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Sources for *Salmonella* contamination of broilers at the farm and the slaughterhouse level

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Lay-out of the presentation

Introduction

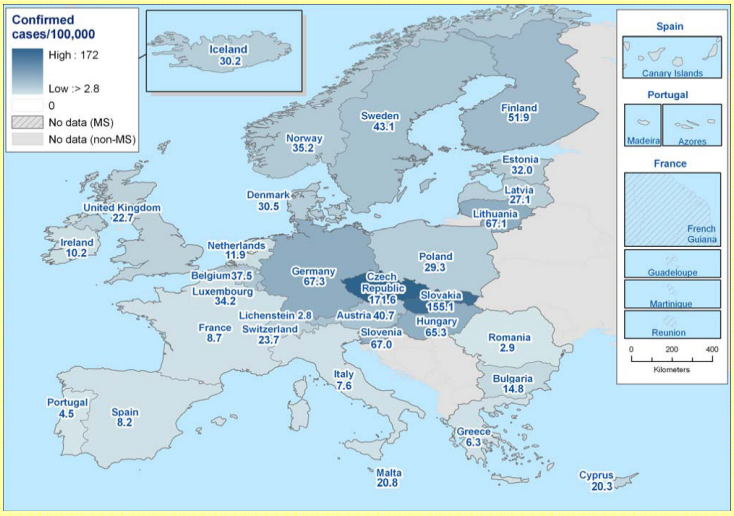
Experiments

Findings of the experiments

Conclusions

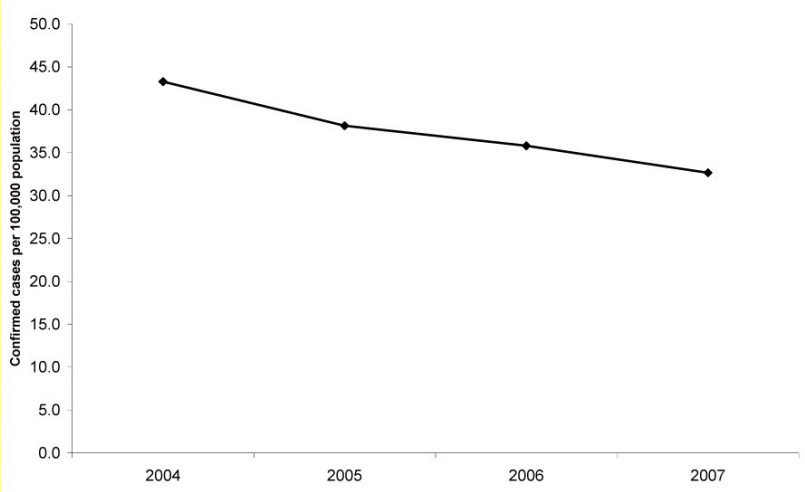
***Salmonella*: second most important zoonotic bacteria causing infection in humans**

