

Targeted low cost strategies for *Salmonella* control in finisher pigs and in the slaughterhouse

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The Irish Agriculture and Food Development Authority

Outline

1. Background & objectives
2. On-farm *Salmonella* control
3. *Salmonella* control in factory lairage
4. Conclusions

Terminology:

Seroprevalence - contact

Faecal - shedding

Caecal / ILN - carriage

BACKGROUND



- Carriage of *Salmonella* in pigs is a significant food safety issue
- 314 food-borne outbreaks related to *Salmonella* reported in the EU for 2013.
 - ~9% linked to the consumption of pork (3rd most commonly reported food source after eggs & egg products, and sweets & chocolate)
- Ireland has a high prevalence of *Salmonella* on pig carcasses (20% based on the 2008 EU Baseline survey)
 - Related to the high level of some *Salmonella* positive pig herds in the country
 - Prevalence levels in the country have still not declined, despite 2010 National Pig *Salmonella* Control Programme



*****A need for low-cost on-farm *Salmonella* control interventions*****

OBJECTIVES

- ① To investigate the effect of feeding organic acids in the late finishing period (~4 wks) on *Salmonella* carriage, seroprevalence and growth
- ② To investigate the effectiveness of cleaning and disinfection to reduce *Salmonella* in the lairage environment of a pig abattoir

1. On-farm *Salmonella* control

FEED ADDITIVES

Adimix®, Nutriad, Kasterlee, Belgium;

Coated Sodium butyrate: 3 kg/tonne

- A. Trial A – 169 Pigs (85 Control, 84 Treatment)
- B. Trial B – 177 Pigs (87 Control, 90 Treatment)

FormaXOL(TM), Kemin, Ireland

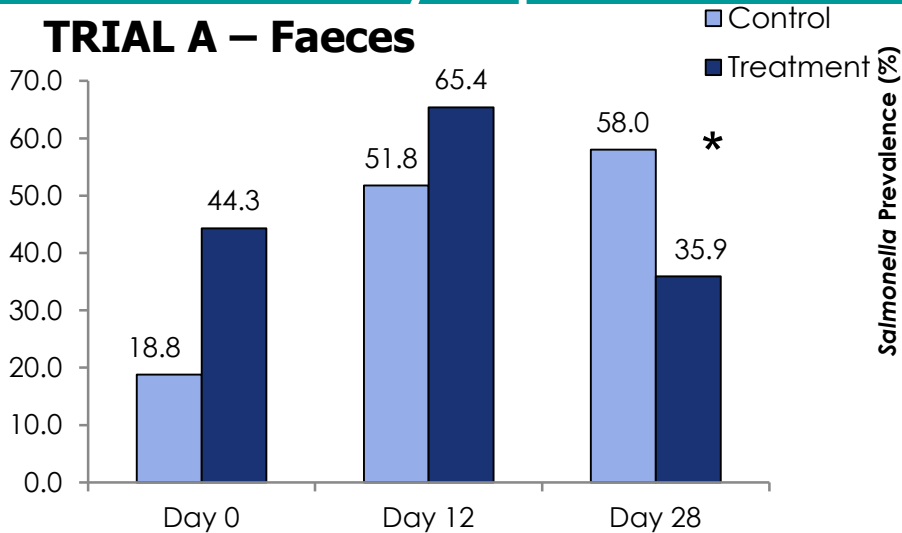
An **Encapsulated Blend of: Formic acid, citric acid and essential oils:** 4 kg/tonne

- C. Trial C – 124 Pigs (62 Control, 62 Treatment)

