

# The surveillance programmes for *Salmonella* in live animals, eggs and meat in Norway 2017



**Veterinærinstituttet**  
Norwegian Veterinary Institute



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## Summary

The *Salmonella* surveillance programme in 2017, documents that the Norwegian population of cattle, swine 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 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 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 (5), 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, poultry and cattle) and fresh meat (pigs and cattle). 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 Norwegian Veterinary Institute coordinates the surveillance programmes, examines the faecal samples and reports the results. 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 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) and dust samples from pullets and rearing flocks.

The *Salmonella* surveillance programme for fresh meat includes examination of swab samples from cattle and swine carcasses, and samples of minced 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 (6).

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 1), whilst broiler flocks and flocks of turkeys, ducks and geese other than breeders are sampled one to three weeks before slaughter (Table 1). Result of the testing must be available before slaughter so actions can be taken in positive flocks.

**Table 1.** Sampling scheme in the surveillance programme for *Salmonella* of *Gallus gallus*, turkey, duck and geese in breeder flocks and flocks in production. All samples are collected in the holding.

Production	Sampling time	Sample material	Sampling by*
<b>Breeder flocks</b>			
Rearing flocks	Day old	5 transport crates from one delivery: Crate liners (>1m <sup>2</sup> in total) or Swab samples (>1m <sup>2</sup> in total) analysed as one pooled sample.	F
	4 weeks old	2 pairs of boot swabs analysed as one pooled sample.	F
	2 weeks before being moved	2 pairs of boot swabs analysed as one pooled sample.	O: Once a year per holding F: Remaining samples
Adult flocks	Every 2 <sup>nd</sup> week	1 pair of boot swabs and 1 specimen of dust (cloth). Analysed as two separate samples. [2 x 150 g faeces analysed separately, if birds kept in cages].	3 x O: 0-4 weeks after moving, 8-0 weeks before slaughter, once in between F: Remaining samples
<b>Production flocks</b>			
Pullets	Day old	5 transport crates: Crate liners (>1m <sup>2</sup> in total) or Swab samples (>1m <sup>2</sup> in total) analysed as one pooled sample.	F
	2 weeks before being moved	2 pairs of boot swabs analysed as one pooled sample. Cage birds: Faecal samples (150 g)	O: Once a year in each holding F: Remaining samples
Layers	Every 15 <sup>th</sup> weeks	2 pairs of boot swabs analysed as one pooled sample. Cage birds: Faecal samples (2x150 g).	O: One of the samples F: Remaining samples
Slaughter flocks	10 - 19 days before slaughter	1 pair of boot swabs and 1 specimen of dust (cloth) analysed as one pooled sample.	O: Once a year per holding F: Remaining samples

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

### Swine

In Norway, there were 87 elite and multiplier breeding swine herds at the start of 2017. More than 95% of marketed breeding animals are purchased from these herds. All elite and multiplier breeding herds are surveyed annually at herd level (7). 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 3,000 swine (both sows and slaughter pigs) should be collected at slaughter.

The estimated sample size for each slaughterhouse ranged from 1 to 536 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 estimated sample size for each slaughterhouse ranged from 1 to 686 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).

#### *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 and cattle for *Salmonella* is done by swabbing carcass surfaces. For each animal species, 3,000 swab samples should be collected at slaughter. The number of swab samples of cattle and swine from each slaughterhouse equals the number of lymph node samples. The sampling is distributed evenly throughout the year. The sampling is done near the end of the slaughter line before the carcasses are refrigerated. Approx. 1,400 cm<sup>2</sup> of each carcass is swabbed (8).

#### *Food products*

The surveillance 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 g. 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 (8). 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

#### *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.

#### *Lymph nodes, carcass swabs and crushed meat samples*

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. The samples are analysed using real-time PCR.

#### *All samples*

A sample is considered positive for *Salmonella* when *Salmonella* is detected by specified method and verified by the National Reference Laboratory (Norwegian Veterinary Institute).

## Results

### Live animals

#### Poultry

Altogether 8,881 faecal samples and boot swabs from 1,358 different holdings were examined (Table 2). One layer flock was positive for *Salmonella*, giving an estimated *Salmonella* prevalence of 0.07% (95% confidence interval: 0.002% - 0.41%) at the flock level. Figure 1 shows the occurrence of *Salmonella* in poultry flocks from the implementation of the programme in 1996.