***Salmonella* infections in humans for 2007 in the EU**



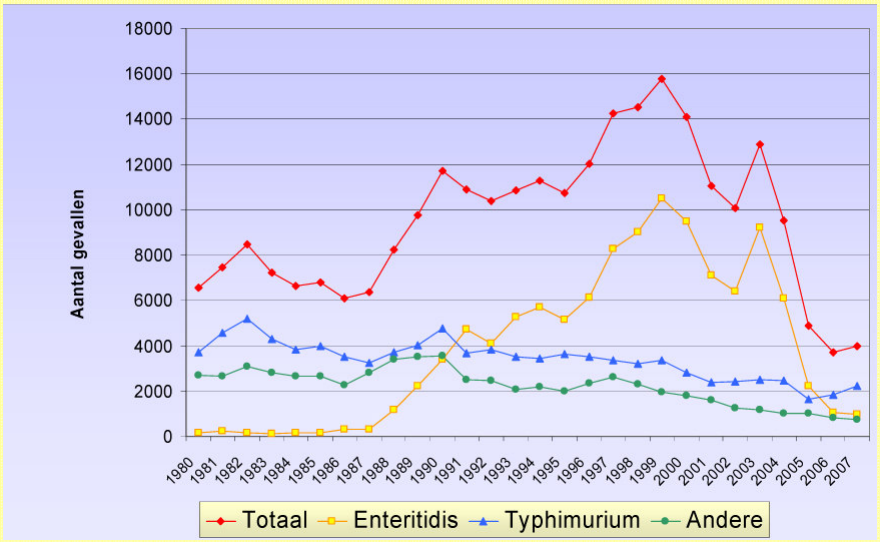
EFSA zoonoses report 2007

Evolution of *Salmonella* infections in humans in the EU



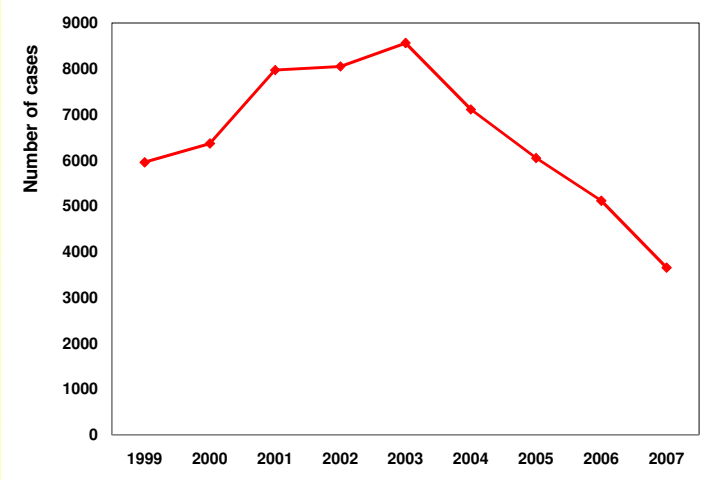
EFSA zoonoses report 2007

Evolution of the number of *Salmonella* infections in humans in Belgium



National Salmonella Reference Centre - WIV

Evolution of the number of *Salmonella* infections in humans in Spain



EFSA zoonoses report s

Poultry meat and table eggs considered as important sources for human *Salmonella* infections

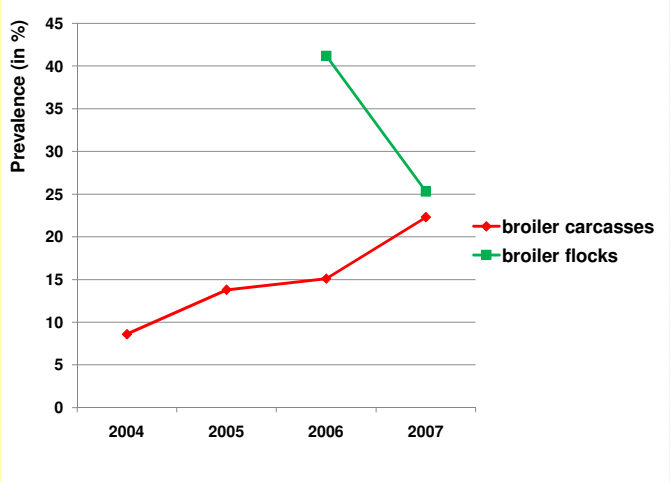
- **to reduce the impact of these products on human illness, measures taken by - poultry industry**
  - official authorities

Regulation 2160/2003 stated that from 2011 on fresh poultry meat may only be placed on the market for human consumption if the product is *Salmonella* negative on 25g.

and

Regulation 646/2007 stated that the percentage of *Salmonella* Enteritidis and Typhimurium positive broilers flock should be reduced to a maximum of 1% or less before 31 December 20011 fresh poultry meat.

