

Global *Salmonella* control in an integrated swine production system.

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Abstract

Salmonellosis is a threat to the whole pork production chain. Different risk factors have been associated with *Salmonella* contamination. The aim of this project was to assess the efficacy of a comprehensive control program in a 30 000 sows integrated company located in Canada, with an emphasis on pre-harvest control measures, to limit *Salmonella* pork carcasses contamination. Based on previous molecular epidemiology investigations, the main sources of contamination were identified as the environment and the replacement gilts. The features of this 10 years program consisted of : Sourcing with negative replacement gilts, use of mash coarse feed on gilt finishers and sow herds, application of detailed cleaning and disinfection procedures on all farms, transport vehicles, slaughtering facilities and accessories, respect of all-in all-out and single source. Moreover, feed withdrawal period was strictly respected before slaughtering and finisher pigs were delivered and slaughtered according to their *Salmonella* status. The effectiveness of the control program was monitored by serology and bacteriology. Every batch of gilts was tested serologically and bacteriologically while commercial finishers were sampled serologically pre-slaughter in order to determine their status. Every salmonellosis clinical case was recorded and confirmed by bacteriological sampling. A subset of carcasses were sampled every day. Decontamination of the environment was monitored through periodic *Salmonella* culture. Results of this control program showed a significant decrease in number of salmonellosis clinical cases as well as the number of seropositive animals before slaughter. The number of carcasses found bacteriologically positive has also decreased over time and remained low. The percentage of replacement gilts found positive by *Salmonella* culture decreased along these years as well as the number of positive samples in the environment. Therefore, we concluded that an effective control of *Salmonella* on pork carcasses can be achieved through appropriate on-farm interventions.

Introduction

Salmonella is one of the most important foodborne pathogen and is a threat to the whole pork production chain. Different risk factors have been associated with high *Salmonella* levels. Among the most frequent ones are: Environmental contamination⁽³⁾, source of replacement gilts⁽³⁾, mixing sources of pigs⁽⁶⁾, use of pelleted feed for sows and finishers^(1,2) and lack of all-in/all-out pig flow. Management of these risk factors can result in reduction of *Salmonella* throughout the pork chain.

Therefore, a 30 000 sows company located in Canada put in place an integrated approach with the aim of limiting *Salmonella* pork carcasses contamination. Based on previous molecular epidemiology investigations, the main sources of contamination within the integrated company were the environment and the replacement gilts. The objective of this paper is to describe a 10 year interventions program that was put in place to control important known risk factors.

Material and Methods

In 1999, the following interventions were put in place to reduce *Salmonella* on farms and on pork carcasses: Sourcing with negative replacement gilts for *S. Typhimurium*, use of mash coarse feed in breeding herds, gilt finishers and sow farms, and application of detailed and rigorous cleaning and

disinfection procedures on all farms, transport vehicles, slaughtering facilities and accessories. The disinfectant used was a mixture of glutaraldehyde and a quaternary ammonium compound. Complimentary interventions were management of all-in/all-out nursery and finishers barns, single source of pig flow, early detection and control of scour and ensuring fasting of pig pre-slaughter.

In order to monitor success of the program, bacteriological sampling and serology for *Salmonella* were used at different levels over time. Decontamination of the in farm environment, including pens, was monitored through periodic *Salmonella* culture. Every batch of gilts was tested either serologically or bacteriologically or both. Commercial finishers were monitored for incidence of Salmonellosis cases and any case was confirmed by *Salmonella* bacteriological sampling. Production lots were also sampled serologically pre-slaughter in order to determine their status. According to their classification as negatives, doubtful or positives, they were allocated to a specific schedule of transport and slaughtering order. A subset of carcasses were sampled every day bacteriologically. Blood samples were analyzed by the Diakit Elisa procedure⁽⁴⁾. The bacteriological culture methods used is described in Letellier *et al*⁽³⁾.

