

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

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Introduction

The *Salmonella* surveillance programme in 2008, documents that the Norwegian population of cattle, swine, sheep, and poultry are only sporadically infected. The estimated prevalence is below 0.3 %.

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). The 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, 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 from swine and poultry ((includes boot swabs), 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.

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 breeding 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.

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

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
Adult flocks	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

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

Table 2. Sampling of laying flocks

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 (150g)	F and O: Once a year in each holding
Laying flocks	Every 15 weeks	Holding	2 pairs of boot swabs. Analysed as one pooled sample. Cage birds: Faecal samples (150g).	F and O: One of the samples

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

Table 3. Sampling of broiler, turkey, duck and geese flocks

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

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

Swine

In Norway there were approximately 135 elite and multiplier breeding swine herds in 2008. 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).

The Commission of the European Communities established a survey to be carried out in 2008 on the prevalence of *Salmonella* spp. and Methicillin-resistant *Staphylococcus aureus* in herds of breeding pigs in the member states and Norway. This was established to get comparable data on the prevalence of *Salmonella* and MRSA in breeding pigs and to set community targets.

All nucleus breeders and multipliers were included in the survey. We chose to include all these herds in this baseline survey, to replace the established annual surveillance of this population in 2008.

In addition, 150 production herds were randomly selected to participate in the baseline survey.

The faecal samples in the baseline survey were taken as individual pinches of at least 25 g pooled 10 and 10.

The pig population is surveyed by sampling a representative proportion of all pigs slaughtered in Norway. A total of 3,000 lymph node samples from swine (both sows and slaughter pigs) should be collected at slaughter. The sample size for each slaughterhouse ranges from 1 to 416 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 284 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).

Clinical cases - all animal species

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 284 and from 1 to 416 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 329 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 is ready. The lymph node 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(includes boot swabs)

Testing for the presence of *Salmonella* spp. 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* spp. when *Salmonella* spp. is detected by specified method and verified by the National Reference Laboratory (National Veterinary Institute).

Results

Live animals

Poultry

A total of 11,502 faecal samples and boot swabs from 1,626 different holdings were examined (Table 4). None of the samples were positive for *Salmonella*.

Swine

A total of 119 nucleus and multiplier herds and 149 production herds were sampled in the baseline survey in 2008 (Table 5). All samples were negative for *Salmonella* spp., giving an estimated prevalence of *Salmonella* spp. of 0 % (confidence Interval 0 % - 1.45 %). The number of samples reported in the baseline survey is not equivalent to the numbers mentioned here, because some samples were rejected from the EU survey due to the fact that sampling had not been performed totally according to the instructions. But these samples were still fulfilling the criteria for being included in the national survey.

A total of 2,126 lymph node samples from slaughtered pigs were examined. Approximately 30 % of the samples were taken from sows and 69 % from slaughter pigs. None of the samples was positive for *Salmonella* giving an estimated *Salmonella* prevalence of 0 % (95 % confidence interval: 0 % - 0.2 %) at the individual carcass level.

Cattle

In 2008, a total of 1,831 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 % - 0.2 %) at the individual carcass level.

Fresh meat

Swab samples from cattle, sheep and swine carcasses

A total of 5,237 swab samples from 38 slaughterhouses were examined in 2008 (Table 6). *S. diarizonae* was detected in two of the samples.

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

A total of 1,116 samples of crushed meat from 58 different plants were examined. Salmonella was detected in six samples where *S. Typhimurium* was detected in two of the samples. *S. Newport*, *S. Enteritidis*, *S. Dublin* and *S. Branedrup* was detected in one sample each.

Table 4. Samples from poultry in the Salmonella surveillance and control programme in 2008

	No. of samples tested	No. of holdings tested	No. of positive holdings	<i>Salmonella</i> serovar
Grandparents and parents				
Layers	868	44	0	
Broilers	2292	99	0	
Turkeys, geese and ducks	177	11	0	
Unknown	347	55	0	
Total - Breeders	3684	209	0	
Other commercial poultry				
Pullets	263	23	0	
Layers	2206	663	0	
Meat production - Broilers	4787	654	0	
Meat production - Turkeys, geese and ducks	557	73	0	
Unknown	5	4	0	
Total - Non breeder holdings	7818	1417	0	
Total	11502	1626	0	

Table 5. Sampling in elite and multiplier breeding swine herds in the Salmonella surveillance and control programme in 2008

Herd category	No. of herds sampled (total*)	No. of samples examined	No. of positive samples	<i>Salmonella</i> serovar
Multiplier herds	119 (135)	1,232	0	
Production herds	149 (150)	1,509	0	

* Total number of herds is estimated as breeding and production herd per 1 January 2008 excluding herds which ended breeding activity during 2008 before being tested.

Table 6. Number of individual lymph node samples from swine and cattle examined in the *Salmonella* surveillance and control programme in 2008

Species	No. of slaughterhouses sampled (total*)	No. of samples examined	No. of positive samples	<i>Salmonella</i> serovar
Sows	16 (27)	651	0	
Slaughter pigs	23 (27)	1,475	0	
Cattle	27 (36)	1,831	0	

* Slaughterhouses where the number of slaughtered animals of a species is less than 100 according to the Slaughter Statistics for 2008 are not included in the sampling scheme.

Table 7. Number of swab samples from carcasses of swine, cattle and sheep examined in the *Salmonella* surveillance and control programme in 2008

Species	No. of slaughterhouses sampled (total*)	No. of samples examined	No. of positive samples	<i>Salmonella</i> serovar
Swine	24 (27)	2,151	0	
Cattle	27 (36)	1,588	0	
Sheep	19 (39)	1,498	2	<i>Salmonella</i> diarizonae 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 2008 are not included

Discussion

The results from the *Salmonella* surveillance programmes in 2008 are in agreement with previous years (8-13) 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 15 % 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 (14). 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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