Evolution of the prevalence of *Salmonella* positive broiler flocks and carcasses in Spain



EFSA zoonoses report 2007

Presence of *Salmonella* in parent flocks, broiler flocks and carcasses in Spain (2007)

	% *Salmonella* positive	% *Salmonella* Enteritidis positive
Parent flocks	2.56	1.48
Broiler flocks	25.28	13.50
Broiler carcasses	22.28	0.0

- ⇨ Parent flocks infected with *Salmonella* Enteritidis leading to infection of broiler flocks by vertical transmission
- ⇨ In contrast to the broiler flocks, broiler carcasses are not contaminated by *Salmonella* Enteritidis

Experiments

1/ *Salmonella* infection in 18 broiler flocks from the hatchery up to the slaughterhouse

- ⇨ Sources for infection at the farm level

2/ *Salmonella* contamination of carcasses from all broiler flocks slaughtered in the morning in 4 different slaughterhouses during 3 sampling days

- ⇨ Sources for contamination at the slaughterhouse level

3/ Effect of *Salmonella* contamination of the slaughter line before slaughter on the contamination of broiler carcasses in 3 slaughterhouses (2 visits each)

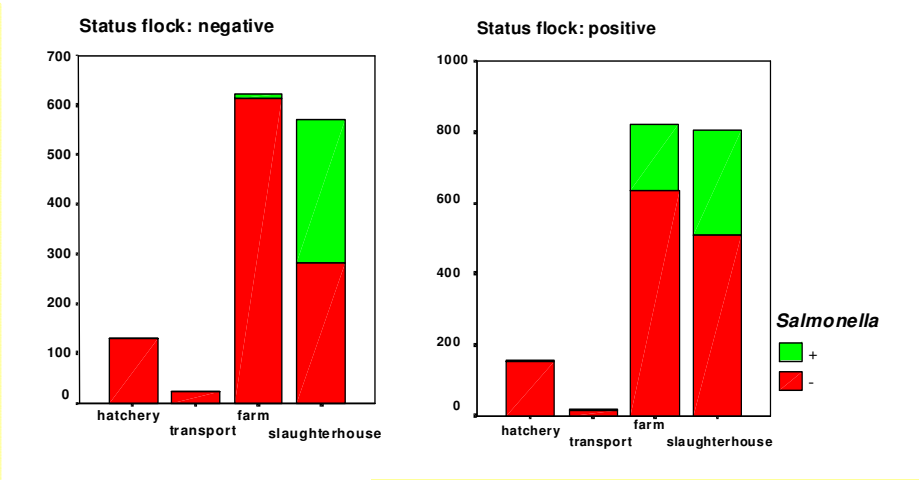
- ⇨ Sources for contamintion at the slaughterhouse level

Findings from experiment 1

Salmonella **infection during rearing of the flocks**

Age of flocks	Number + flocks
14	9
28	7
42	6
Total + flocks	10

Isolation of *Salmonella* in function of the infection status of the flocks



Hatchery/transport contamination and infection of flocks

Flock	Hatchery	Transport**	Broilers
3	-	Hadar	-
8	-	Enteritidis	**Enteritidis**
9	Enteritidis*	-	**Enteritidis**

Serotypes in bold still shed at slaughter age
*** broken eggshells**
**** transport box papers**

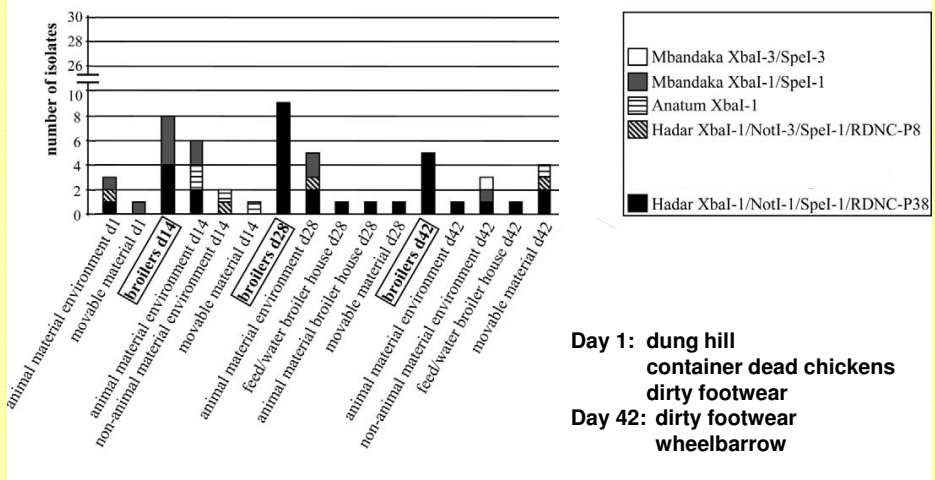
- **Role of the hatchery in the infection of broiler flocks due to**
  - **vertical transmission of *Salmonella***
  - **hygiene in hatchery**

