Leveraging Data to Mitigate Food Safety Risk in Live Production and Processing

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Questions?

Connecting the dots...

Breeder Farm → Hatchery → Grow-out farm → Processing Plant

Breeder data → Grow-out farm data → Salmonella → Parts

Risk factors at the processing level identified

Using a Conditional Decision Tree to Understand Risk in the Processing Plant

Decision Trees
Correlational Analyses
Logistic Regression
GIS mapping
Odds Ratios

Review of Backwards and Forwards Logistic Regression

Develop a model of multiple independent variables to predict Salmonella positivity and negativity
Using Logistic Regression to Identify Risky Farms

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<th>Odds Ratio</th>
<th>95% C.I. for Odds Ratio</th>
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Next Generation Sequencing of Salmonella Heidelberg Under Different Processing Conditions

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Connecting the dots...

Data

Decision Trees
Correlational Analyses
Logistic Regression
GIS mapping
Odds Ratios

Current Control Principles for Salmonella

- Biosecurity
- Cleaning & Disinfection
- On-farm surveillance
- Vaccination
- Competitive exclusion
- Pre and pro-biotics
- Feed and water hygiene
- HACCP
- Processing plant dips and sprays
- FSIS surveillance (performance standard)
What happens to Salmonella when you challenge them and don’t kill them?

To answer the question: they get creative and stubborn (i.e., they express different genes that allow them to survive and make it more difficult to kill them the next time you challenge them).

New Tools to Mitigate Virulence in Food Systems?

Candidate virulence genes for Salmonella

Salmonella have several ‘pathogenicity islands’ (SPIs), 2 of which encode a type III secretion system for virulence proteins:

- SP1 required for invasion
- SP2 required for intracellular accumulation

A large number of virulence genes are required for the successful pathogenesis of Salmonella infections (Forshall, 2006).

Experimental Design

Breeder Farm → Hatchery → Grow-out farm → Processing Plant

Processing in More Detail...

Slaughter → Evisceration → Second Process

Simulating the Chiller at benchtop

Control: SH
SH + PAA
SH + Ach
SH + Cecure

Keep at 4 C for 90 minutes to ‘simulate’ chiller conditions

Next Gen Sequencing Protocol

1. RNA ‘freeze’ and extraction
2. DNase Treatment
3. rRNA depletion
4. RNA library preparation
   1. RNA fragmentation
   2. Synthesise ds cDNA
   3. Adapter ligation
   4. PCR enrichment
5. Bioanalyzer to determine fragment length
6. Clone and sequence to confirm presence of SH genome
7. Pool and sequence
8. Library analysis

Data Analysis

Genes that are down regulated in low pathogenic strains of SE
Next Generation Sequencing

The old days...

Next generation

Illumina, 2014

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Thank you & Questions