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Trends and sources in human campylobacteriosis

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Introduction

In 2011, the number of human *Salmonella* cases decreased to the lowest level observed since the eighties. Especially cases due to *S.* Enteritidis have decreased dramatically since the peak in 1997, but also the number of cases due to *S.* Typhimurium was low. Very few *Salmonella* outbreaks were reported and there were no outbreaks caused by *S.* Enteritidis. For the first time in more than a decade none of the *Salmonella* outbreaks could be related to meat of Danish origin. The first *Salmonella* Strathcona outbreak was reported by Denmark in 2011. Internationally, outbreaks due to this serotype have not been reported previously. The source was imported tomatoes. The most severe foodborne outbreak in 2011 was linked to the German VTEC outbreak where the source was fenugreek sprouts.

As in previous years, the *Salmonella* source account estimated that almost half of the human cases of salmonellosis were due to travel. More than 70% of the *S.* Enteritidis cases was acquired abroad which is similar to previous years. The majority of the *S.* Typhimurium cases was still acquired in Denmark. For the sporadic cases not related to travel, Danish pork was estimated to be the most important source although decreasing markedly compared to the previous year mainly because there were no outbreaks related to Danish pork in 2011. The relative importance of eggs as a source of infection continued to decrease and was the source with lowest estimated number of cases next to Danish produced beef. No cases were attributed to Danish broiler meat.

The number of human *Campylobacter* cases was similar to last year and *Campylobacter* continues to be the most common zoonotic pathogen reported in Denmark contributing to more than 70% of the cases.

Campylobacter source account

For the first time, a Danish *Campylobacter* source account is presented; attributing human campylobacteriosis cases acquired in Denmark to different sources of animal origin. Two different models have been used. Both models produce similar results; attributing the majority of the human cases to the broiler chicken reservoir (>50%). The second most important reservoir was estimated to be cattle. It should be noted that if this modelling is to be used equally to the *Salmonella* source account more isolates and sources need to be included.

Monophasic *Salmonella* Typhimurium-like strains

Monophasic *Salmonella* Typhimurium-like strains have emerged in several countries in recent years and for the first time, an overview of findings in production animals and food in Denmark is presented. These strains are common in the Danish meat production chain. More than 70% of the isolates was multi-resistant, however, the isolates were not resistant to cephalosporines and flouroquinolones, which are antimicrobial agents critical for treatment of human infections.

From a legislation and risk management point of view these monophasic strains are treated equally to S. Typhimurium, e.g. they are included in EU regulations on targets and microbiological food safety criteria for *S.* Typhimurium.

Salmonella in pig production

The first monitoring and control programme of *Salmonella* in the Danish pig production was initiated in 1993. Since then, a total of five larger surveys on the occurrence of *Salmonella* in the slaughter pigs have been conducted of which the latest was from 2011. A comparison between the surveys has been performed and the results showed at least a four-fold increase in the prevalence of *Salmonella* spp. in the slaughter pigs and a doubling of the prevalence of *S.* Typhimurium since the lowest levels were detected in the second survey in 1998.

The annual Report on Zoonoses presents a summary of the trends and sources of zoonotic infections in humans and animals, as well as the occurrence of zoonotic agents in food and feeding stuffs in Denmark in 2011. Greenland and the Faroe Islands are not represented. The report is based on data collected according to the Zoonoses Directive 2003/99/EC, supplemented by data obtained from national surveillance and control programmes as well as data from relevant research projects. Corrections to the data may occur after publication resulting in minor changes in the presentation of historical data in the following years report. The report is also available at www.food.dtu.dk.

Salmonella in broiler and table egg production

For broiler and table egg production, no breeding flocks were positive for *Salmonella* in 2011.

Only 0.5% of the table egg layer flocks were found positive. In EU, the 2% target for *S*. Enteritidis and *S*. Typhimurium in table egg layer flocks is set out in the Regulation (EC) No 1168/2006. Denmark has been below this target for many years.

