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The surveillance programme for *Salmonella* spp. in live animals, eggs and meat in Norway 2022

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Content

Summary

The *Salmonella* surveillance programmes in 2022 documents that the Norwegian population of cattle, swine and poultry are only sporadically infected. The estimated prevalence is below 0.2% 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 number of confirmed cases of human salmonellosis has decreased in Europe over the past 10 years (1). The reduced prevalence of *Salmonella* in European poultry is presumed to contribute to the observed reduction. The number of cases infected in Norway has remained relatively stable in the last 10 years but decreased in 2020 and 2021, probably due to measurements against the COVID-19 pandemic in Norway.

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). The program for poultry was revised and updated in 2006. The programmes are approved by the EU Commission (5), allowing Norway to require additional guarantees regarding *Salmonella* when importing live animals and food products of animal origin from the European Union. The Norwegian Food Safety Authority (NFSA) is responsible for implementing the surveillance programmes. The Norwegian Veterinary Institute (NVI) is responsible for sampling plans, laboratory investigations and reporting components of the programme.

The surveillance covers live animals and meat of pigs and cattle and live poultry, poultry meat and eggs. Any *Salmonella* isolated in the programmes, irrespective of serovar, is notifiable to the Norwegian Food Safety Authority. 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. Approved commercial laboratories perform the examination of samples collected at slaughterhouses and cutting plants.

Aims

The aims of the programmes 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 environmental samples from adult breeding flocks and broilers.

The *Salmonella* surveillance programme for fresh meat includes examination of swab samples from cattle and swine carcasses, and samples of crushed meat from red meat cutting plants and cold stores.

The number of samples requested in the different parts of the programmes 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 sampled 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, geese and guinea fowls in breeder flocks and flocks in production. All samples are collected in the holding.*

Production	Sampling time	Sample material	Sampling by*
Breeder flocks			
Rearing flocks	Day old	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	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 2nd 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].	2 x O: 0-4 weeks after moving, 8-0 weeks before slaughter, once in between F: Remaining samples
Production flocks			
Pullets	Day old	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	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 15th week	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 92 elite and multiplier breeding swine herds at the start of 2022. 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 the time of sampling, 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 volume for each slaughterhouse ranged from 1 to 535 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 volume for each slaughterhouse ranged from 1 to 645 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 testing. 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^2 of each carcass is swabbed (8).

Food products
The surveillance programme for cutting plants and cold stores is based on 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.

Laboratory methods

Faecal samples (including boot swabs)
Testing for the presence of *Salmonella* was carried out using VIDAS®SPT, which is an automated qualitative ELISA test for the detection of *Salmonella* in animal faecal- and environmental samples from the primary production stage and based on a novel recombinant phage protein-based technology. The method is validated according to ISO 16140.

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. The method is validated according to ISO 16140.

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

Results

Live animals

Poultry
Altogether 9,065 faecal samples (boot swabs) with or without specimen of dust (cloths) from 1,331 different holdings were examined (Table 2). All samples were negative for *Salmonella*. 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 2022.*

Type of production	No. of holdings	No. of flocks	No. of samples	No. of positive[3]	*Salmonella* serovar
Grandparents[1]					
Layers	2	3	32	0	
Parents[1]					
Layers	8	25	94	0	
Broilers	84	195	1,505	0	
Turkey	3	15	119	0	
Ducks and geese	3	10	75	0	
Total breeders	**100**	**248**	**1,825**	**0**	
Egg production					
Pullets	14	106	179	0	
Layers	575	887	1,933	0	
Meat production					
Broilers	588	4,679[2]	4,679	0	
Turkey	44	292[2]	292	0	
Ducks and geese	10	157[2]	157	0	
Total non breeders	**1,231**	**6,121**	**7,240**	**0**	
Total	**1,331**	**6,369**	**9,065**	**0**	

[1] Include rearing- and adult flocks
[2] Number of slaughter batches
[3] Number of positive flocks

