Salmonella 201: The Importance of *Salmonella* Diversity

In our last PathKinex™ update, we discussed challenges associated with *Salmonella* in poultry and livestock production and explored available pre-harvest solutions to help reduce it. In this edition, we investigate the topic of serotype diversity within *Salmonella* and discuss why diversity is a crucial consideration when evaluating *Salmonella* interventions. Then, we take a sneak peek of the serotypes we are detecting through our PathKinex™ surveillance work.

Characterizing *Salmonella* Diversity Through Serotyping

Salmonella is a widely diverse genus with many serotypes, a factor that makes finding effective solutions more difficult. Serotypes are groups within a single species of microorganisms that share distinctive surface structures. *Salmonella* are separated into many serotypes based on two surface structures: the O antigen—the outermost portion of the bacteria's surface covering—and the H antigen—a slender, threadlike structure that is part of the flagella.[1] Different serotypes have varying levels of ability to cause illness.

There are **more than 2,500 *Salmonella* serotypes**, and some of these can be further classified into groups of strains that differ by their gene contents. These are referred to as genovars.

Poultry:
Non-typhoidal *Salmonella* is responsible for approximately 93 million cases of gastroenteritis and 155,000 fatalities around the world each year. Poultry is a major reservoir for various non-typhoidal *Salmonella* serotypes among food-producing animals, so the most common serotypes of avian origin are studied closely. These include:

- *Salmonella* Typhimurium
- *Salmonella* Enteritidis
- *Salmonella* Heidelberg

Dairy:
Detecting *Salmonella* in the feces of dairy cows or calves and in the environment on dairy farms is common. A study performed by the USDA's National Animal Health Monitoring System (NAHMS) displayed that 40% of dairy operations had at least one cow that was *Salmonella*-positive via fecal culture.[2] Most common serotypes in dairy include:[3]

- *Salmonella* Dublin
- *Salmonella* Cerro
- *Salmonella* Montevideo
- *Salmonella* Kentucky

Swine:
Clinical salmonellosis in swine is most commonly associated with two serovars: *Salmonella* Choleraesuis and *Salmonella* Typhimurium. *Salmonella* infections in

pigs are frequently asymptomatic; however, when symptoms are present, they are often characterized by yellow diarrhea, dehydration, decreased feed intake, fever, and wasting.[4]

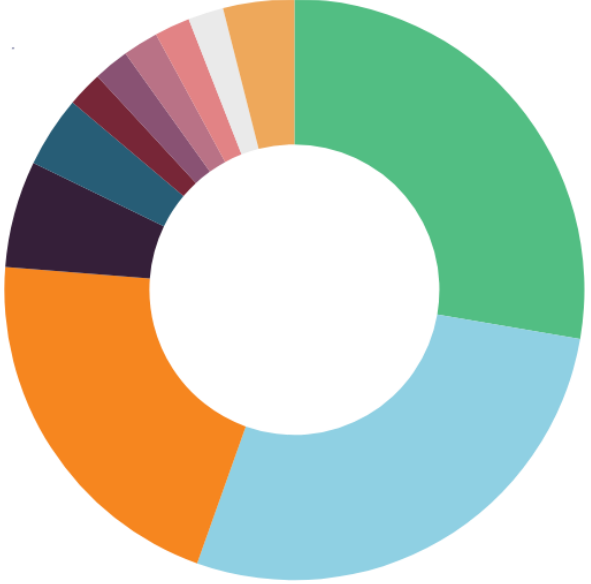
Building *Salmonella* Diversity in Our Strain Libraries

Salmonella serotypes can vary by geographical region, predominance of specific serotypes can fluctuate over time, and new serotypes can emerge. To meet these challenges, a diverse *Salmonella* library representative of contemporary serotypes is critical for screening and development of novel control solutions. This can help ensure that the intervention works across most or all serotypes and has a greater likelihood of providing efficacy as new serotypes arise.

To build diverse *Salmonella* libraries here at Microbial Discovery Group, we have cultured hundreds of isolates from the ceca, intestine, and environment of poultry during the live production period. Isolates from international poultry sources are represented in our collection as well. Our libraries also contain *Salmonella* from a variety of other sources including post-harvest retail chicken, backyard chickens, dairy cows and calves, and swine.

Serotyping at Microbial Discovery Group

We serotyped a subset of our library's isolates from U.S.-originated poultry, international poultry, and post-harvest poultry. *Salmonella* Enteritidis and *Salmonella* Typhimurium were in the top three detected serotypes of each group of isolates that we tested, corresponding to the most common serotypes from the literature.



U.S. Poultry Serotypes

Salmonella Typhimurium - 28%
Salmonella Infantis - 28%
Salmonella Enteritidis - 21%
Salmonella Rissen - 6%
Salmonella Thompson - 4%
Salmonella Kentucky - 2%
Salmonella Schwarzengrund - 2%
Salmonella Molade - 2%
Salmonella Heidelberg - 2%
Salmonella Minnesota - 2%
Salmonella Unclassified Genovar - 4%

Figure 1: Serotyping results of 53 U.S. poultry *Salmonella* isolates.