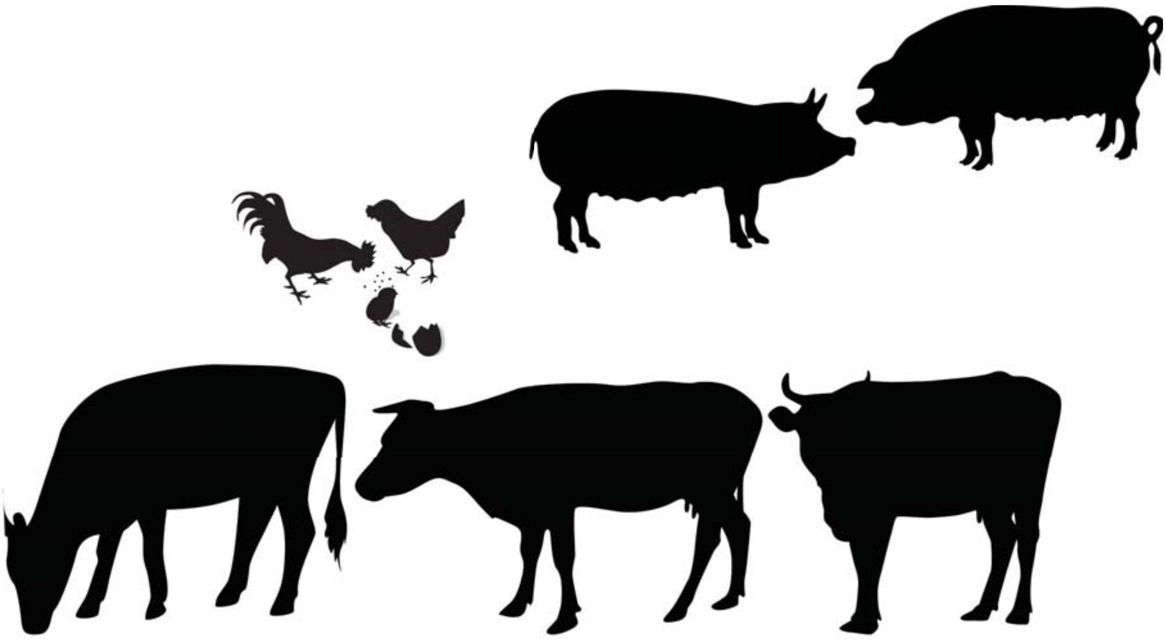
In the broiler flocks, the *Salmonella* prevalence has been low for more than a decade and only 1.2% of the flocks were positive in 2011. The EU target of 1% set out in the Regulation (EC) No 646/2007 for *S*. Enteritidis and *S*. Typhimurium had to be reached by December 31st 2011. Denmark has been below the target for several years and the prevalence for these two serotypes was 0.2% in 2011. In 2011, the food safety criterion of absence of *S*. Enteritidis and *S*. Typhimurium in 25g fresh poultry meat came into force. The Danish legislation states that fresh broiler meat from *Salmonella* positive flocks are not put on the marked in Denmark.

Listeria

Following a steady increase in the number of human listeriosis cases from 2004 to 2009, the number of human cases decreased in 2011 as in 2010. Due to the increase during the previous years, new risk management initiatives for *Listeria monocytogenes* were started in 2011. Among other things, the initiatives included a survey of *L. monocytogenes* in ready-to-eat (RTE) risk products on the marked. Cold smoked fish, especially cold smoked Greenland halibut had the highest proportion of samples with more than 100 cfu/g. The microbiological food safety criteria set out in Regulation (EC) No 2073/2005 states that *L. monocytogenes* must not be present in levels above 100 cfu/g during the shelf life of the RTE product.

