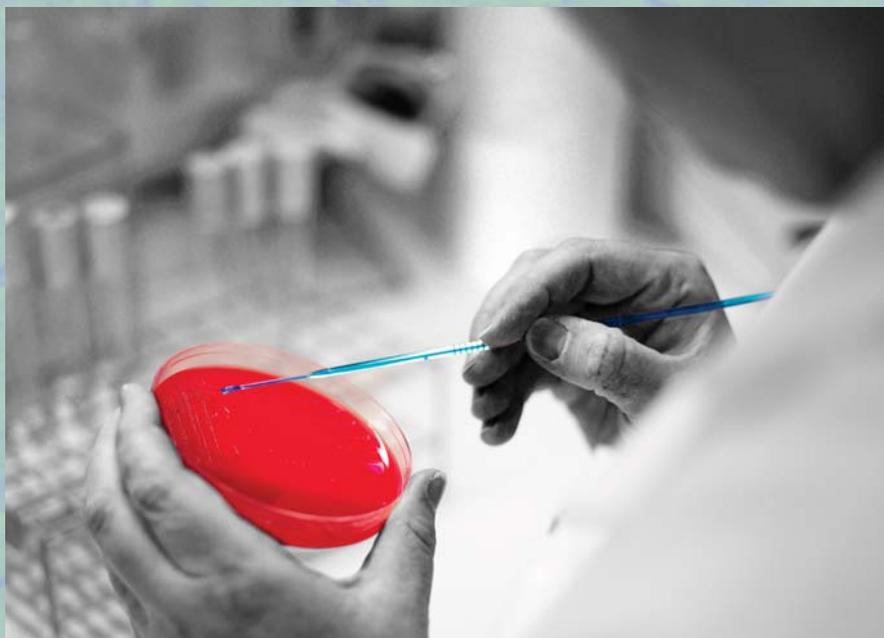


The surveillance and control programme for *Salmonella* in live animals, eggs and meat in Norway

*Solveig Jore
Petter Hopp
Merete Hofshagen
Bjarne Bergsjø
Torkjel Bruheim
Michaela Falck
Olav Eikenes
Henriette Glosvik*



*Editor Ann-Charlotte Karlsson
Technical editor Hanne Mari Jordsmyr
Scientific editors Hege Hellberg and Ståle Sviland
National Veterinary Institute*



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National Veterinary Institute
PO Box 750 Sentrum
N-0106 Oslo
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Fax: + 47 23 21 60 01
Tel: + 47 23 21 60 00
E-mail: vipost@vetinst.no
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The Salmonella surveillance programme in 2009, documents that the Norwegian population of cattle, swine, sheep, and poultry are only sporadically infected. The estimated prevalence is below 0.1% in all examined populations.

Introduction

The occurrence of Salmonella in Norwegian production animals and animal products is very low compared to most other countries, and has been so during the last decades.

The recorded incidence of human salmonellosis has quite increased in Norway during the last three decades. However, the overall situation seems to have been stable the last years. For the majority of salmonellosis cases (approximately 75-80%), the patients have acquired the disease abroad (1).

As it is very important to maintain this favourable situation in Norway, the Norwegian Salmonella surveillance and control programmes (2) were established in 1995, and launched simultaneously with comparable programmes in Sweden and Finland (3, 4). These programmes are approved by the EU Commission (EFTA Surveillance Authority Decision No. 68/95/COL of 19.06.1995), allowing Norway to require additional guarantees regarding Salmonella when importing live animals, feed and food products of animal origin from the European Union.

The surveillance covers live animals (pigs, cattle and poultry) and fresh meat (pigs, poultry, cattle and sheep). Any Salmonella isolated in the programme irrespectively of serovar, is notifiable to the Norwegian Food Safety Authority which maintains overall responsibility. When Salmonella is isolated, action is taken

to eliminate the infection, prevent transmission, and prevent contamination of food products. The National Veterinary Institute coordinates the surveillance programmes, examines the faecal samples and publishes the results in monthly and annual reports. Private laboratories perform the examination of samples collected at slaughterhouses and cold stores.