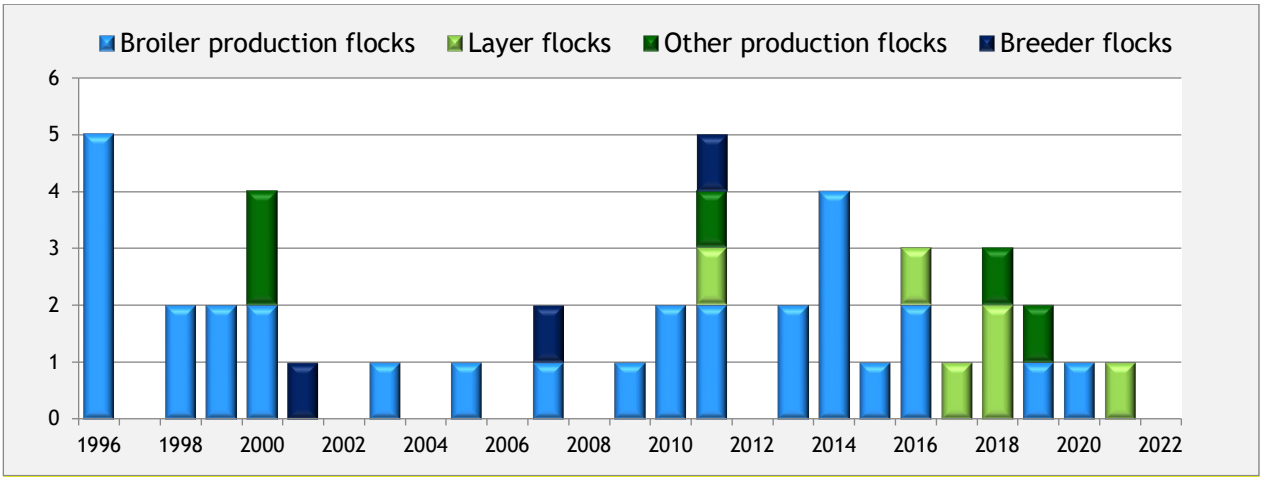

***Figure 1**: Number of positive poultry flocks found in the Salmonella surveillance programme since the start in 1996.*

Swine
Altogether 1,310 faecal samples from 67 elite and multiplier breeding herds were examined. *Salmonella* was not detected.

A total of 3,169 lymph node samples from 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% CI: 0.002% - 0.17%) 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 3,337 lymph node samples from cattle were examined (Table 3). One sample was positive for Sal*monella* giving an estimated *Salmonella* prevalence of 0.03% (95% CI: 0.001% - 0.17%) at the individual carcass level. Figure 2 shows the occurrence of *Salmonella* in samples from cattle since the start of the programme.

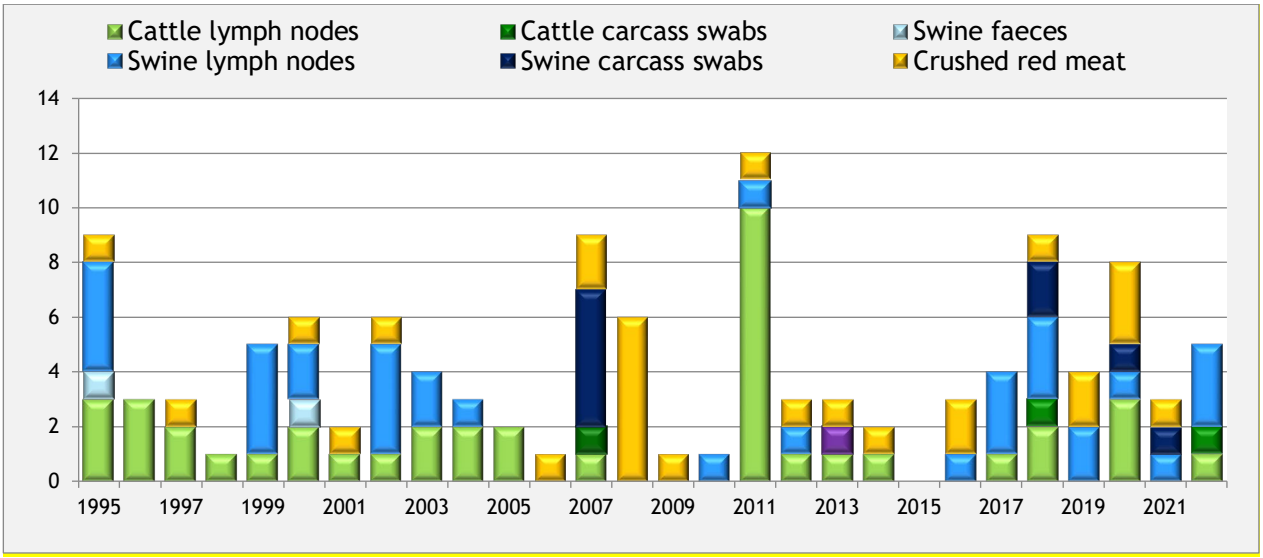

***Figure 2**: Number of positive faeces samples, lymph nodes, carcass swabs and crushed meat samples from cattle and swine found in the Salmonella surveillance programme since the start in 1995.*

Fresh meat

Swab samples from cattle and swine carcasses
A total of 6,049 swab samples were examined (Table 3). One sample was positive for *Salmonella* giving an estimated *Salmonella* prevalence of 0.02% (95% CI: 0.0004% - 0.09%) at sample level.

