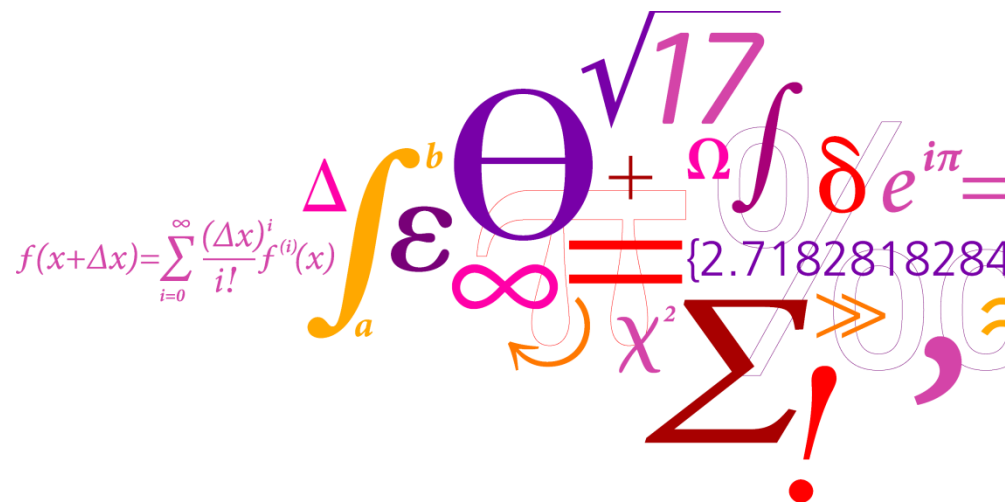


Correlation between *Salmonella* and hygiene indicators in the Danish fresh pork chain