Evaluation of case-by-case control and *Campylobacter* action plan

In 2011, two Danish management initiatives were evaluated with regard to their effect; the case-by-case control and the action plan against *Campylobacter* in broilers. The case-by-case control was initiated late 2006 as an intensified non-discriminatory control of Salmonella and *Campylobacter* in fresh meat. The action plan against *Campylobacter* in broilers was adopted in 2008 and includes a number of initiatives to be implemented in the broiler production on a voluntary basis and several initiatives to educate consumers.



1. Trends and sources in human salmonellosis

By Leonardo de Knegt (ledkn@food.dtu.dk) and Tine Hald

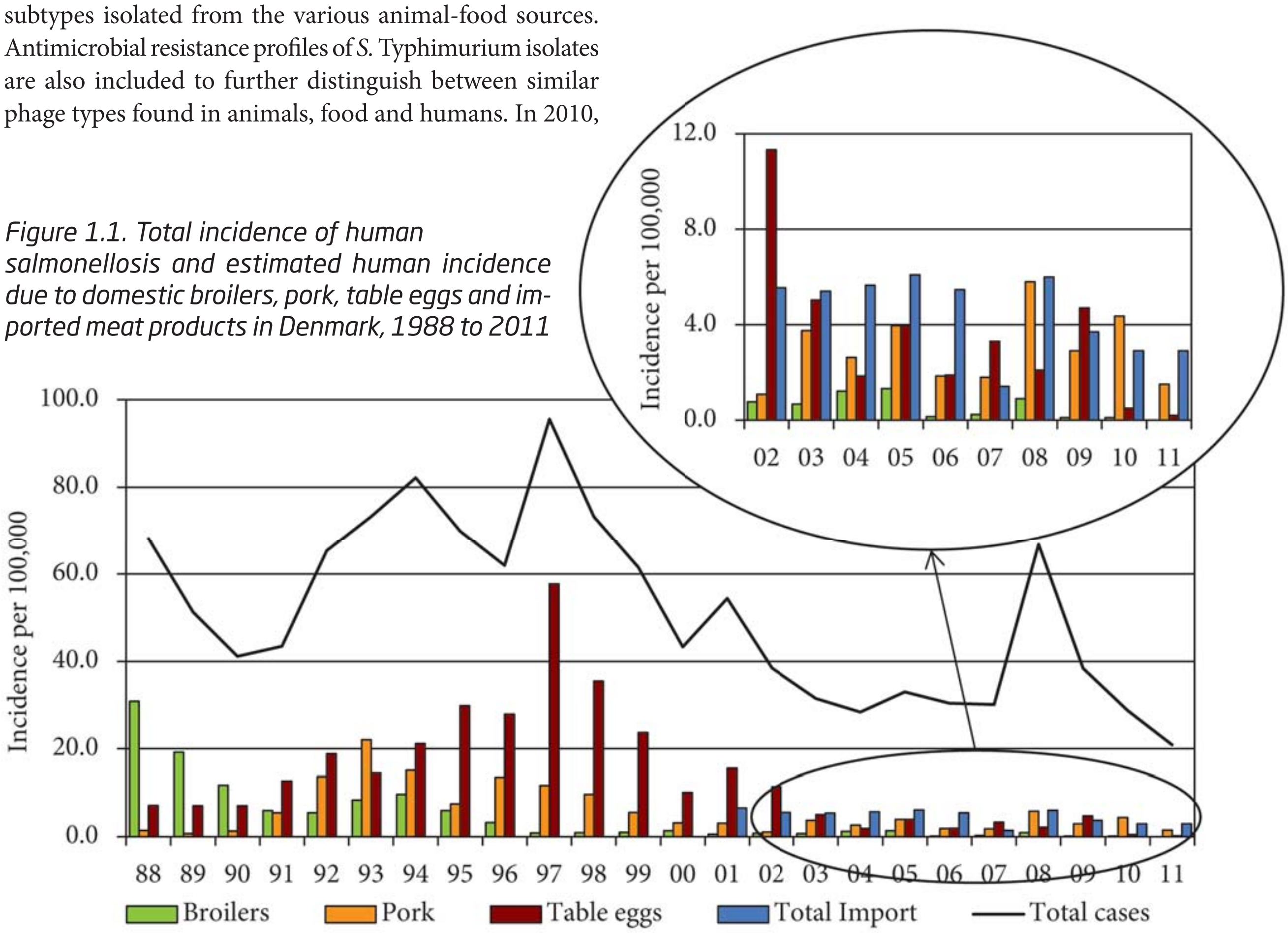
During the last two decades, *Salmonella* has been one of the leading causes of foodborne infections in Denmark. Different food-animals have been associated with peaks in the incidence of human salmonellosis, such as broilers in the eighties, pigs in the mid-nineties and laying hens in the late nineties (1,2). In 2011, the number of reported human cases reached a low level not seen since the mid-eighties. Being able to identify the causative food sources and thereby prioritizing interventions is believed to have contributed significantly to the reduced burden of foodborne salmonellosis in Denmark.