Cutting plants for fresh meat
A total of 3,161 samples of crushed meat were examined (Table 3). *Salmonella* was not detected.

Figure 2 shows the occurrence of *Salmonella* in swab samples and samples from crushed meat since the start of the programme.

***Table 3**: Number of individual lymph nodes, carcass swabs and crushed meat samples examined in the Salmonella surveillance programme in 2022.*

Species	No. of samples examined	No. of positive samples	*Salmonella* serovar
Lymph node samples			
Sows	1,408	2	S. Typhimurium
Slaughter pigs	1,761	1	S. Typhimurium
Cattle	3,337	1	S. Typhimurium
Swab samples from carcass			
Sows	1,383	0	
Slaughter pigs	1,585	0	
Cattle	3,081	1	S. ent. subsp. *diarizonae* serovar 42:r:z
Crushed meat samples	3,161	0	

Discussion

The Norwegian food-producing animals are very rarely infected with *Salmonella*. Data from outbreaks of salmonellosis in humans indicate that a great variety of foods can be implicated. When infection is contracted in Norway, imported foods are more often implicated than foods produced in Norway.

All poultry flocks examined in 2022 were negative for *Salmonella*. It is the first time since 2012 that all production categories in the Norwegian poultry population have been free from *Salmonella*.

Lymph node samples from three pig herds and one cattle herd tested positive for S. Typhimurium in 2022. The herds were followed up by the Norwegian Food Safety Authority by sampling of faeces from all animals, feed and the environment in the farms. Only samples from one of the pig herds was positive. The Norwegian Veterinary Institute detect regularly S. Typhimurium in wild birds. Such wild animal reservoirs may be considered as a risk for both human and animal infection, and S. Typhimurium is isolated most frequently from swine and cattle. However, the prevalence of S. Typhimurium in production animals 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 all populations except swab samples from sows in 2022, but the programme still documented a very low *Salmonella* prevalence in the examined populations.

The results from the *Salmonella* surveillance programmes in 2022 are in agreement with previous years that the Norwegian cattle, swine and poultry populations are only sporadically infected with *Salmonella*. The estimated prevalence has been below 0.5% in the examined populations for all years the surveillance programmes have run.

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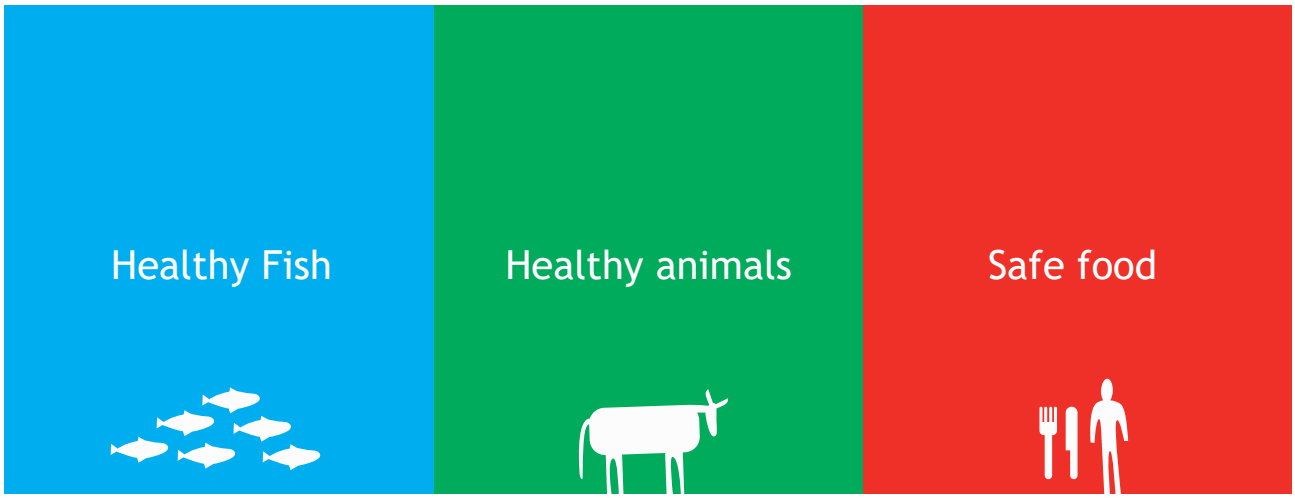

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