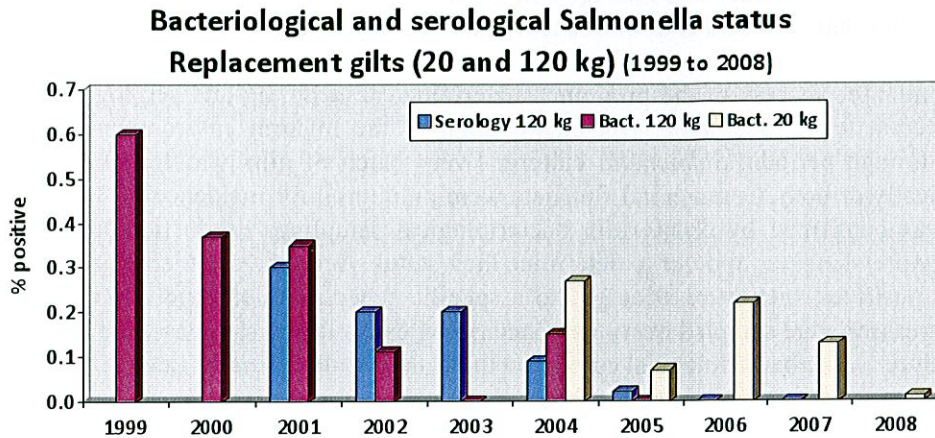
Results

At beginning of the program, sampling of the environment showed very often positive *Salmonella* culture even after cleaning and disinfection procedures. Transport vehicles and pens were the most frequently contaminated. *Salmonella* was also recovered occasionally from boots, brooms, water bowls, loading chute and alley ways (Table 1). The percentage of replacement gilts found positive serologically and bacteriologically have decreased along the years (Graph #1). Number of clinical Salmonellosis and positive *Salmonella* cultures decreased over time in gilts herd and fatteners (Graph #2). The same trend was maintained on number of seropositive animals before slaughter (Graph #3). The number of carcasses found bacteriologically positives remains low since 2006 after a constant decrease (Graph #4).

Table 1. Sampling of disinfected environment previously exposed to *Salmonella* positive pigs

Samples	# positifs / # tested	% positives
Transport vehicles	16/160	10%
Pens	16/180	9%
Unloading ramps + alley ways	5/14	36%
Water bowls	1/9	11%
Brooms	3/3	100%
Boots	1/2	50%
Feed bins	0/4	0%
Heater	0/1	0%

Figure 1



		Years									
		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Salmonella SPP isolation (120 kg gilts)	# positive /# tested	27/45	64/175	17/49	8/72	0/72	6/40	0/16	N.A.	N.A.	N.A.
Isolation (20 kg gilts)	# positive /# tested	N.A.	N.A.	N.A.	N.A.	N.A.	37/136	12/168	21/96	8/64	1/145
Serology (120 kg)	# positive /# tested	N.A.	N.A.	51/170	18/88	19/96	9/105	1/48	0/56	0/56	N.A.