Hygiene house/environment contamination and infection of flocks

Flock	Hygiene house	House environment	Broilers
1	Ventilation	-	-
3	-	Feed in trays, fecal material from dog	-
13	-	Dung hill, puddles, fecal material dog	-
14	-	Fecal material dog	-
15	-	Clean footwear, clean footwear other houses, fecal material other animals, container dead chickens	+ (other serotype)
17	-	Clean footwear	+
18	-	Clean footwear	+

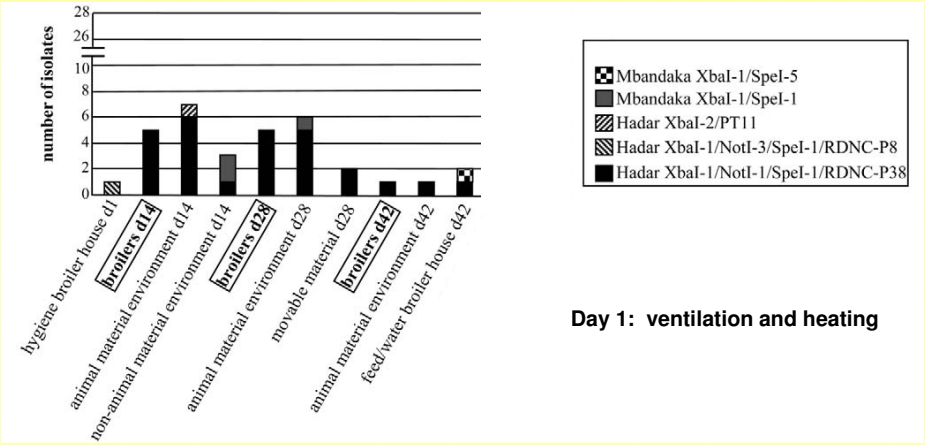
- ⇨ ***Salmonella*** **present in the house before the arrival of the chickens**
- ⇨ ***Salmonella*** **present in the environment of the house**

Hygiene house/environment contamination and infection of flock 6



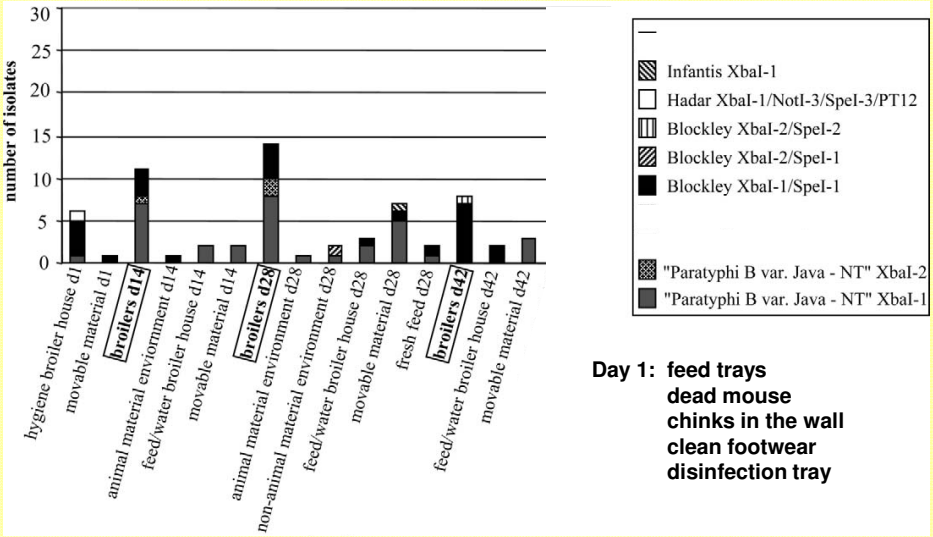
Day 1: dung hill
container dead chickens
dirty footwear
Day 42: dirty footwear
wheelbarrow

