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

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The *Salmonella* surveillance programme in 2010, 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 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, 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 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 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 (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.

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	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].	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 layer 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 (150 g)	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 (150 g).	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 production flocks

Sampling time	Sampling place	Sample material	Sampling by*
10 - 19 days before slaughter	Holding	1 pair of boot swabs and 1 specimen of dust (cloth). 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 121 elite and multiplier breeding swine herds in 2010. 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 one to 425 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 one to 285 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, a total of 3,000 swab samples should be collected at slaughter. For each slaughter-house, the sample size ranges from one to 285 and from one to 425 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 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 (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 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 (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 (Norwegian Veterinary Institute).

Results

Live animals

Poultry

A total of 11,387 samples were received for examination and out of these 227 samples were rejected for examination. Altogether 11,160 faecal samples and boot swabs from 1,442 different holdings were examined (Table 4). Two samples were positive for *Salmonella*.

Swine

A total of 2090 faecal samples from 117 elite and multiplier breeding herds (including AI centres and testing stations) were examined in 2010 (Table 5). *Salmonella* was not detected in any of the samples. A total of 2,226 lymph node samples from slaughtered pigs were examined. Approximately 32 % of the samples were taken from sows and the remaining from slaughter pigs. One sample was positive for *Salmonella* (*Salmonella* Bovismorbificans) giving an estimated *Salmonella* prevalence of 0.5 % (95 % confidence interval: 0.001 % - 0.25 %) at the individual carcass level.

Cattle

In 2010, a total of 1854 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 % - 0.20 %) at the individual carcass level.

Fresh meat

Swab samples from cattle and swine carcasses

A total of 3437 swab samples from 37 slaughterhouses were examined in 2010 (Table 6). None of the samples was positive for *Salmonella*.

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

A total of 1656 samples of crushed meat from 51 different plants were examined. None of the samples was positive for *Salmonella*.

Table 4. Samples from poultry examined in the *Salmonella* surveillance and control programme in 2010

Poultry breeding flocks	No. of samples tested	No. of holdings tested	No. of positive holdings	<i>Salmonella</i> serovar
Grandparents and parents				
Layers	517	15	0	
Broilers	2759	88	0	
Turkeys, geese and ducks	191	9	0	
Total - Breeders	3467	109	0	
Other commercial poultry				
Pullets	263	19	0	
Layers	2177	633	0	
Meat production - Broilers	4504	640	2	<i>Salmonella</i> Senftenberg <i>Salmonella</i> Brandenburg
Meat production - Turkeys, geese and ducks	742	69	0	
Unknown	7	3	0	
Total - Non breeder holdings	7693	1331	2	
Total	11160	1422	2	

Table 5. Sampling in elite and multiplier breeding swine herds in the *Salmonella* surveillance and control programme in 2010

Herd category	No. of herds sampled (total*)	No. of samples examined	No. of positive samples	<i>Salmonella</i> serovar
Elite breeding herds	50 (51)	902	0	
Multiplier herds	67 (70)	1,188	0	

* Total number of herds is estimated as breeding and production herd per 1 January 2010 excluding herds which ended breeding activity during 2010 before being tested.

Table 6. Number of individual lymph node samples from swine and cattle examined in the *Salmonella* surveillance and control programme in 2010

Species	No. of slaughterhouses sampled	No. of samples examined	No. of positive samples	<i>Salmonella</i> serovar
Sows	12	715	0	
Slaughter pigs	16	1,511	1	<i>Salmonella</i> Bovismorbificans
Cattle	19	1,854	0	

Table 7. Number of swab samples from carcasses of swine and cattle examined in the *Salmonella* surveillance and control programme in 2010

Species	No. of slaughterhouses sampled	No. of samples examined	No. of positive samples	<i>Salmonella</i> serovar
Swine	16	1,811	0	
Cattle	24	1,626	0	

Discussion

The results from the *Salmonella* surveillance programmes in 2010 are in agreement with previous years (8-14) that the Norwegian cattle, swine 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 and cattle.

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 *Salmonella* Typhimurium in the wild fauna (wild birds and hedgehogs) represented a risk for human infection (15). Such wild animal reservoirs may also be considered a risk for farm animals. The prevalence of *Salmonella* 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 and cattle should have been 3,000 per year. The required sample size was not reached for the populations of swine and cattle. 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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The Norwegian Food Safety Authority (NFSA) is a governmental body whose aim is to ensure through regulations and controls that food and drinking water are as safe and healthy as possible for consumers and to promote plant, fish and animal health and ethical farming of fish and animals. We encourage environmentally friendly production and we also regulate and control cosmetics, veterinary medicines and animal health personnel. The NFSA drafts and provides information on legislation, performs risk-based inspections, monitors food safety, plant, fish and animal health, draws up contingency plans and provides updates on developments in our field of competence.

The NFSA comprises three administrative levels, and has some 1300 employees.

The NFSA advises and reports to the Ministry of Agriculture and Food, the Ministry of Fisheries and Coastal Affairs and the Ministry of Health and Care Services.

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