To support risk management strategies, the Danish Zoonosis Centre, National Food Institute, uses a source attribution model to obtain yearly estimates of the contribution of the major animal-food sources to human infections of *Salmonella*. The principle of the method is to compare the number of human cases caused by different *Salmonella* sero- and phage types with the distribution of the same subtypes isolated from the various animal-food sources. Antimicrobial resistance profiles of *S.* Typhimurium isolates are also included to further distinguish between similar phage types found in animals, food and humans. In 2010, the European Food Safety Authority published an opinion on "*Salmonella* Typhimurium-like" strains (3), and based on this it was decided to add the monophasic strains *S.* 1,4,[5],12:i to *S.* Typhimurium in the source account model (see chapter 4 for more information).

Since the model was first implemented in 1995, it has evolved from being purely deterministic to becoming a stochastic model, built under a Bayesian framework. In 2008, a new methodological development was introduced in the model (4), which applies data from multiple years thereby improving the robustness and accurateness of the results without compromising their comparability with estimates from previous years. From 2011, six-month time units have been used to inform the model when attributing cases from a year, providing bi-annual source attribution estimates.

The incidence of human salmonellosis in 2011 was 21.0 cases per 100,000 inhabitants, being 5.3 for *S.* Enteritidis

Figure 1.1. Total incidence of human salmonellosis and estimated human incidence due to domestic broilers, pork, table eggs and imported meat products in Denmark, 1988 to 2011



Source: Danish Zoonosis Centre, National Food Institute

and 6.9 for *S.* Typhimurium including the monophasic *S.* 1,4,[5],12:i strains (appendix B, Table A2). These numbers show that the decrease in incidence observed since 2008 continued between 2010 and 2011. The overall trend in human salmonellosis cases attributable to the major food-animal sources is presented in Figure 1.1.

The most important food source of salmonellosis in Denmark in 2011 was estimated to be domestic pork (Figure 1.2 and appendix A, Table A1), to which 7.4% of all *Salmonella* laboratory-confirmed cases were attributed. This represents a reduction compared with the previous year, when 16.4% of the cases were attributed to pork. A reduction was seen for both sporadic and outbreak-related cases; there were no outbreaks attributed to domestic pork in 2011. As in 2010, the second most important food source was imported pork, estimated to contribute with 5.6% of reported cases (3.7% sporadic and 1.9% outbreak-related). The relative importance of Danish table eggs continued to decrease from 12.3% egg-related cases in 2009 (the majority of cases was due to two outbreaks) to 1.8% in 2010 and 1.0% in 2011. Like in 2010, no outbreaks were linked with table eggs. Ducks and imported broilers, on the other hand, showed an increase in relative importance from 2010 to 2011 (appendix A, Table A1), with the number of cases related to imported broilers being similar to the estimate from 2009. The remaining food sources presented no significant changes compared to the previous year. Overall, the total relative contribution of imported meat products increased compared with 2010 although the total number of cases estimated to imported meat sources was similar in 2010 and 2011. The relative change was due to a 50% reduction in the estimated number of cases due to domestic sources during the same period, 292 cases in 2010 and 124 cases in 2011. Nearly half (46%, 538 cases) of all *Salmonella* cases were estimated to be acquired abroad, of which 424 actually reported having travelled within seven days prior to onset of symptoms. Although the proportion of cases attributed to travel changed only from 47% to 46% since last year, this represents a 14% decrease in the estimated number of travel-related cases when compared to 2010, due to the smaller number of reported cases in 2011.