Hygiene house/environment contamination and infection of flock 7 (successive flock of flock 6)



Day 1: ventilation and heating

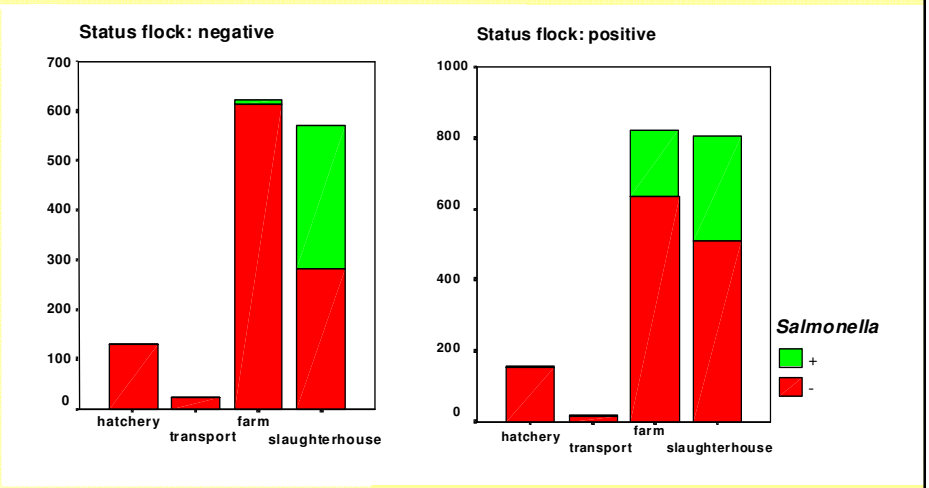
Hygiene house/environment contamination and infection of flock 10



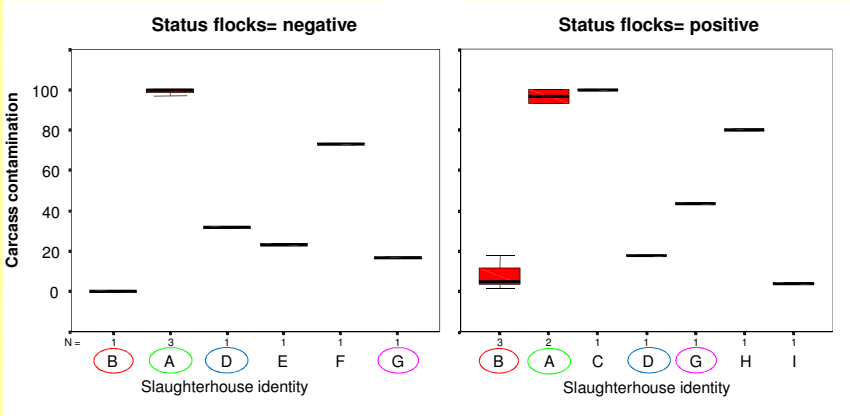
Day 1: feed trays
dead mouse
chinks in the wall
clean footwear
disinfection tray

- **Flock 18: Fresh feed contaminated and chickens shed the corresponding serotype for a short time**
- **3 other flocks shed *Salmonella* (one flock at the slaughter age) but despite the intensive sampling scheme *Salmonella* only found in clean footwear**

Carcass contamination in function of the infection status of the flocks



Salmonella status flocks and carcass contamination



- **Carcass contamination not correlated with the status of the flocks, but with the identity of the slaughterhouses**

Salmonella serotypes in broilers, fecal material in transport containers and carcasses