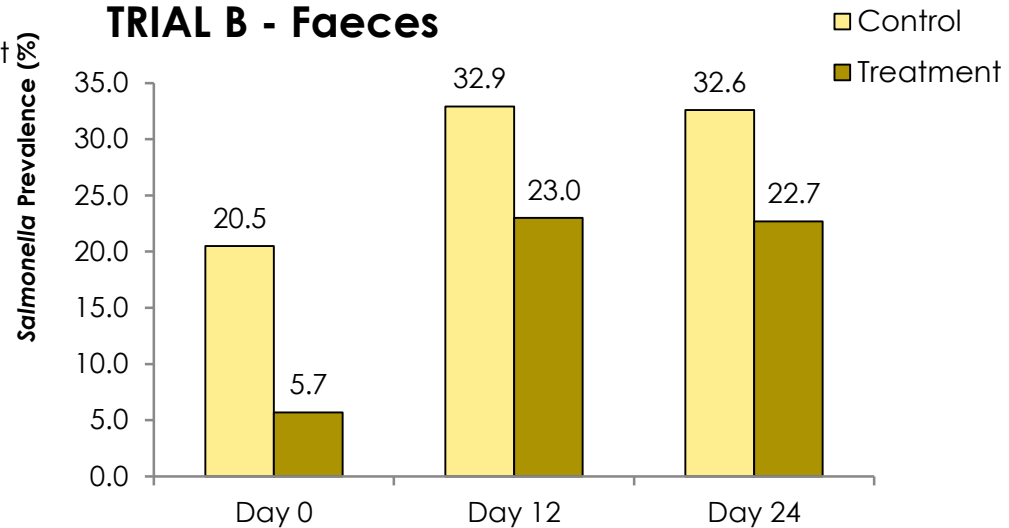


RESULTS: *Salmonella* in faeces, caeca, and lymph nodes

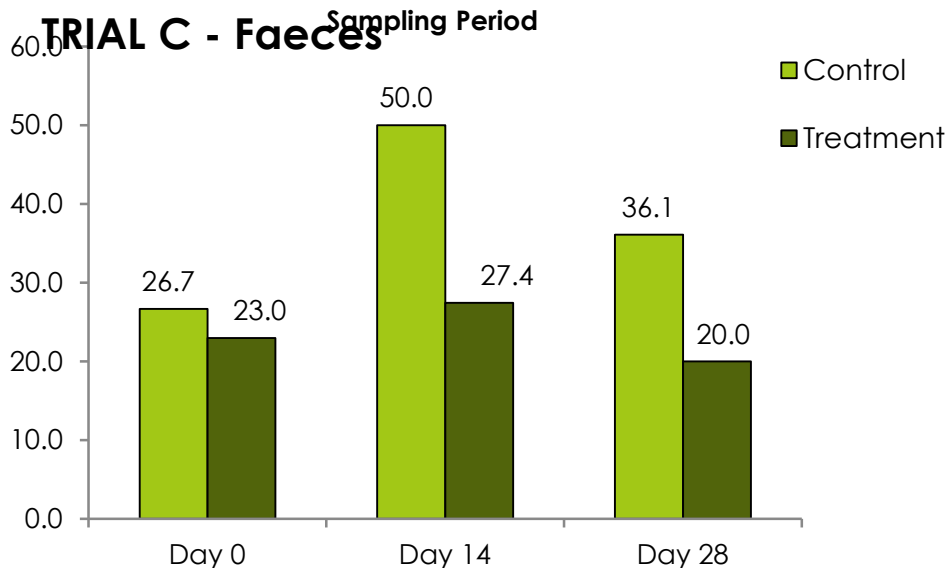
TRIAL A – Faeces



TRIAL B - Faeces



TRIAL C - Faeces



CAECA AND LYMPH NODES:

- No significant differences were observed between control and treatment groups in terms of *Salmonella* recovery from the caeca or lymph nodes for trials A, B, or C.

RESULTS: *Salmonella* serology

- ① Sodium butyrate decreased seroprevalence in Trial A and B, but not to below the cut-off used for high risk in Ireland (>50%).
- ② Blend of Formic acid, Citric acid, and Essential oils decreased seroprevalence in Trial C but again not to below the cut-off used for high risk in Ireland (>50%).