Aims

The aims of the programme are to ensure that Norwegian food-producing animals and food products of animal origin are virtually free from Salmonella, to provide reliable documentation of the prevalence of Salmonella in the livestock populations and their products, and to prevent an increased occurrence of Salmonella in Norway.

Materials and methods

The Salmonella surveillance and control programme for live animals includes examination of faecal samples (including boot swabs) from swine and poultry, and lymph node samples from cattle and swine (at least five ileo-caecal lymph nodes from each animal).

The Salmonella surveillance and control programme for fresh meat and poultry meat includes examination of swab samples from cattle, swine and sheep carcasses, and samples of crushed red meat from slaughterhouses and cold stores.

The number of samples requested in the different parts of the programme is estimated to be sufficient to detect at least one Salmonella-positive sample if the prevalence in the population is at least 0.1%, with a confidence level of 95%, assuming a 100% sensitive test.



Photo: Colourbox

Table 1. Sampling of *Gallus gallus* breeder flocks, and breeder flocks of turkey, duck and geese.

O = Official personnel (Norwegian Food safety Authority), F = Farmer

Production	Sampling time	Sampling place	Sample material	Sampling by
Rearing flocks	Day old	Holding	5 transport crates from one delivery: Crate liners (>1m ² in total) or Swab samples (>1m ² in total). Analysed as one pooled sample.	F
	4 weeks old	Holding	2 pairs of boot swabs. Analysed as one pooled sample.	F
	2 weeks before being moved	Holding	2 pairs of boot swabs. Analysed as one pooled sample.	F and O: Once a year in each holding
Goose	Every 2nd week	Holding	5 pairs of boot swabs. Analysed as two pooled samples. [2 x 150 g faeces, analysed separately, if birds kept in cages].	F and 3 x O: 0-4 weeks after moving, 8-0 weeks before slaughter, once in between

Sampling scheme for live animals

Poultry

The present Salmonella programme has been established pursuant to Article 5 of regulation (EC) 2160/2003 of the European Parliament and of the Council of 17 November 2003 on the control of Salmonella and other specified food-borne zoonotic agents (5).

All breeder flocks and commercial production flocks are included in the surveillance programme. All breeder flocks are certified and the sampling is in accordance with table 1. All layer flocks are sampled twice during the rearing period and every 15 weeks during the egg laying period (table 2), whilst broiler flocks and flocks of turkeys, ducks and geese other than breeders are sampled one to three weeks before slaughter (table 3). Result of the testing must be ready before slaughter so actions can be taken for positive flocks.

Swine

In Norway there were 126 elite and multiplier breeding swine herds in 2009. More than 95% of marketed breeding animals are purchased from these herds. All elite and multiplier breeding herds are surveyed annually at herd level (6). Pooled faecal samples

are collected from all pens (up to a maximum of 20) containing piglets aged two to six months. If there are less than three pens of piglets at this stage, additional individual faecal samples are collected from all sows (up to a maximum of 59).

The pig population is surveyed by sampling a representative proportion of all pigs slaughtered in Norway. Lymph node samples from a total of 3,000 swine (both sows and slaughter pigs) should be collected at slaughter. The sample size for each slaughterhouse ranges from 1 to 400 and is based upon the number of onsite slaughtered animals in relation to the national total. The sampling is distributed evenly throughout the year (7).

Cattle

The surveillance is based on sampling a representative proportion of all cattle slaughtered in Norway. A total of 3,000 lymph node samples from cattle should be collected at slaughter. The sample size for each slaughterhouse ranges from 1 to 270 and is based upon the number of onsite slaughtered animals in relation to the national total. The sampling is distributed evenly throughout the year (7).