Slaughter-house	Flock number	Nb. + carcasses	Serotypes isolated from		
			Broilers	Fecal material	Carcasses
A	1*	60/60	-	-	7 serotypes
	6	30/30	**Hadar**, Mbandaka	**Hadar**, Indiana, Virchow	**Hadar**, Indiana, Virchow + 6 other serotypes
	7	28/30	**Hadar**	Agona, Blockley, Montevideo, Tyhimurium	**Hadar**, Agona, Blockley, Typhimurium + 3 other serotypes
B	2	1/60	Agona	-	Typhimurium
	4	0/60	-	Hadar	-
	8*	3/60	**Enteritidis**	Typhimurium	**Enteritidis**** + 1 other serotype
	9	11/60	**Enteritidis**, Braenderup, Mbandaka	-	**Enteritidis** + 1 other serotype
C	10	47/47	**Blockley**, Paratyphi B,	**Blockley**, Paratyphi, B, Mbandaka	**Blockley****, Enteritidis, Mbandaka
H	16	20/30	**Anatum**	Typhimurium, Hadar, not typable	Typhimurium, Hadar, not typable + 1 other serotype

Serotypes shed at the age of 42 days are indicated in bold
***Flock not slaughtered as the first**
**** Predominant serotype**

Salmonella Hadar genotypes in broilers, fecal material in transport containers and carcasses (flock 6)

	Genotype		
	1	**2**	**3**
Broilers			**+**
Transport containers		**+ (3)**	**+ (1)**
Carcasses	**+ (1)**	**+ (6)**	**+ (1)**

Between brackets: number of strains belonging to this genotype

⇨ **Most *Salmonella* Hadar strains not originated from the slaughtered flock**

Contamination of ready-to-use transport containers

118 out 168 transport containers (70%) *Salmonella* positive

- Source for
  - contamination of fecal material collected from transport containers
  - exterior contamination of transported chickens
  - uptake and colonisation of transported chickens ???

Findings from experiment 2

Slaughterhouse	Number of colonized flocks*	Number of positive flocks/total flocks	Number of positive carcasses (of 20)
A	3	7/13	1-3
B	1	2/10	1-19
C	1	14/17	2-12
D	2	8/16	2-9

* Either crop or duodeneum/cecum positive

- In all slaughterhouses:
  contamination of carcasses despite flocks *Salmonella* negative, but the degree of contamination was slaughterhouse dependent

Data slaughterhouse A

Sampling day	Flock	Neck skins		Duodeneum and ceca	
		No. (of 20)	Sero-/genotype	No. (of 6)	Sero-/genotype
1	1	3	Hadar – 1		
	2	2	Hadar – 1		
	4	2	Hadar – 1		
2	5	1	Indiana – 1	4	Typhymurium – 1
	6	1	Newport – 1	1	London – 1
	7		Not typable – 1		
	8	1		1	Not typable – 1

All crop samples *Salmonella* negative

- ⇨ Day 1: contamination of carcasses with the same *Salmonella* strain
- ⇨ Day 2: infected birds no source for contamination of carcasses

Data slaughterhouse C

Sampling day	Flock	Neck skins		Crop	
		No. (of 20)	Sero-/genotype*	No. (of 3)	Sero-/genotype
1	1	12	Agona – 2 (6) Virchow – 1 (2) Typhimurium – 2 (1)		
	2	9	Agona – 2 (4) Typhimurium – 2 (2) Ealing – 1(1)	1	Typhimurium – 2
	3	8	Agona – 2 (2) Typhimurium – 2 (2) Not typable – 2 (1)		
	4	6	Typhimurium – 2 (3) Agona – 2 (1) Agona – 3 (1) O4:d:- – 1 (1)		
	5	5	Typhimurium – 2		
	6	3	Typhimurium – 2		
	7	3	Typhimurium – 2 (2) O4:d:- – 1 (1)		

* between brackets: number of isolates

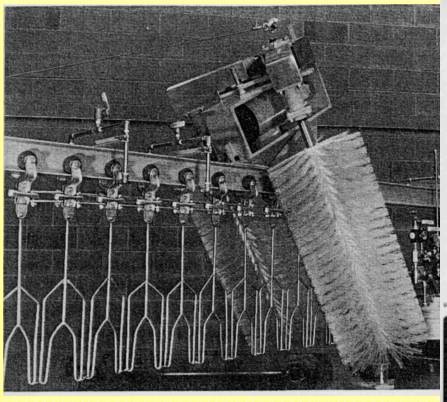
- ⇨ Contamination of carcasses with the same *Salmonella* strains
- ⇨ Flock 2: positive in the crop, origin: contaminated transport containers?