PRODUCTION PARAMETERS

Sodium butyrate and the mixture of Formic acid, Citric Acid, and Essential oils did not affect:

1. Feed intake
2. Body weight gain
3. Feed conversion efficiency (FCE)



COST-BENEFIT ANALYSIS

	TRIAL A		TRIAL B		TRIAL C	
	Control	Sodium Butyrate	Control	Sodium Butyrate	Control	Formic acid, Citric acid, Essential Oils
Finisher Feed Cost per pig (€/pig)	22.78	23.49	18.35	18.98	24.73	25.93
Total Finisher Feed Cost per kg LW gain (€/kg Live weight gain)	0.89	0.85	0.91	0.92	0.76	0.84

 **€0.04**

 **€0.01**

 **€0.08**

Conclusions

Short term feeding (<30 days) of acids is effective in reducing *Salmonella* shedding and seroprevalence but only in the absence of a co-infection

They did NOT:

- Reduce the seroprevalence to below the cut-off used for the high *Salmonella* risk category in Ireland (50%)
- Reduce intestinal carriage at slaughter
- Impact production parameters: feed intake, body weight gain, FCE

A cost benefit of €0.04/kg of live-weight gain for sodium butyrate

Feeding a mixture of formic acid, citric acid and essential oils was not cost beneficial

2. Salmonella control in factory lairage

BACKGROUND

- Pigs are at risk of becoming infected or re-infected with *Salmonella in the lairage*
- As little as 2-hours needed following exposure to a contaminated environment to acquire *Salmonella*
- **Cleaning and disinfection** of the lairage environment can limit the prevalence/spread of *Salmonella*



TYPICAL CLEANING REGIMES

Wash (with or without high pressure) to remove gross organic matter;
OR

High-pressure wash + detergent + water rinse to remove the
detergent + disinfectant (left to dry or removed with water after a
sufficient contact time); OR

High-pressure wash + disinfectant, with or without a water rinse; OR

High-pressure wash + detergent + water rinse

OBJECTIVES

Evaluate cleaning and disinfection regimes (with Quaternary Ammonium Chloride or Chlorocresol disinfectants) on their ability to:

1. Eliminate *Salmonella*, and
2. Reduce levels of *Enterobacteriaceae* within the lairage pen environment



CLEANING & DISINFECTION PROTOCOLS

Type of Protocol	Cleaning and Disinfection Steps ^a	Sampling Day
Routine Cleaning (Monday to Thursday)	Before Power Wash (1) After Power Wash (2) After QAC ^b Disinfectant (Holquat®) or After Chlorocresol Disinfectant (Interkokask®)	Mid-Week (Tuesday/Wednesday)
Intensive Cleaning (Friday)	Before Power Wash (1) After Power Wash (2) After Detergent (Rapier®) (3) After Detergent + QAC ^b Disinfectant or After Detergent + Chlorocresol Disinfectant	End of Week (Friday/Saturday)
Drying Following Intensive Cleaning (Sunday)	(4) After QAC ^b -Drying or After Chlorocresol-Drying	Sunday

^a 2 floor and 1 wall swab was taken at each step in the cleaning protocol

^b QAC – Quaternary Ammonium Chloride disinfectant

DISINFECTANTS



Holquat (QAC disinfectant)

- 25 kg drum
- Use rate: 2%



Interkokask (Chlorocresol disinfectant)