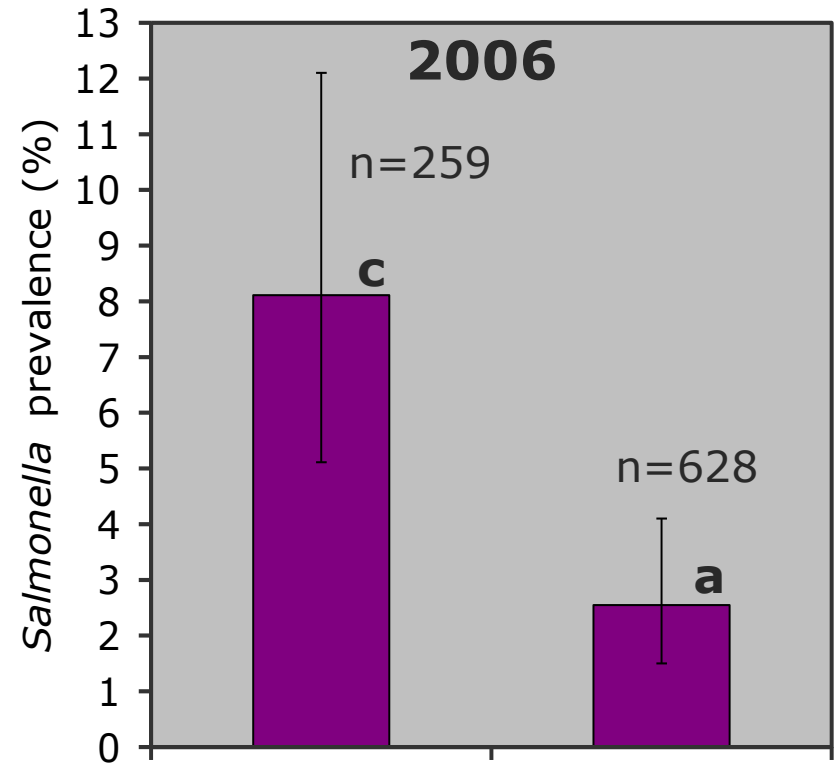
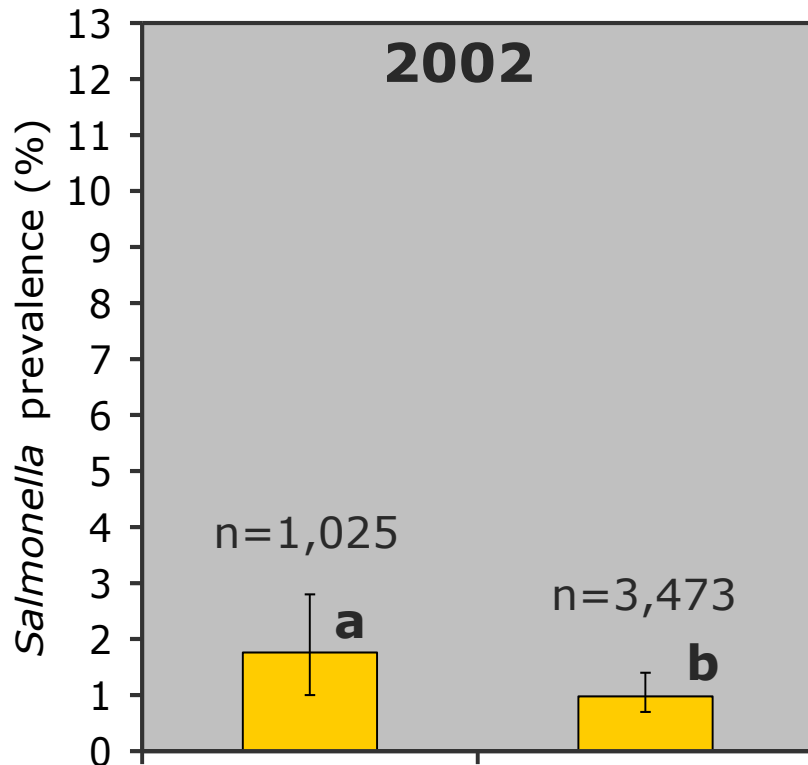
Tina Beck Hansen, DTU