Figure 2

**Salmonellosis cases and Salmonella SPP
isolation in fatteners (1999 to 2008)**

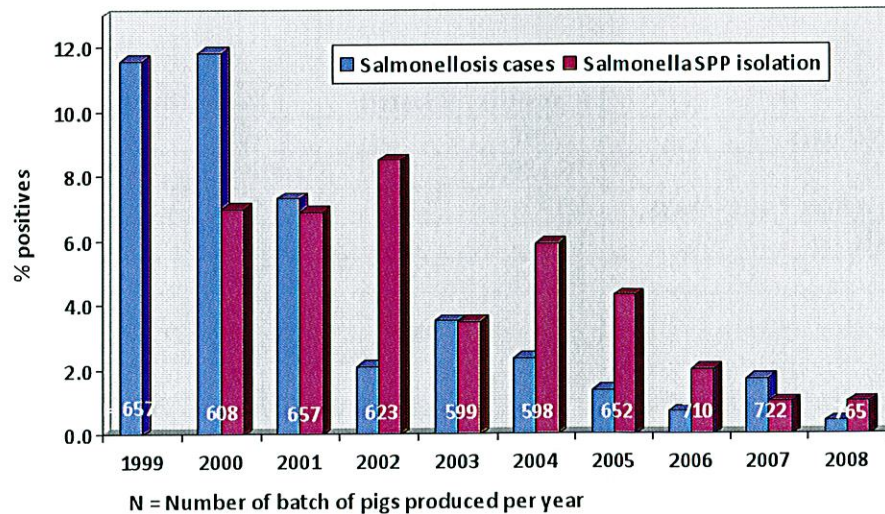


Figure 3

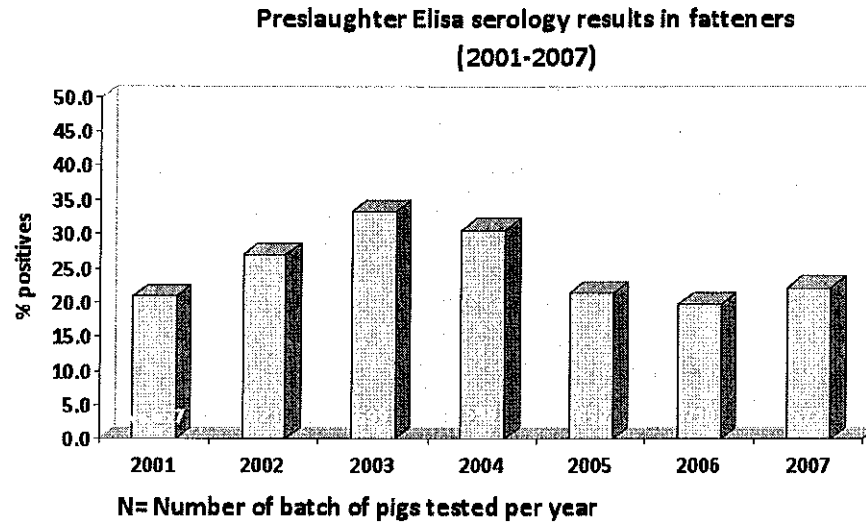
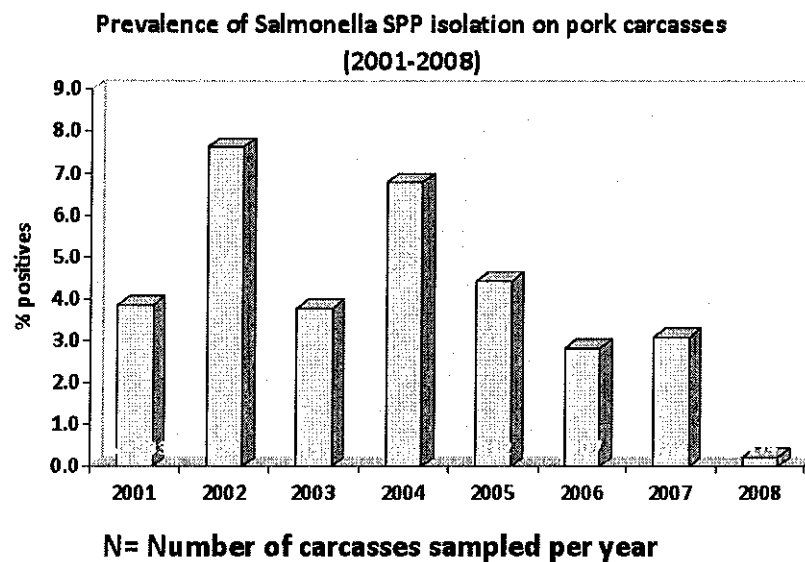


Figure 4



Discussion

Control of *Salmonella* on pork meat in an integrated company requires a long term approach. Every control points has to be managed and integrated in a global approach in order to limit *Salmonella* contamination. Based on our experience, some risk factors have more impact and the strategy must focus on them : Source of replacement gilts free of *S. Typhimurium* and decontamination of the environment (free from *Salmonella*). Complementary procedures such as all-in/all-out pig flow, single source of incoming animals and pre-slaughter management may help to achieve a better control on the program. Monitoring of interventions through bacteriological sampling and serology is compulsory in order to reevaluate and readjust the control program. For example, many disinfection protocols were tested before finding an efficient one. In our hands, an integrated approach, in all steps of the production pyramid, from the gilt farms to the pork meat was the best way to achieve the objectives.

Conclusion

An effective control of *Salmonella* on pork carcasses can be achieved through appropriate and integrated interventions. Continuous monitoring is essential to validate the program.

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