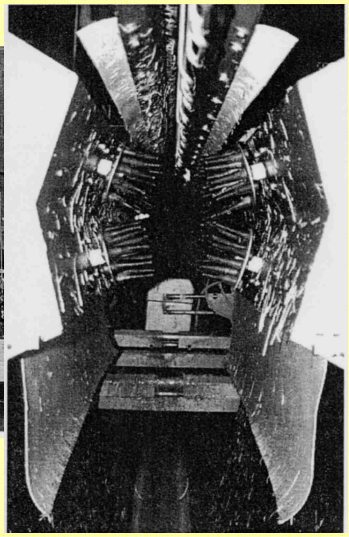
Data slaughterhouse D

Sampling day	Flock	Neck skins		Crop		Duodenum and ceca	
		No. (of 20)	Sero-/ genotype	No. (of 3)	Sero-/genotype	No. (of 6)	Sero-/genotype
2	9	2	Agona – 4 Infantis – 1				
	11	6	Infantis – 2 (5) Virchow – 2 (1)			2	Infantis – 2
3	12	5	Blockley – 1 (3) Infantis – 3 (2)				
	14	3	Blockley – 1 (2) Infantis – 3 (1)				
	15	3	Infantis – 1				
	16	9	Infantis – 1	2	Infantis – 1		

- ⇨ On day 2: birds no source for contamination of carcasses
- ⇨ On day 3: flock 12 and 14 common serotypes
  flock 15 and 16 common serotype, crop contamination increase carcass contamination

Findings from experiment 3





Effect of the environmental contamination on the carcass contamination in slaughterhouse 1

✓ **Environmental contamination before slaughter**

	No +/ total No	serotype	PFGE
Scalding tank	6/15	Typhimurium	T-1
		Paratyphi B	P-1
		Indiana	I-1
		Blockley	B-1
Plucking machine	9/15	Typhimurium	T-1
		Paratyphi B	P-1
		Indiana	I-1
		Agona	A-1
			A-2
		Montevideo	M-1
			M-2
			M-3
Evisceration line	2/14	Typhimurium	T-1
		Paratyphi B	P-1

✓ **Contamination during slaughter of the first flock**

	No +/ total No	serotype	PFGE
Transport containers	1/6	Typhimurium	T-1
Feathers			
Before scalding	3/3	Typhimurium	T-1
		Rissen	
After scalding	2/3	Typhimurium	T-1
		Paratyphi B	
During plucking	3/3	Typhimurium	T-1
		Agona	A-2
		Montevideo	M-1
Neck skin			
After plucking	13/30	Typhimurium	T-1
		Paratyphi B	P-1
		Blockley	B-1
After evisceration	18/30	Typhimurium	T-1
			T-2
		Paratyphi B	P-1
		Blockley	B-1
		Minnesota	M-1
Intestines	0/12		

Effect of the environmental contamination on the carcass contamination in slaughterhouse 2

	No +/total No	serotype	PFGE
Slaughterline			
Scalding tank	2/15	Liverpool	L-1
Plucking line	2/15	Liverpool	L-1
Evisceration line	0/14		
During slaughter 1° flock			
Transport containers	0/6		
Feathers			
Before scalding	1/3	Liverpool	L-1
Before plucking	0/3		
During plucking	0/3		
Neck skin			
After plucking	4/30	Liverpool	L-1
After evisceration	1/30	Liverpool	L-1
Intestines	0/12		

Conclusions

Possible sources for *Salmonella* infection/contamination

- ✓ Hatchery
  - vertical transmission
  - hygiene
- ✓ Farm
  - hygiene house
  - environmental contamination
    - ↳ importance of the hygiene gate
  - feed
- ✓ Transport to the slaughterhouse
  - contamination of transport container
- ✓ Slaughterhouse
  - contamination of slaughter equipment
  - slaughter of *Salmonella* positive flocks

Acknowledgements

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