Gudrun Sandø, DVFA

Søren Aabo, DTU



Introduction



Type of retailer

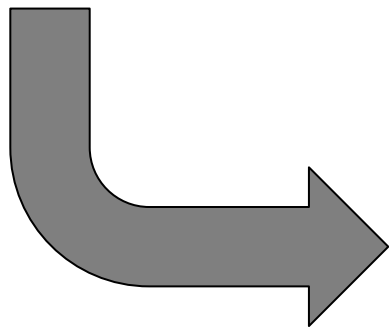
4.6-fold

Type of retailer

2.6-fold

Objective

- To identify where in the pork chain hygiene failures occur
 - At cutting? Small or large cutting plant?
 - At retail? Butcher shops or supermarkets?
 - Or both?
- To investigate if hygiene indicators correlate to *Salmonella* in fresh pork?
 - *Enterobacteriaceae*
 - Enterococci



Targeted interventions

Sample collection

CUTTING PLANTS

June to December 2010

18 cutting plants

6 large

12 small

1.569 samples

Salmonella

Enterobacteriaceae

Enterococci

RETAIL STORES

July 2010 to March 2011

414 stores

278 supermarkets

134 butcher shops

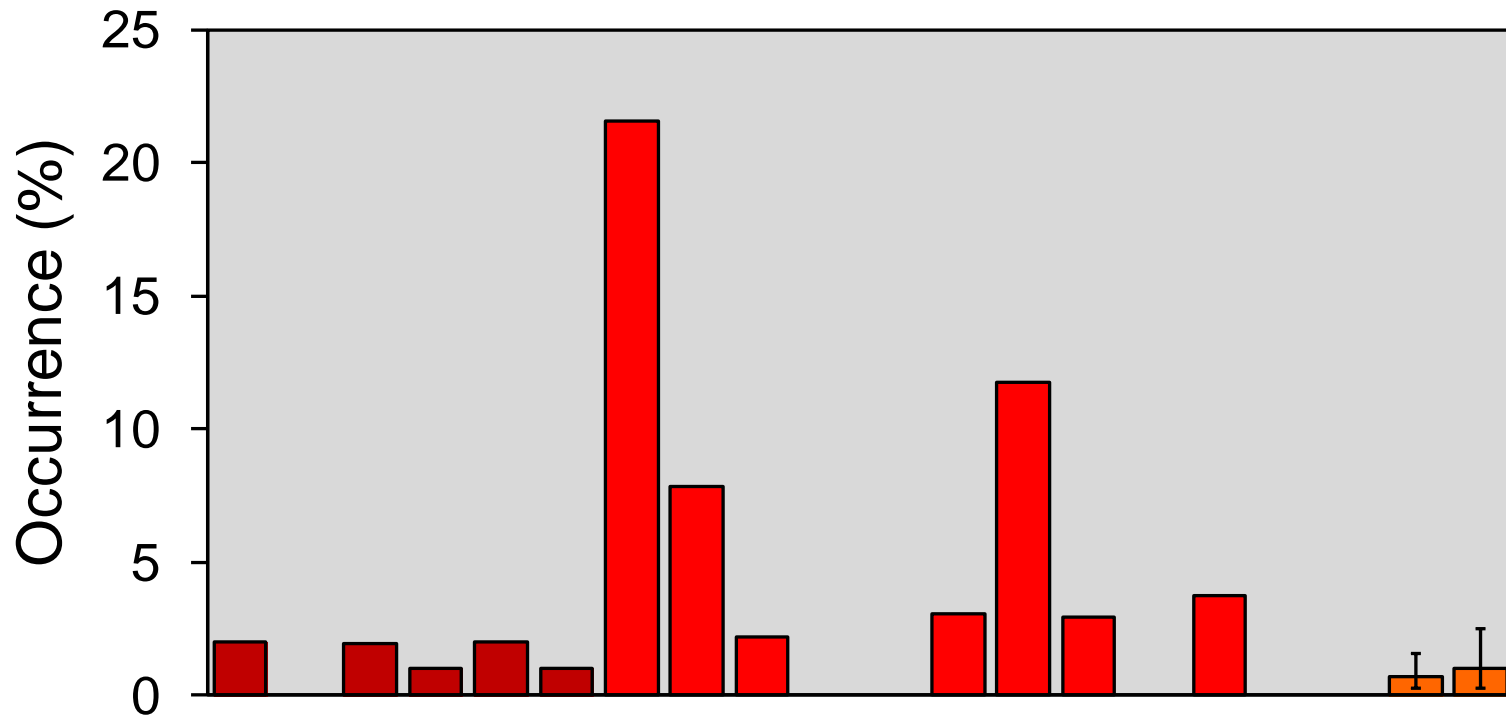
1.232 samples

Salmonella

Enterobacteriaceae

Enterococci

Salmonella in pork at cutting plants

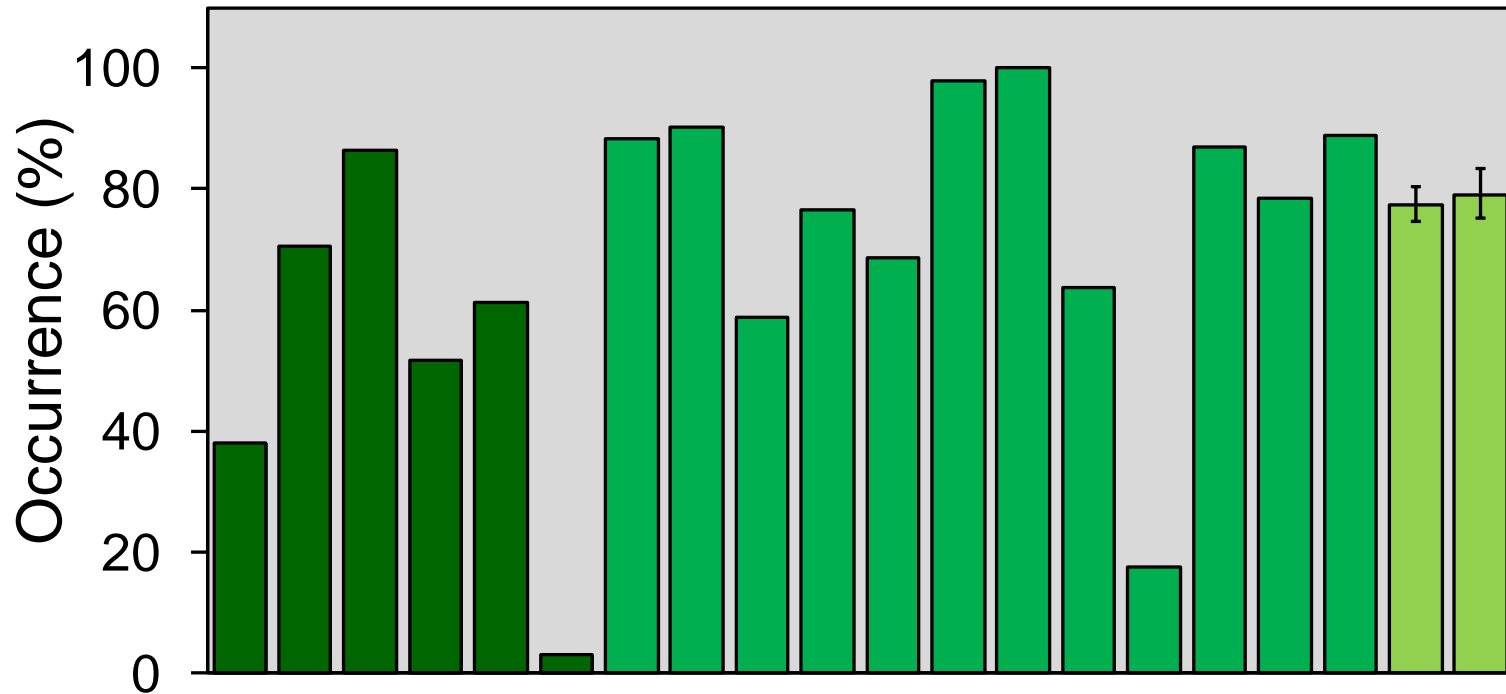


Large cutting plants: 1.3 %

Small cutting plants: 3.7 %

*Avg. supermarkets
Avg. butcher shops*