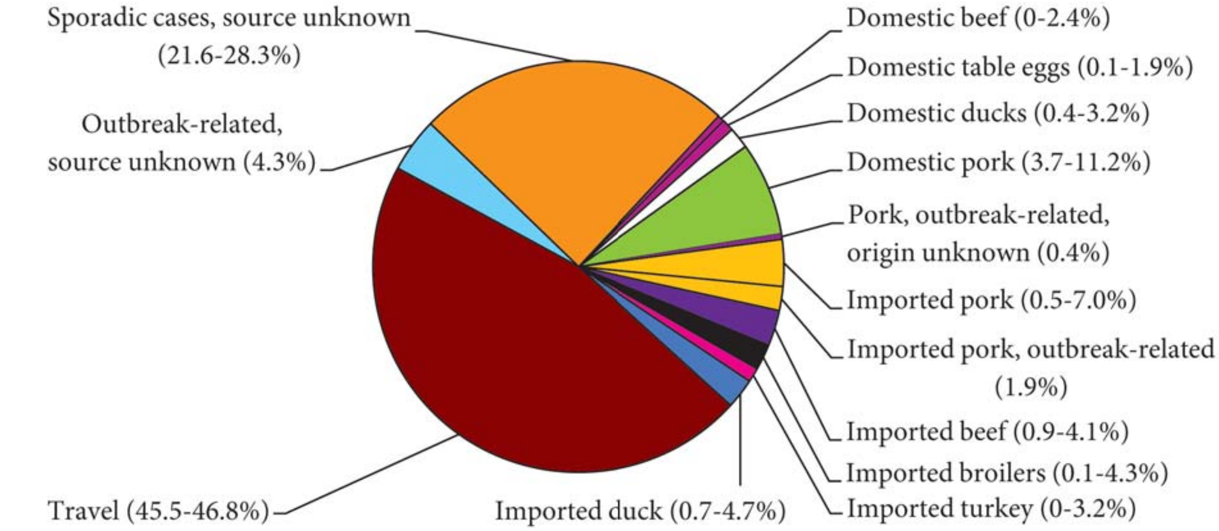
Around 25% of reported sporadic *Salmonella* cases could not be associated with any of the included food sources. These cases may be caused by imported or domestically produced fruits and vegetables (survey data presented in appendix C, Table A23), food-animals not included in the national surveillance or by non-food sources of infection, such as direct contact with pet animals.

Of the 293 reported *S.* Enteritidis cases, 70.5% was estimated to be related to international travel. As in 2010, there were no *S.* Enteritidis outbreaks related to Danish products in 2011.

A total of 386 *S.* Typhimurium cases were reported in 2011 (including the 141 cases of monophasic *S.* 1,4,[5],12:i), of which 25.7% were estimated to be related to international travel and 7.0% were associated with outbreaks. Of those, an outbreak of *S.* Typhimurium DT120 traced back to pork imported from Poland accounted for 22 cases, while a further five cases of *S.* Typhimurium DT104 were caused by a food item produced with a mix of Danish and Spanish pork. There were no *S.* Typhimurium cases related to domestic outbreaks in 2011.