Table 2. Number of samples from poultry examined in the *Salmonella* surveillance programme in 2017.

Breeder flocks	No. of holdings	No. of flocks	No. of samples	No. of positive*	<i>Salmonella</i> serovar
<b>Grandparent flocks</b>					
Layers	3	4	47	0	
<b>Parent flocks</b>					
Layers	7	11	134	0	
Broilers	97	136	1 627	0	
Turkey, geese and duck	9	19	217	0	
<b>Total breeders</b>	<b>116</b>	<b>170</b>	<b>2 025</b>	<b>0</b>	
<b>Production flocks</b>					
Pullets	16	153	239	0	
Layers	558	814	1 817	1	<i>S. diarizonae</i>
Broilers	596	4 361	4 361	0	
Turkey, geese and duck	72	289	439	0	
<b>Total non breeders</b>	<b>1 242</b>	<b>5 617</b>	<b>6 856</b>	<b>1</b>	
<b>Total</b>	<b>1 358</b>	<b>5 787</b>	<b>8 881</b>	<b>1</b>	

\* Number of positive flocks

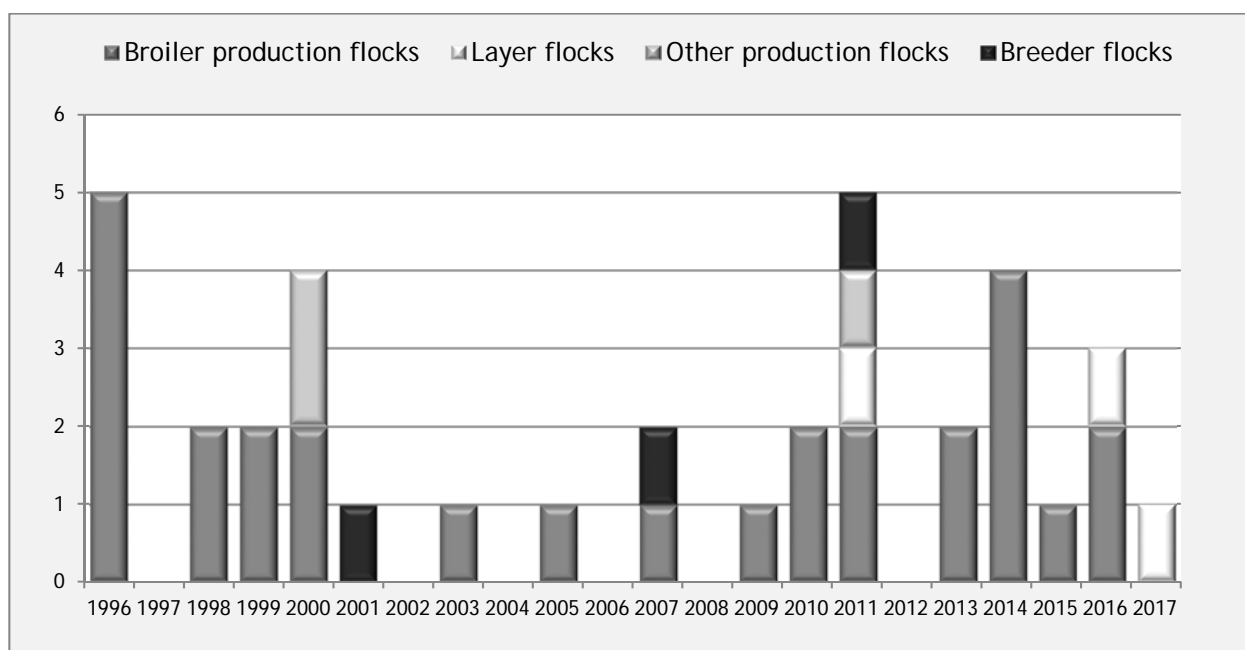


Figure 1. Number of positive poultry flocks found in the *Salmonella* surveillance programme since the start in 1996.

*Swine*

Altogether 1,552 faecal samples from 82 elite and multiplier breeding herds (including AI centres and testing stations) were examined. *Salmonella* was not detected.