Table 2. Sampling of layer flocks. O = Official personnel (Norwegian Food safety Authority), F = Farmer

Production	Sampling time	Sampling place	Sample material	Sampling by
Rearing flocks	Day old	Holding	5 transport crates: Crate liners (>1m ² in total) or Swab samples (>1m ² in total). Analysed as one pooled sample.	F
	2 weeks before being moved	Holding	2 pairs of boot swabs. Analysed as one pooled sample. Cage birds: Faecal samples (150 g)	F and O: Once a year in each holding
Goose	Every 15 weeks	Holding	2 pairs of boot swabs. Analysed as one pooled sample. Cage birds: Faecal samples (150 g)	F and O: One of the samples

Table 3. Sampling of broiler, turkey, duck and geese flocks.
O = Official personnel (Norwegian Food safety Authority), F = Farmer

Sampling time	Sampling place	Sample material	Sampling by
7 - 19 days before slaughter	Holding	2 pairs of boot swabs. Analysed as one pooled sample.	F and O: Once a year in each holding

All animal species - Clinical cases

Animals with clinical symptoms consistent with salmonellosis should be sampled for bacteriological diagnosis. In addition, all sanitary slaughtered animals are tested for the presence of Salmonella. Data from these two categories of samples are not included in this report.

Sampling scheme for fresh meat

Swab samples from carcasses

The testing of slaughtered pigs, cattle and sheep for Salmonella is done by swabbing carcass surfaces. For each animal species, a total of 3,000 swab samples should be collected at slaughter. For each slaughterhouse, the sample size ranges from 1 to 270 and from 1 to 400 for cattle and swine, respectively. The number of swab samples of cattle and swine from each slaughterhouse equals the number of lymph node samples. The number of swab samples from sheep ranges from 1 to 345 per slaughterhouse. The sampling is distributed evenly throughout the year. The sampling is done near the end of the slaughter line before the carcasses are refrigerated. Approximately 1,400 cm² of each carcass is swabbed (somewhat less for sheep) (7).

Food products

The surveillance and control programme for cutting plants and cold stores are based upon samples of crushed red meat taken from the equipment or from trimmings. Each sample consists of 25 grams. Each production line is sampled separately (but analysed as one pooled sample). The sampling should be performed randomly during operation. The number of samples taken in cutting plants and cold stores is given by the production capacity of the plant, and ranges from one sample per week to two per year (6).

Pre-packed fresh meat intended for cold stores does not have to be examined if they come from cutting plants that are included in the programme. However, freshly packed or repacked meat should be sampled.

Laboratory methods

Lymph nodes and carcass swabs

All lymph nodes from one animal are divided into two equal parts. One half is used for testing and the other half is stored at 4°C until the results of the bacteriological examination are ready. The lymph nodes from at most five animals are pooled and homogenized before

bacteriological examination. Swab samples are pooled in groups of five before testing. If a pooled sample is confirmed positive for Salmonella, the individual samples are examined separately. Microbiological examination of the samples is carried out according to the Nordic Committee on Food Analysis method No. 71, but slightly amended to make the method applicable to the various kinds of materials.

Faecal samples(including boot swabs)

Testing for the presence of Salmonella is carried out using ISO 6579:2002/Amd.1:2007(E): Annex D: Detection of Salmonella spp. in animal faeces and in environmental samples from the primary production stage. A sample is considered positive for Salmonella when Salmonella is detected by specified method and verified by the National Reference Laboratory (National Veterinary Institute).

Results

Live animals

Poultry

A total of 10,987 samples were received for examination and out of these 91 samples were rejected for examination. Altogether 10,896 faecal samples and boot swabs from 1,552 different holdings were examined (Table 4). One sample was positive for Salmonella.

Swine

A total of 1898 faecal samples from 116 elite and multiplier breeding herds (including AI centres and testing stations) were examined in 2009 (Table 5). Salmonella was not detected in any of the samples.

A total of 2,479 lymph node samples from slaughtered pigs were examined. Approximately 35% of the samples were taken from sows and the remaining from slaughter pigs. None of the samples was positive for Salmonella giving an estimated Salmonella prevalence of 0% (95% confidence interval: 0% - 0.15%) at the individual carcass level.

