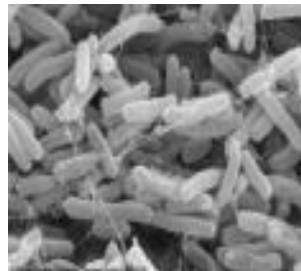

Microbial risk assessment in pork processing: modelling zoonotic pathogen dynamics

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Food Safety

- Important public health issue

- Major zoonotic foodborne diseases of microbial origin (W.H.O.):
 - Salmonellosis (37.5/100,000)
 - Campylobacteriosis (395.6/100,000)
 - Colibacillosis (2.8/100,000)
 - Listeriosis (24 cases)
- * (Yersiniosis – 11.7/100,000)

A common thread - Pork/Pigs

- *S. Typhimurium*, *C. jejuni* and *C. coli* are frequently isolated from the gut of pigs in the slaughter house and retail
- Pigs are the main reservoirs for *Y. enterocolitica*
- *E. coli* (VTEC) and *L. monocytogenes*

My research seeks to
answer 3 main
questions

Question 1

What is the risk that specific pork products in New Zealand are contaminated with *C. jejuni*; *C. coli*; *L. monocytogenes*; *VTEC*; *S. Typhimurium*; & *Y. enterocolitica*?



Question 2

What are the key processes in the food chain that determine the level of contamination / risk

Question 3

What strategies can be implemented to curb this risk?

Selected pork products:

- Ham
- Sausage
- Minced pork

Areas of study:

Slaughter house and further processing plants

Addressing the issues

Qualitative and quantitative risk modelling techniques + observation and microbial studies

Quantitatively:

Modular Process Risk Model (MPRM)

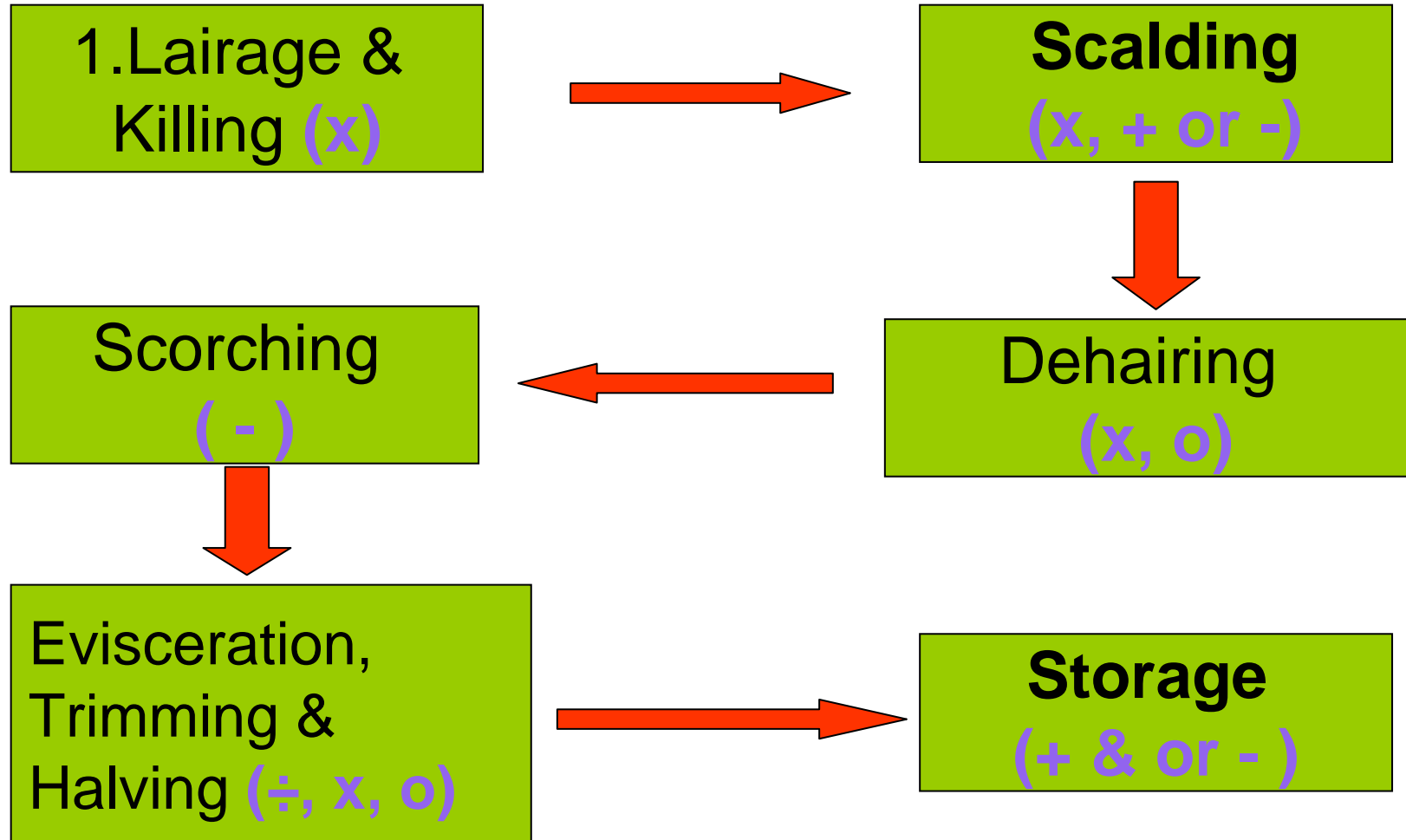
- Food pathway is divided into modules
- Each processing step is identified as:

Growth, Inactivation, Mixing, Partitioning, Removal & Cross-contamination

Farm Prevalence



Slaughter House Modules & Processes



Modelling methods

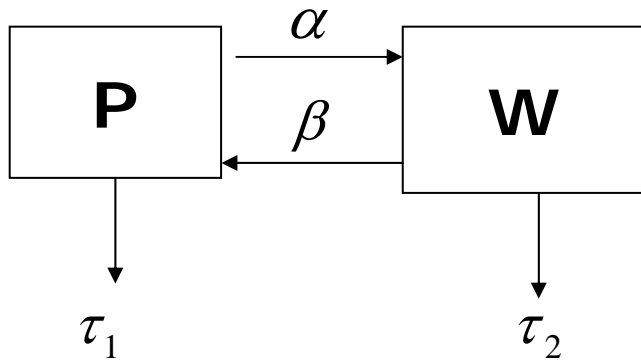
- Stochastic modelling
 - Probability distributions – input and output variables
- Differential equations
 - Analytical and numerical methods
- Excel, Visual Basic and @Risk

Model Structure

Lairage		
Model 1. (Infection transmitted between pigs)	S. Typhimurium	Formula
Number of pigs in lairage	1000	<i>Round(RiskNormal(1000,100),0)</i>
Prevalence of infected pigs in lairage	0.25	<i>RiskBeta(40,120)</i>
Proportion of infected pigs shedding	0.38	<i>RiskBeta(60, 100)</i>
Number of shedding pigs in lairage	94	<i>RiskBinomial(B8,B9*B10)</i>
Number infected but not shedding	156.00	<i>RiskBinomial(B8,B9)-B11</i>
Time spent in lairage (minutes)	170	<i>RiskUniform(100,240)</i>
Transmission parameter for pig to pig transmission	0.0002	
Probability of each animal being infected from shedders	0.9591	<i>1-EXP(-B14*B11*B13)</i>