- 10 kg drum
- Use rate: 2-3%
- Used in the poultry industry

SAMPLE COLLECTION



Before Power Wash



After Power Wash

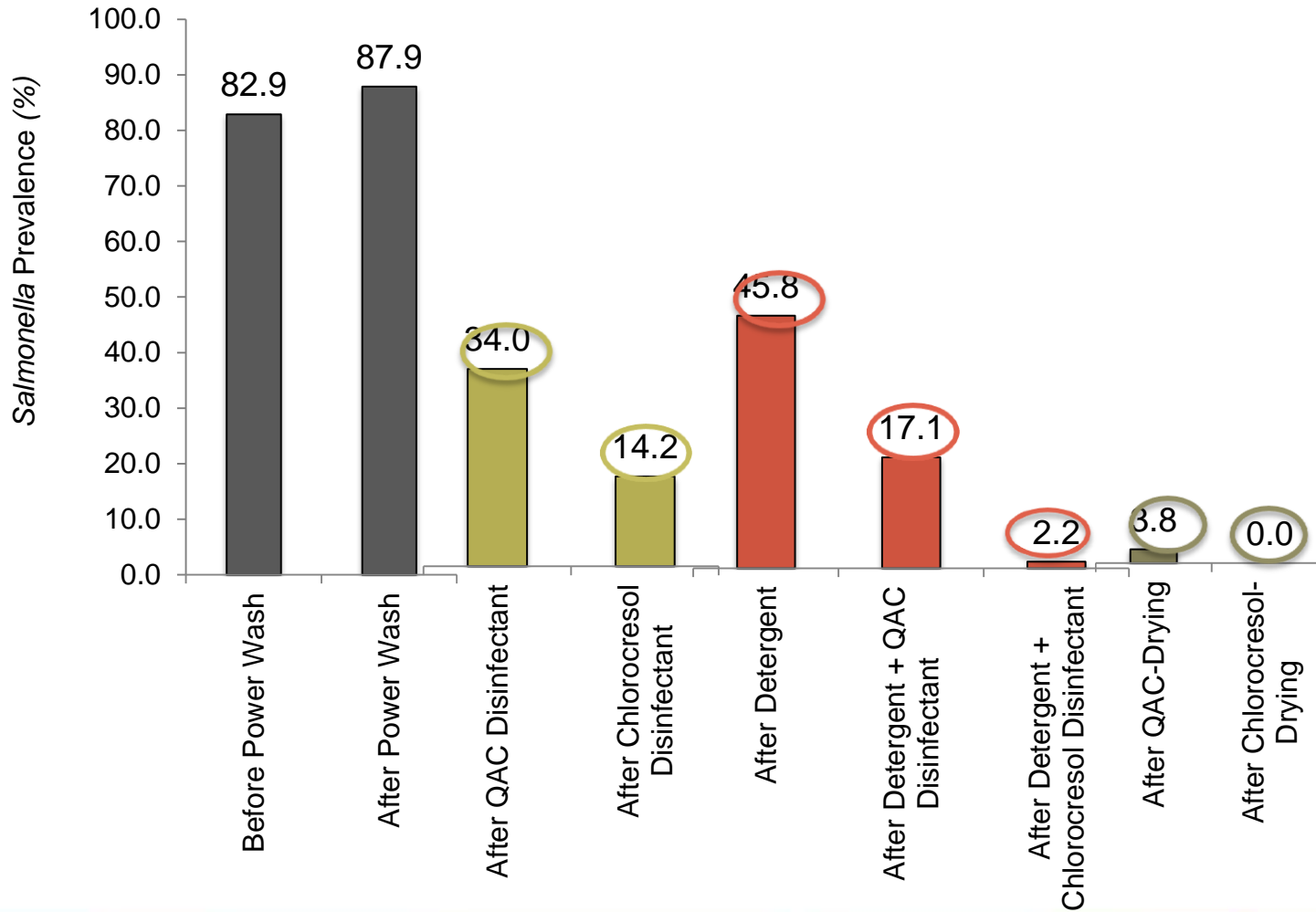


After Detergent;
After QAC Disinfectant;
After Chlorocresol Disinfectant



After QAC Drying;
After Chlorocresol Drying

RESULTS: *SALMONELLA* PREVALENCE



RESULTS: ODDS RATIOS

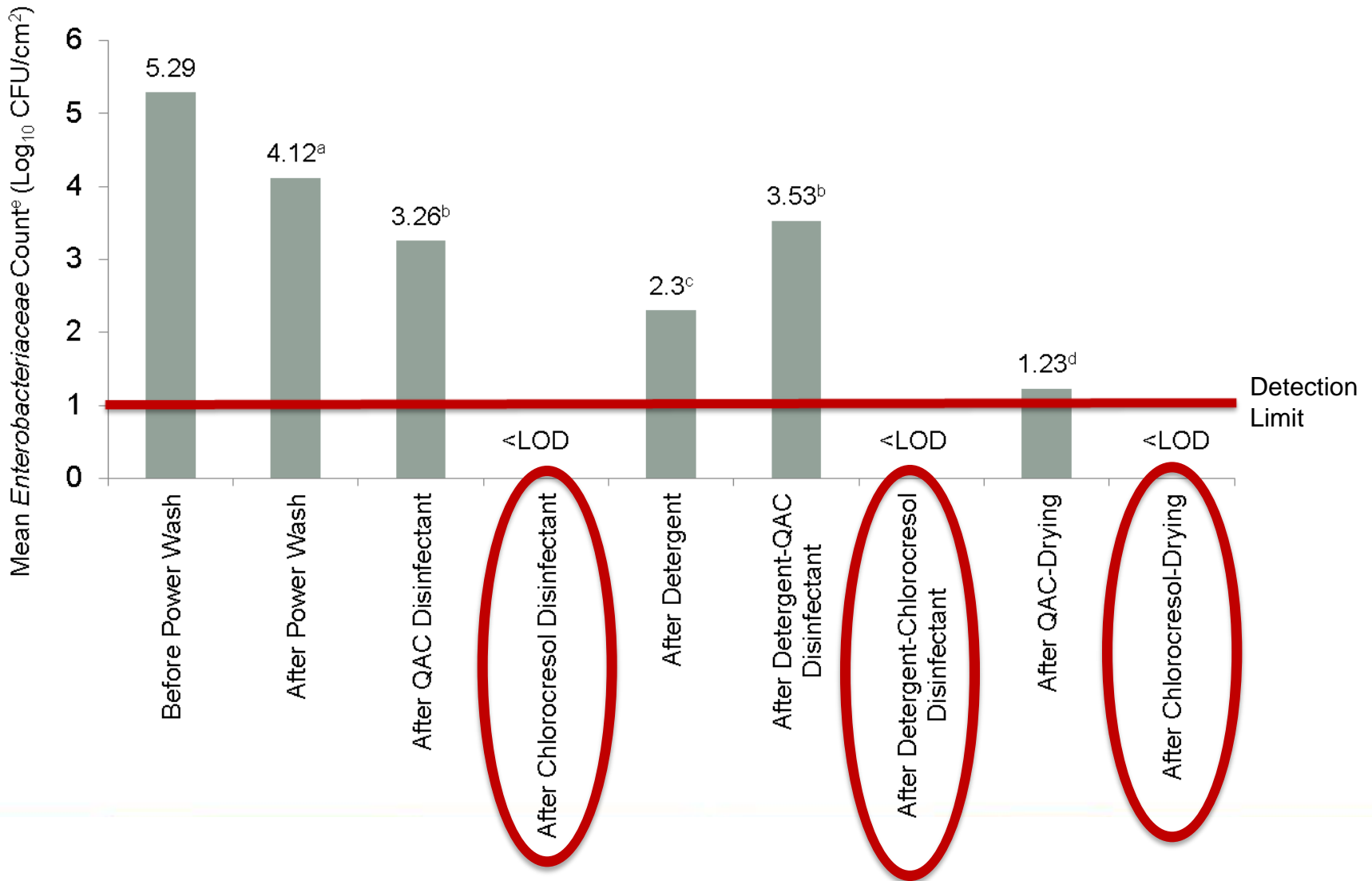


- Increased likelihood of *Salmonella* contamination

Washing	Detergent	Chlorocresol	Drying	Odds
yes	yes	yes	yes	

- Chlorocresol disinfectant vs detergent after power washing - 5:1 on
- Detergent and chlorocresol vs. detergent after power washing - 38:1 on

RESULTS: *Enterobacteriaceae* counts



^{a, b, c, d} Steps sharing the same letter are not significantly different with $p = 0.05$.

^e Mean *Enterobacteriaceae* counts from floor swabs from all 12 pens sampled on 2-3 occasions.

CONCLUSIONS

Power washing alone did not reduce *Salmonella* prevalence

Routine Cleaning with chlorocresol after power washing was more effective than the QAC-based disinfectant.

Intensive Cleaning combining detergent with chlorocresol was more effective than using detergent followed by the QAC-based disinfectant.

Drying after intensive cleaning with chlorocresol eliminated *Salmonella*.

Enterobacteriaceae counts reduced below limit of detection following application of chlorocresol with or without drying of the pens.

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Questions?