Enterobacteriaceae in pork at cutting plants

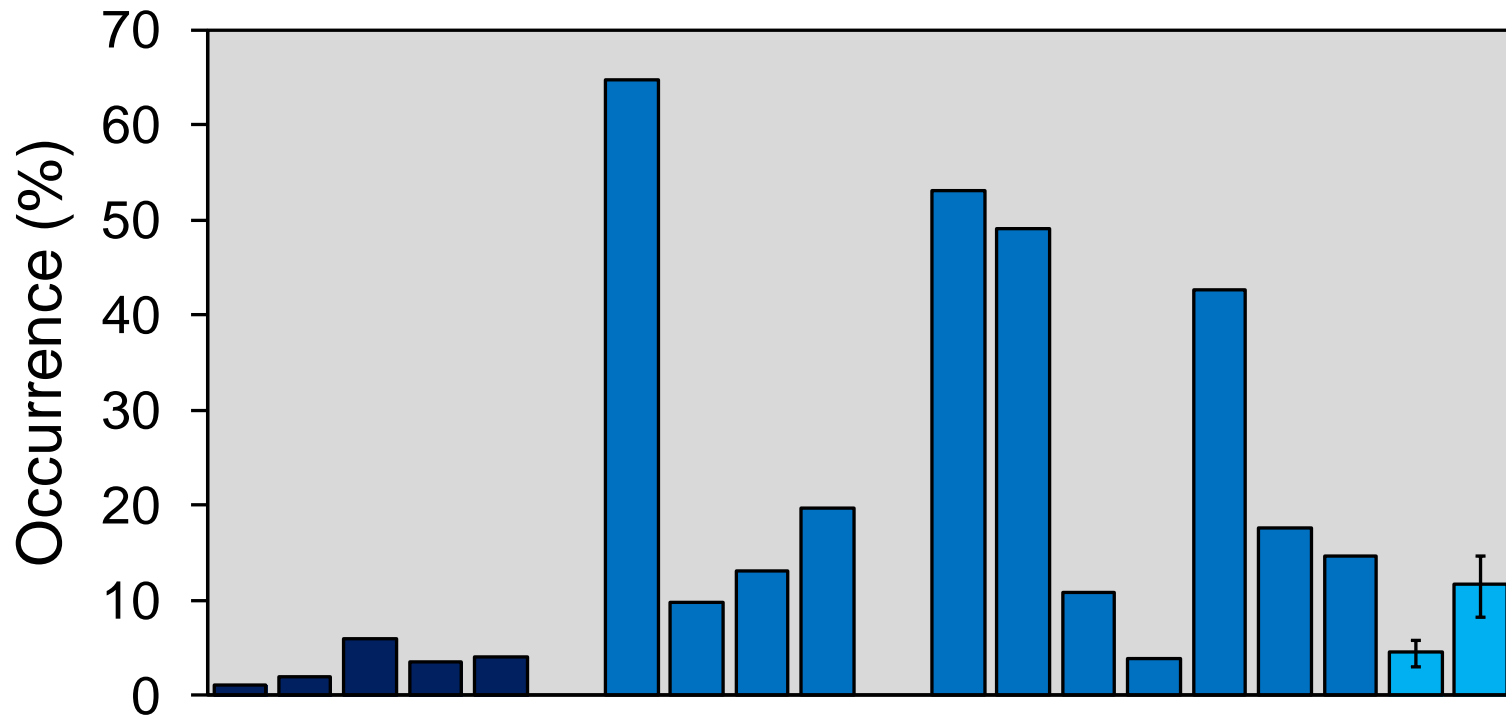


Large cutting plants: 47 %

Small cutting plants: 74 %

Avg. supermarkets
Avg. butcher shops

Enterococci in pork at cutting plants



Large cutting plants: 2.4 %

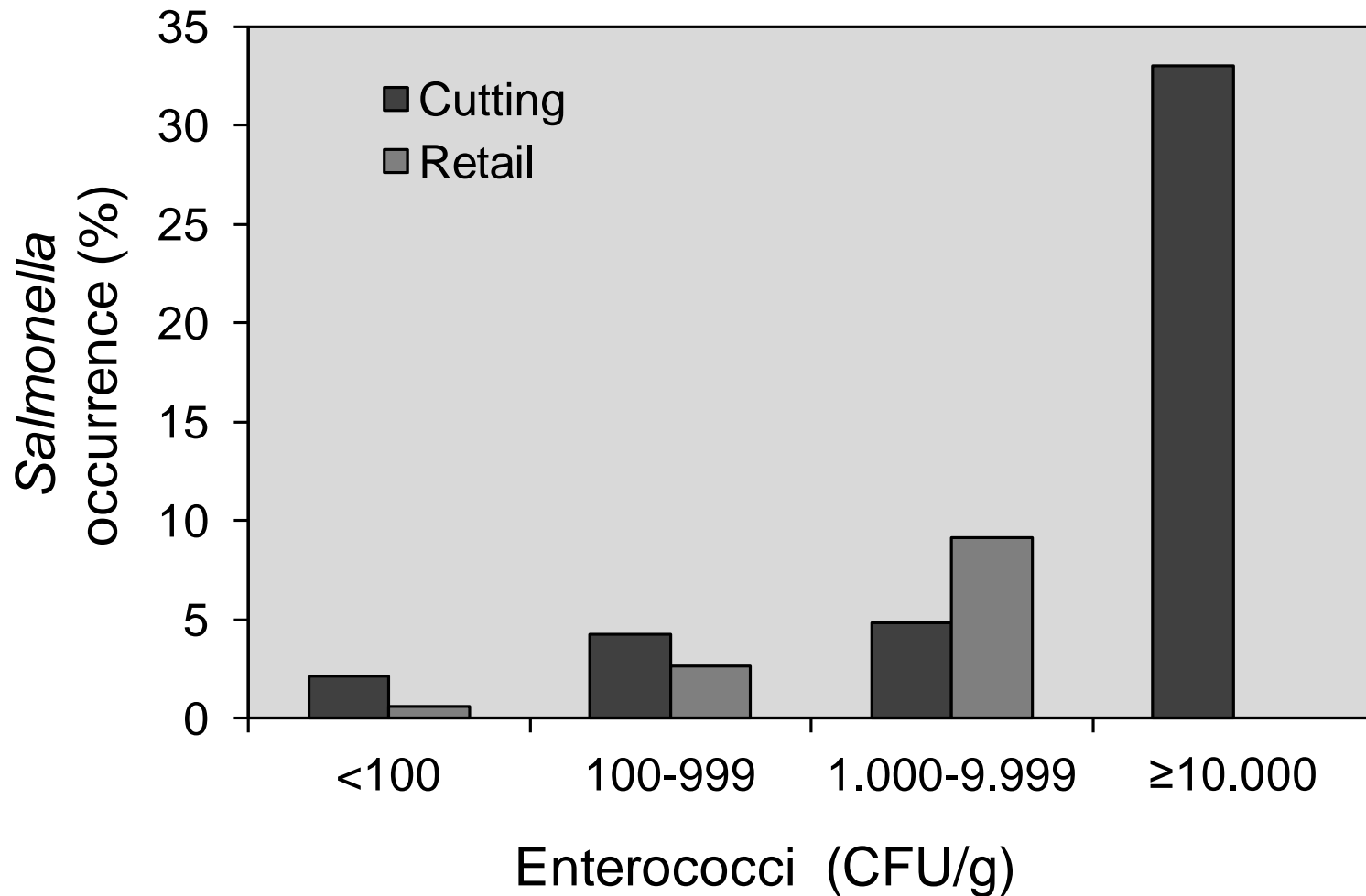
Small cutting plants: 24 %

*Avg. supermarkets
Avg. butcher shops*

Correlation between occurrence of *Salmonella* and hygiene indicators

2 x 2 statistics	Enterococci (≥ 100 CFU/g)		<i>Enterobacteriaceae</i> (≥ 1.000 CFU/g)	
	Cutting	Retail	Cutting	Retail
<i>Salmonella</i> (detected in 25 g)	$P = 0.02$	$P = 0.03$	$P = 0.002$	$P = 0.70$
Enterococci (≥ 100 CFU/g)			$P < 0.001$	$P < 0.001$

Salmonella occurrence vs. indicator concentration



Salmonella occurrence (■,%) vs. concentration of indicator

Enterococci (log CFU/g)	<i>Enterobacteriaceae</i> (log CFU/g)					Mean
	<1	1 - 2	2 - 3	3 - 4	≥4	
<2	1.3	3.1	2.2	4.6	6.7	2.2
2 - 4	15	0	1.8	5.0	6.0	4.3
≥4	N.S.	N.S.	0	0	67	33
Mean	1.5	2.9	2.1	4.7	8.8	2.5