A total of 3,226 lymph node samples from slaughtered pigs were examined (Table 3). Approximately 45% of the samples were taken from sows and the remaining from slaughter pigs. Three samples were positive for *Salmonella* giving an estimated *Salmonella* prevalence of 0.09% (95% confidence interval: 0.02% - 0.27%) at the individual carcass level. Figure 2 shows the occurrence of *Salmonella* in samples from swine since the start of the programme.

*Cattle*

A total of 3,149 lymph node samples from cattle were examined (Table 3). One sample was positive for *Salmonella* giving an estimated *Salmonella* prevalence of 0.03% (95% confidence interval: 0.001% - 0.18%) at the individual carcass level. Figure 2 shows the occurrence of *Salmonella* in samples from cattle and swine since 1995.

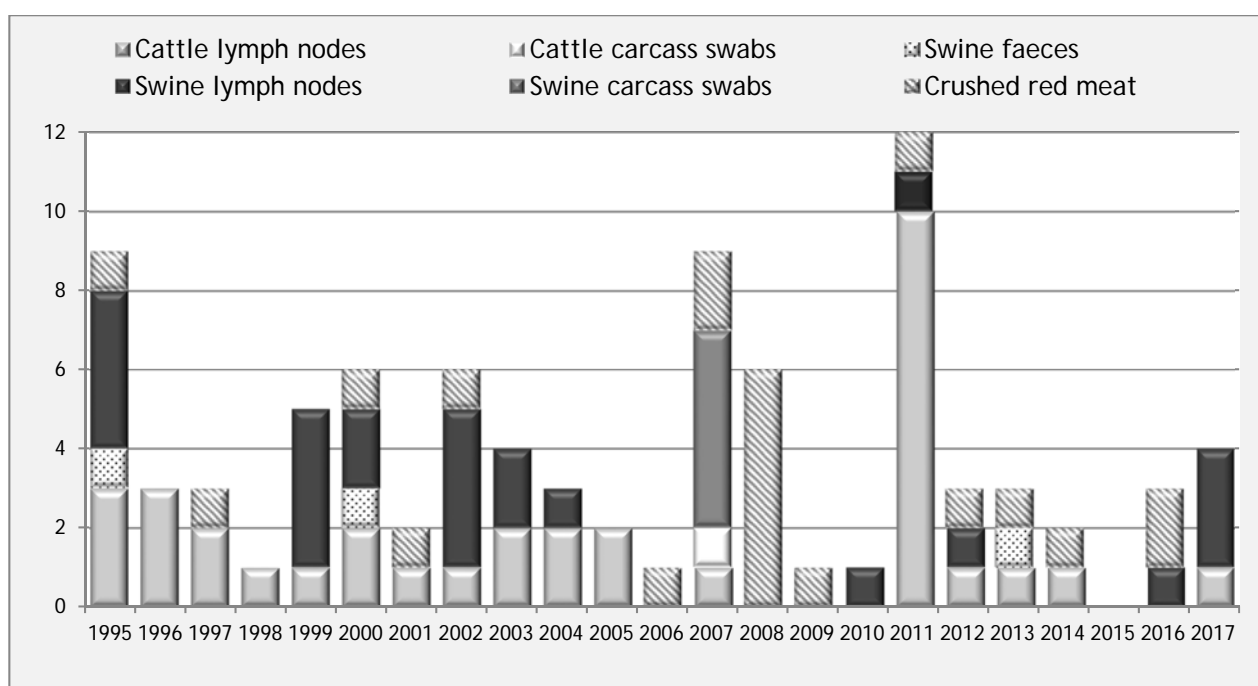


Figure 2. Number of positive faeces samples, lymph nodes, carcass swabs and crushed meat samples from cattle and swine found in the *Salmonella* surveillance programme since the start in 1995.

Table 3. Number of individual lymph nodes, carcass swabs and crushed meat samples examined in the *Salmonella* surveillance programme in 2017.

Species	No. of samples examined	No. of positive samples	<i>Salmonella</i> serovar
<b>Lymph node samples</b>			
Sows	1 482	2	<i>S. Typhimurium</i> , <i>S. Umbilo</i>
Slaughter pigs	1 744	1	<i>S. Typhimurium</i>
Cattle	3 149	1	<i>S. Typhimurium</i>
<b>Swab samples from carcass</b>			
Sows	1 502	0	
Slaughter pigs	1 696	0	
Cattle	3 121	0	
<b>Crushed meat samples</b>			
	3 170	0	

## Fresh meat

### *Swab samples from cattle and swine carcasses*

A total of 6,319 swab samples were examined (Table 3). *Salmonella* was not detected.

