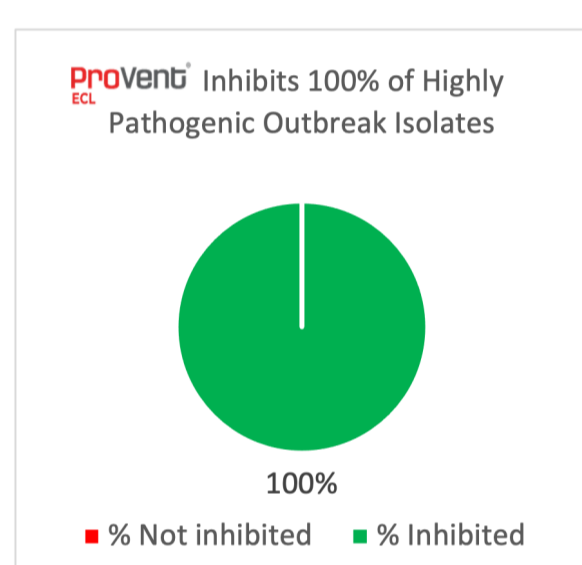
Overview of *E. coli* isolates antibiotic resistance and virulence gene profiles of the 45 *E. coli* isolates used.

** Genotyping data was provided for 71% of isolates.

*Antibiotic resistance data was provided by diagnostic laboratories for 67% of isolates.

Figure 1. Summary of *E. coli* isolate profiles provided by Veterinary diagnostic laboratories.

ProVent® ECL *Bacillus* show inhibitory activity against 100% of disease-associated *E. coli* isolates collected from veterinary diagnostic laboratories



Findings

- ***Bacillus* strains in ProVent® ECL show effective *in vitro* inhibition of the growth of a wide variety of *E. coli* isolates causing enteric outbreaks on commercial farms.**
 - Provent® ECL strains successfully inhibited growth of 100% of tested *E. coli* from veterinary diagnostic laboratories in an *in vitro* assay.

ProVent® ECL Antimicrobial Susceptibility Testing shows high degree of inhibitory coverage of all 45 highly pathogenic *E. coli* isolates.

While *Bacillus* can provide a wide variety of benefits to the host, not all strains perform equally, and no single strain can do it all. Intensive screening with a diverse variety of enteric pathogens during development was key to ensuring ProVent® ECL's broad, effective protection. The heat map below illustrates the power of our multi-strain approach against 45 highly pathogenic *E. coli* isolates.

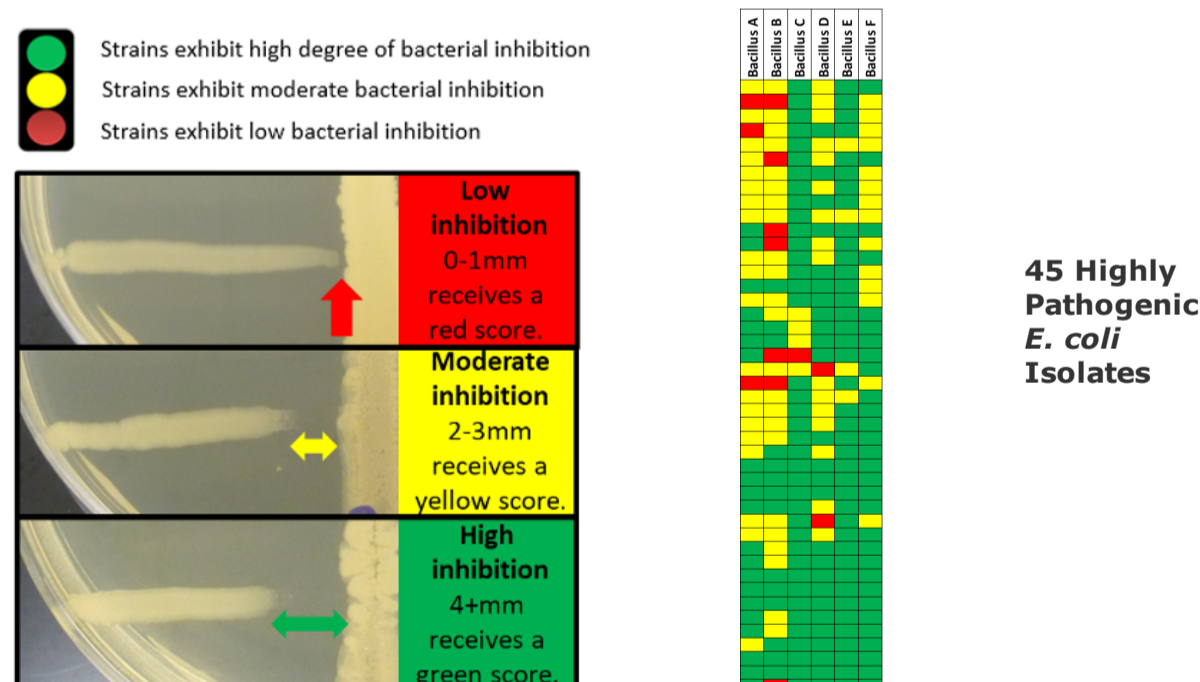


Figure 3. Heat map summary of antimicrobial susceptibility testing results for 45 swine veterinary *E. coli* isolates.

Action

Virulence gene-harboring, multi-drug resistant *E. coli* can be troublesome for today's swine health teams. While the impacts of pathogenic *E. coli* are often in the spotlight, United Animal Health's Pathkinex surveillance work has found that the relative risk of disease is elevated to an even greater extent when virulence genes from multiple pathogen types are present³. Additional environmental stressors such as weaning or heat stress also compromise gut integrity, further increasing the risk of opportunistic pathogens. Complex enteric challenges require comprehensive tools. ProVent® ECL is up to the challenge, containing a combination of complimentary *Bacillus* selected from high performing animals and screened for broad antimicrobial capabilities. These strains, combined with a blend of synergistic ingredients, work together to provide ProVent® ECL comprehensive capabilities as a tool for managing enteric health in challenge situations.

Discussion Question

What interventions are your customers most frequently utilizing for management of virulent F18+ *E. coli* on their farms?

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:

1. 21, A. H. | A. (2022, April 21). *Why are we seeing more F18 now?* National Hog Farmer. Retrieved April 22, 2022, from <https://www.nationalhogfarmer.com/animal-health/why-are-we-seeing-more-f18-now>
2. Magstadt, D., Murray, D., Kuecker, K. (2021, September 28). F18-Associated Gut Edema Management [Webinar]. Swine Health Information Center (SHIC) and American Association Swine Veterinarians (AASV).
3. Galbraith, E, Leistikow, K, Son, S, Lee, J, King, M. (2021) Surveillance of microbial virulence genes in over 5000 pigs reveals associations between gene abundance, health status and production stage. Proceedings, 52nd Annual American Association of Swine Veterinarians.356.

Pathkinex™ Updates are intended to provide you with the latest research insights on emerging pathogens and are for your internal use.

Together United Animal Health and Microbial Discovery Group are pioneering the investigation of relationships between microbial database genes and animal health. Our PathKinex™ platform and growing database of rectal and intestinal swab samples provide a unique resource for identifying and exploring connections between microorganisms and host or environmental factors, and we are pleased to share our key findings with you!