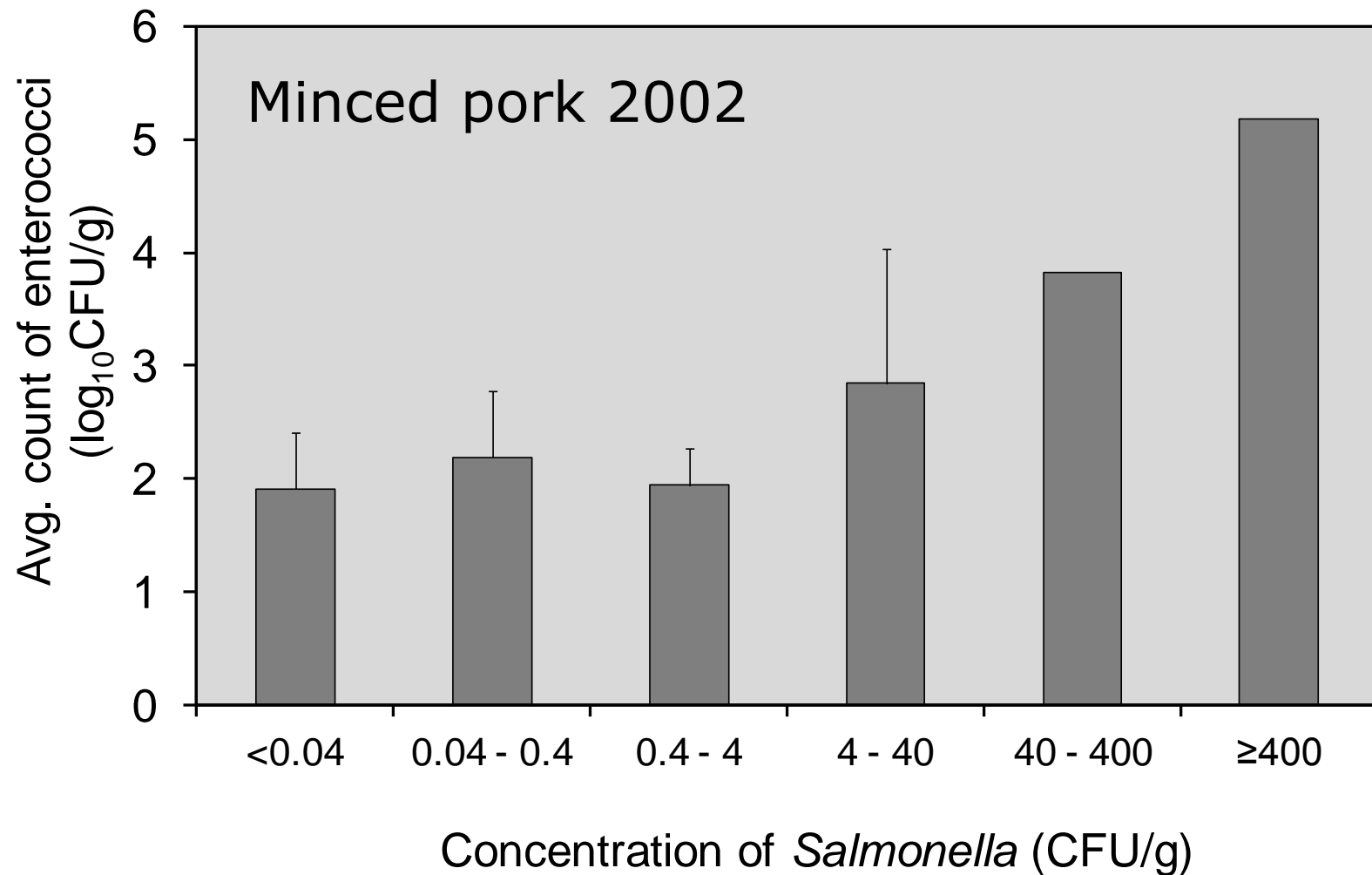
N.S.: No samples

Correlation between concentrations of enterococci and *Enterobacteriaceae* at cutting in samples positive for *Salmonella*

% *Salmonella* positive samples (≥ 0.4 CFU/g)

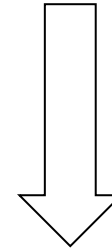
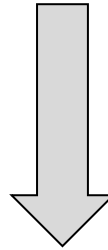
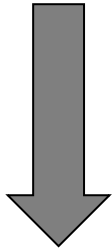
Enterococci (log CFU/g)	<i>Enterobacteriaceae</i> (log CFU/g)	
	< 3	≥ 3
< 2	27 %	25 %
≥ 2	33 %	38 %

Correlation between concentration of enterococci and *Salmonella* at retail in minced pork



Perspectives

Good correlation between *Salmonella* and hygiene indicators



At cutting

Risk based process hygiene criteria

Minimize *Salmonella* input to retail

At retail

Tool to disclose hygiene failures

Keep *Salmonella* at low level

Outbreak prevention

Tool to identify causes for hygiene failures

Prevention of *Salmonella* outbreaks

Thank you for your attention