International Poultry

Salmonella Enteritidis - 37%
Salmonella Infantis - 12%
Salmonella Senftenberg - 5%
Salmonella Kentucky - 2%
Salmonella Schwarzengrund - 2%
Salmonella Unclassified Genovar - 34%

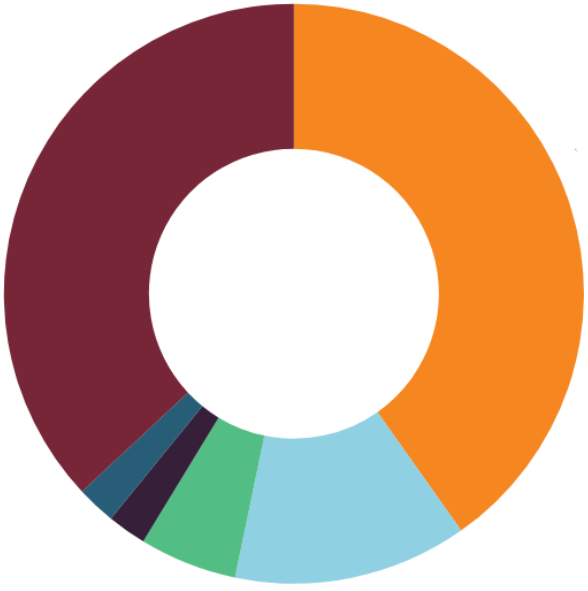


Figure 2: Serotyping results of 41 international poultry *Salmonella* isolates.

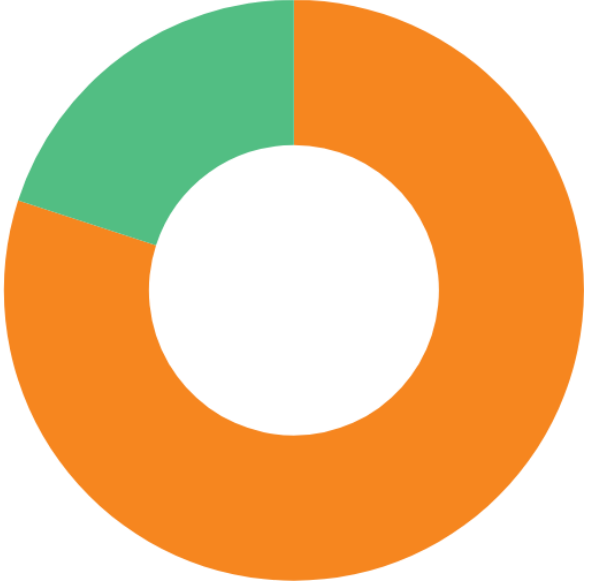


Figure 3: Serotyping results of 10 post-harvest poultry *Salmonella* isolates.

Salmonella diversity poses significant challenges for mitigation in poultry and livestock production, and the emergence of new serotypes could further complicate disease management and control. A diverse *Salmonella* library is an important prerequisite for the evaluation of novel solutions. Comprehensive strategies that target multiple serotypes simultaneously, help address other coinfecting pathogens, and promote a healthy gastrointestinal tract may be most effective in controlling *Salmonella*. Implementing such measures is crucial to safeguarding animal health and food safety, ultimately protecting public health.

Question to consider:

How are your customers currently handling challenges with *Salmonella*?

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Helpful Links:

PathKinex™ Update February 2024: *Salmonella* Coinfections
PathKinex™ Update October 2023: Dairy *Salmonella*
Global Sales Meeting 2023: Microbial Cross-Species Insights

References

1. Centers for Disease Control and Prevention. (2022, September 9). *Serotypes and the importance of serotyping Salmonella*. Centers for Disease Control and Prevention. https://www.cdc.gov/salmonella/reportspubs/salmonella-atlas/serotyping-importance.html

2. Holschbach, C. L., & Peek, S. F. (2018). *Salmonella* in dairy cattle. *Veterinary Clinics of North America: Food Animal Practice*, *34*(1), 133–154. https://doi.org/10.1016/j.cvfa.2017.10.005

3. Valenzuela, J. R., Sethik, A. K., & Aulik, N. D. (2017). Antimicrobial resistance patterns of bovine *Salmonella enterica* isolates submitted to the Wisconsin Veterinary Diagnostic Laboratory: 2006-2015. *J Dairy Sci., 100*(2), 1319–1330. https://doi.org/10.3168/jds.2016-11419.

4. Soliani, L., Rugna, G., Prosperi, A., Chiapponi, C., & Luppi, A. (2023). *Salmonella* infection in pigs: Disease, prevalence, and a link between swine and human health. *Pathogens*, *12*(10), 1267. https://doi.org/10.3390/pathogens12101267