Outputs: Informs subsequent modules - Evisceration

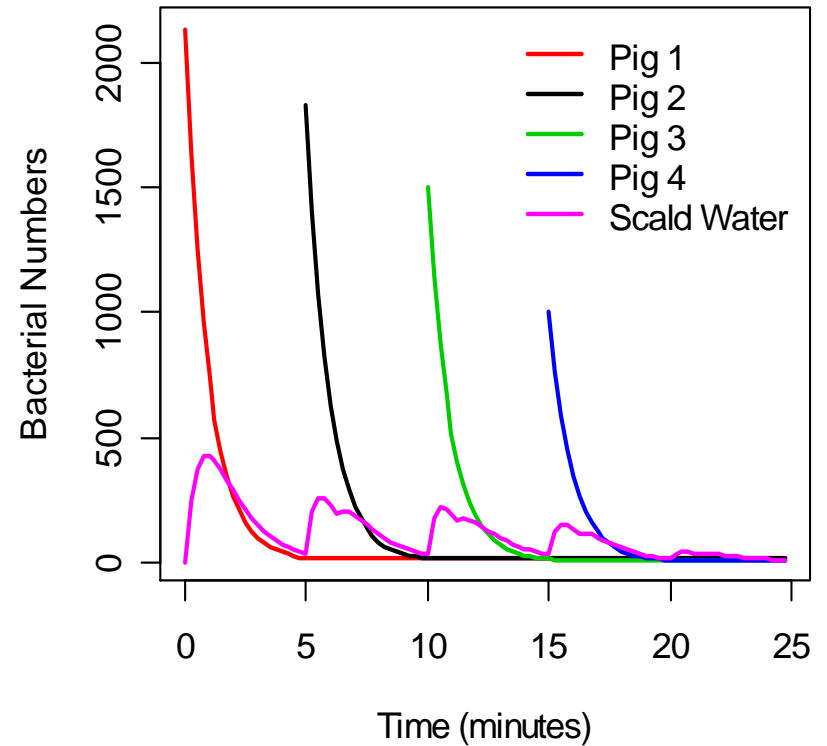
Scald Tank Model



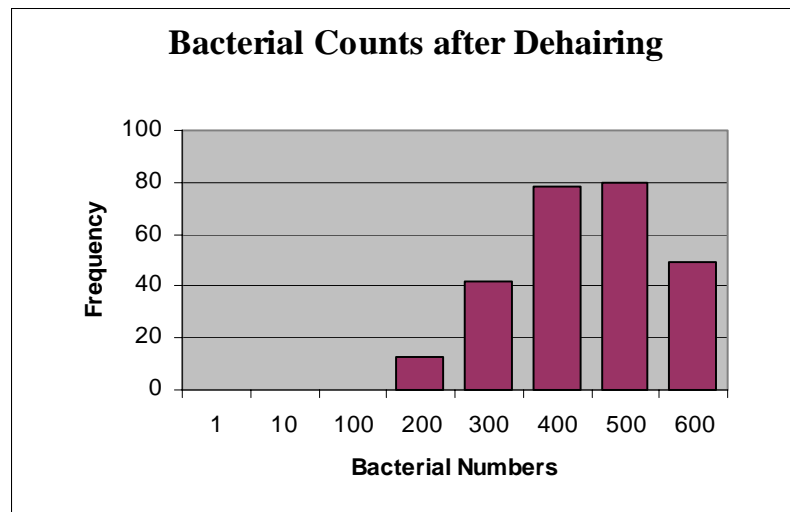
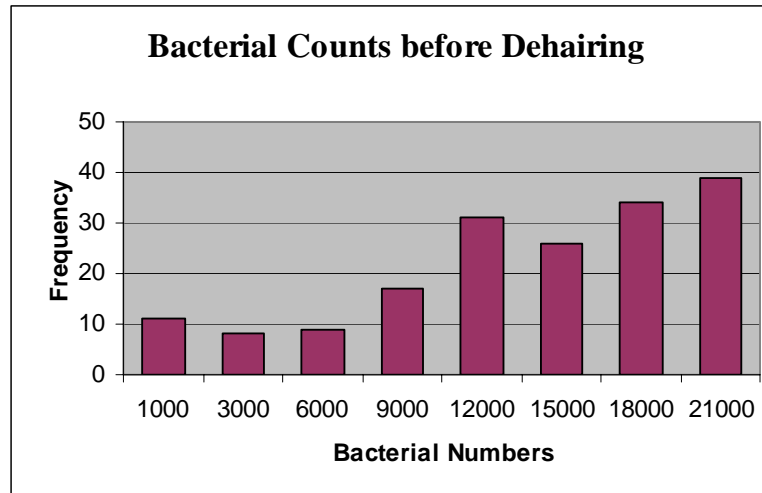
$$P(t) = (P(0)\beta - 1)e^{-(\tau + \beta + \alpha)t} + (1 + W(0))\alpha e^{-\alpha t} / (\beta + \alpha)$$

$$W(t) = (W(0)\alpha - 1)e^{-(\tau + \beta + \alpha)t} + \beta e^{-\alpha t} (1 + P(0)) / (\beta + \alpha)$$

Reduction of Viable bacteria in Scalding



Output - Model Output



Future Work

- ❑ Collect data
- ❑ Fine tune Slaughter Model for organisms, conduct sensitivity analyses
- ❑ Determine the effect of different intervention strategies on bacterial contamination of the pig carcass in the abattoir
- ❑ Conclusion - I don't know as yet.

Acknowledgements

- Software Developers
- Roger Morris Foundation