### *Cutting plants and cold-stores for fresh meat*

A total of 3,170 samples of crushed meat were examined (Table 3). *Salmonella* was not detected. Figure 2 shows the occurrence of *Salmonella* in samples from crushed meat since the start of the programme.

## Discussion

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, and *S. Typhimurium* is isolated most frequently from swine and cattle. However, the prevalence of *S. Typhimurium* is low, and 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 and cattle should be at least 3,000 per year. The required sample size was reached for both the population of cattle and swine, and the programme documented a very low *Salmonella* prevalence in the examined populations.

One layer flock tested positive for *S. diarizonae* in 2017. The serotype is frequently isolated in sheep herds in Norway, and *S. diarizonae* was found in faecal samples from the sheep on the farm. Three lymph node samples from swine and one from cattle were *Salmonella* positive and all four herds were followed up by sampling of live animals. *Salmonella* was isolated only in the slaughter pig herd. The results from the *Salmonella* surveillance programmes in 2017 are in agreement with previous years that the Norwegian cattle, swine and poultry populations are only sporadically infected with *Salmonella*. The estimated prevalence is below 0.5% in the examined populations for all years the surveillance programmes have run.

## References

1. Jørgensen H, Heier BT, Hauge K, Lange H, Herrador BG, Jore S, Hofshagen M: Zoonoserapporten 2016. Veterinærinstituttet, 2017. <https://www.vetinst.no/rapporter-og-publikasjoner/rapporter/2017/zoonoserapporten-2016>
2. Anonymous. The Norwegian Salmonella surveillance and control programmes for live animals, eggs and meat. Oslo: Veterinary and Food Department, Norwegian Ministry of Agriculture; 1998.
3. Anonymous. The Swedish Salmonella control programmes for live animals, eggs and meat. National Veterinary Institute, Swedish Board of Agriculture, National Food Administration; 1995.
4. Anonymous. The Finnish Salmonella control programmes for live animals, eggs and meat. Veterinary and Food Department, Finnish Ministry of Agriculture and Forestry; 1994.
5. EFTA Surveillance Authority: Decision No. 68/95/COL of 19.06.1995.
6. Forskrift om kontroll med Salmonella i fjørfe, fjørfefør, fjørfekjøtt og egg av 8.6.2007 nr. 603. <http://lovdata.no/dokument/SF/forskrift/2007-06-08-603>
7. Forskrift om overvåking av og kontroll med forekomsten av Salmonella hos levende storfe og svin av 31.01. 1995 nr. 107. <http://lovdata.no/dokument/SF/forskrift/1995-01-31-107>
8. Forskrift om overvåking av og kontroll med forekomst av Salmonella i ferskt kjøtt av 10.4.1995 nr. <http://lovdata.no/dokument/SF/forskrift/1995-04-10-368>
9. Heir E, Lindstedt B A, Nygard I, Vardund T, Hasseltvedt V, Kapperud G. Molecular epidemiology of Salmonella Typhimurium isolates from human sporadic and outbreak cases. *Epidemiology and infection* 2002; 128: 373-82. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2869832/pdf/12113480.pdf>



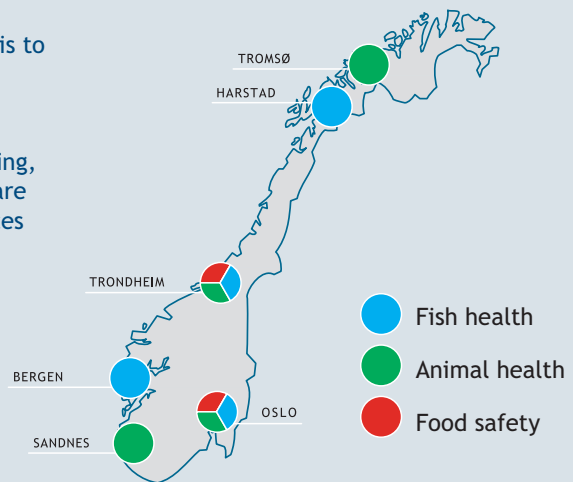
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