Cattle

In 2009, a total of 2,441 lymph node samples from cattle were examined (Table 6). None of the samples was positive for Salmonella giving an estimated Salmonella prevalence of 0% (95% confidence interval: 0% - 0.15%) at the individual carcass level.

Table 4. Samples from poultry examined

	No. of samples tested	No. of holdings tested	No. of positive holdings	<i>Salmonella</i> serovar
Grandparents and parents				
Layers	595	38	0	
Broilers	2621	108	0	
Turkeys, geese and ducks	176	11	0	
Unknown	6	6	0	
Total - Breeders	3 398	141	0	
Other commercial poultry				
Pullets	358	29	0	
Layers	2 278	653	0	
Meat production - Broilers	4 262	642	1	<i>Salmonella</i> Typhimurium fagtype DT40
- Turkeys, geese and ducks	598	78	0	
Unknown	2	1	0	
Total - Non breeder holdings	7 498	1456	1	
Total	10 896	1552	1	

Fresh meat

Swab samples from cattle, sheep and swine carcasses

A total of 5,868 swab samples from 32 slaughterhouses were examined in 2009 (Table 6). *S. diarizonae* was detected in one of the samples.

Cutting plants and cold-stores for fresh meat and poultry meat

A total of 1,184 samples of crushed meat from 59 different plants were examined. *S. Dublin* was detected in one sample originating from cattle.

Table 5. Sampling in elite and multiplier breeding swine herds

Herd category	No. of herds sampled (total*)	No. of samples examined	No. of positive samples	<i>Salmonella</i> serovar
Elite breeding herds	48 (53)	773	0	
Multiplier herds	68 (73)	1 125	0	

* Total number of herds is estimated as breeding and production herd per 1 January 2009 excluding herds which ended breeding activity during 2009 before being tested.

Table 6. Number of individual lymph node samples from swine and cattle examined

Species	No. of slaughterhouses sampled (total*)	No. of samples examined	No. of positive samples	<i>Salmonella</i> serovar
Sows	13 (26)	859	0	
Slaughter pigs	19 (26)	1 620	0	
Cattle	24 (34)	2 441	0	

* Slaughterhouses where the number of slaughtered animals of a species is less than 100 according to the Slaughter Statistics for 2009 are not included in the sampling scheme.

Table 7. Number of swab samples from carcasses of swine, cattle and sheep examined

Species	No. of slaughterhouses sampled (total*)	No. of samples examined	No. of positive samples	<i>Salmonella</i> serovar
Swine	20 (26)	2 029	0	
Cattle	25 (34)	2 097	0	
Sheep	20 (39)	1 742	0	<i>Salmonella diarizonae</i> 61:k:1,5,7

* Slaughterhouses where the number of slaughtered animals of a species is less than 100 according to the Slaughter Statistics for 2009 are not included

Discussion

The results from the *Salmonella* surveillance programmes in 2009 are in agreement with previous years (8) that the Norwegian cattle, swine, sheep and poultry populations are only sporadically infected with *Salmonella*. The estimated prevalence is below 0.3% in the examined populations for any of the years the surveillance programmes have run. *S. Typhimurium* is isolated most frequently from swine, cattle and poultry, while *S. enterica* subsp. *diarizonae* is found most frequently from sheep.

Between 20% and 25% of the recorded human cases of salmonellosis are domestic in origin showing that domestic food products of animal origin represent a minor risk with regard to *Salmonella* infection in humans. In 2002 it was shown that two clones of *S. Typhimurium* in the wild fauna (wild birds and hedgehogs) represented a risk for human infection (9). Such wild animal reservoirs may also be considered a risk for farm animals. The prevalence of *S. Typhimurium* is still low, it may be assumed that farm animal populations have been and still are quite well protected from these reservoirs.

The number of swab and lymph node samples examined from swine, sheep and cattle should have been 3,000 per year. The required sample size was not reached for the populations of swine, cattle and sheep. A follow up of the personnel taking and reporting the samples is needed. Never the less, the programme was able to document a very low *Salmonella* prevalence in the examined populations.

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Photo: Colourbox

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