From the 75 *S.* Typhimurium cases attributed to domestic products, 33.2% were caused by strains susceptible to all tested antimicrobial agents, 51.5% by strains resistant to one to three antimicrobial agents, and 15.3% by strains

Figure 1.2. Estimated sources of 1,166 cases of human salmonellosis in Denmark, 2011 (See also Appendix A, Table A1)



Note: Sporadic and outbreak-related cases with unknown source include all sources not in the model. E.g. one outbreak with 43 cases where the source was tomatoes imported from Italy was included to the "outbreak-related, source unknown" category.
Source: Danish Zoonosis Centre, National Food Institute

resistant to four or more antimicrobial agents (multi-resistant); no cases caused by strains resistant to quinolones were attributed to domestic foods (Figure 1.3). This marks a significant increase in the percentage of domestic resistant isolates when compared to 2010, when 77% of isolates were susceptible to all antimicrobial agents, and only 1.7% was multi-resistant. Although an increase of almost 17% was observed for resistant types (from 55.3% in 2010 to 71.9% in 2011) in *S.* Typhimurium infections attributed to imported meat products (88 out of 386 cases), the occurrence of multi-resistant types decreased from 19.3% to 3.7% in the same period. From the 98 *S.* Typhimurium cases acquired abroad, 49% were caused by resistant types, 16.6% by multi-resistant types, 15.8% by types resistant to quinolones, and 18.6% by types susceptible to all tested antimicrobial agents.

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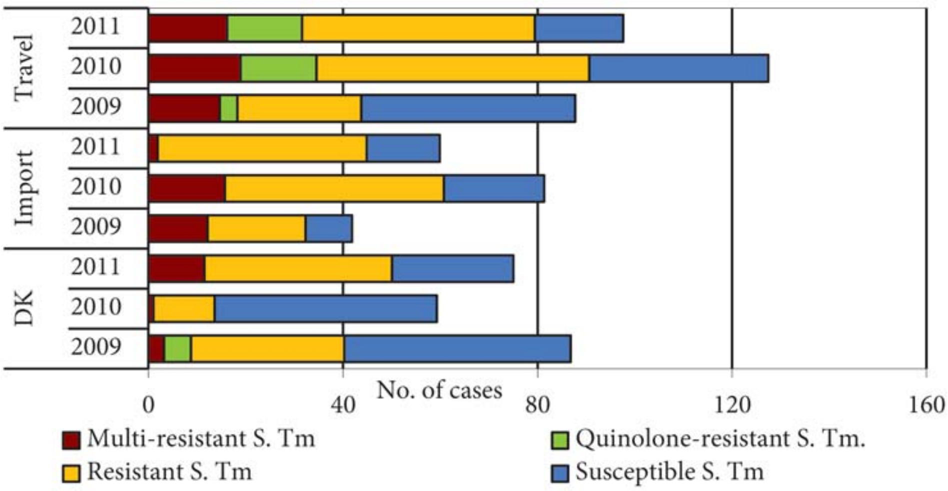
Figure 1.3. Estimated sources of antimicrobial resistant[a] S. Typhimurium infections in humans, 2009-2011



a) Resistant: Resistant to one to three antimicrobial agents; Multi-resistant: Resistant to four or more antimicrobial agents.
Source: Danish Zoonosis Centre, National Food Institute

Where do we acquire *Salmonella* infections?

By Birgitte Helwigh and Luise Müller

In 2011, as in the previous years, Statens Serum Institut attempted to interview all registered *Salmonella* cases where no travel information was reported by the general practitioner. The patients were asked about the date of disease onset and whether they had travelled abroad within a seven-day period prior to disease onset. This information was complemented with information from general practitioners' reports. Travel information was obtained from a total of 77.6% of the *Salmonella* cases in 2011. Among the cases with known travel history, 71.7% of the *S.* Enteritidis cases, 19.5% of the *S.* Typhimurium cases, 35.2% of the monophasic *S.* Typhimurium-like cases and 48.6% of cases with other serotypes were infected abroad. The group of other serotypes comprises considerable variation in terms of serotypes (Table 1.1).

The distribution pattern of travel-related and domestically acquired *Salmonella* infections (not including outbreak related cases) was comparable to prevoius years (Figure 1.4). Most of the travel-related *Salmonella* infections in 2011 was acquired in Thailand, Turkey and Egypt.

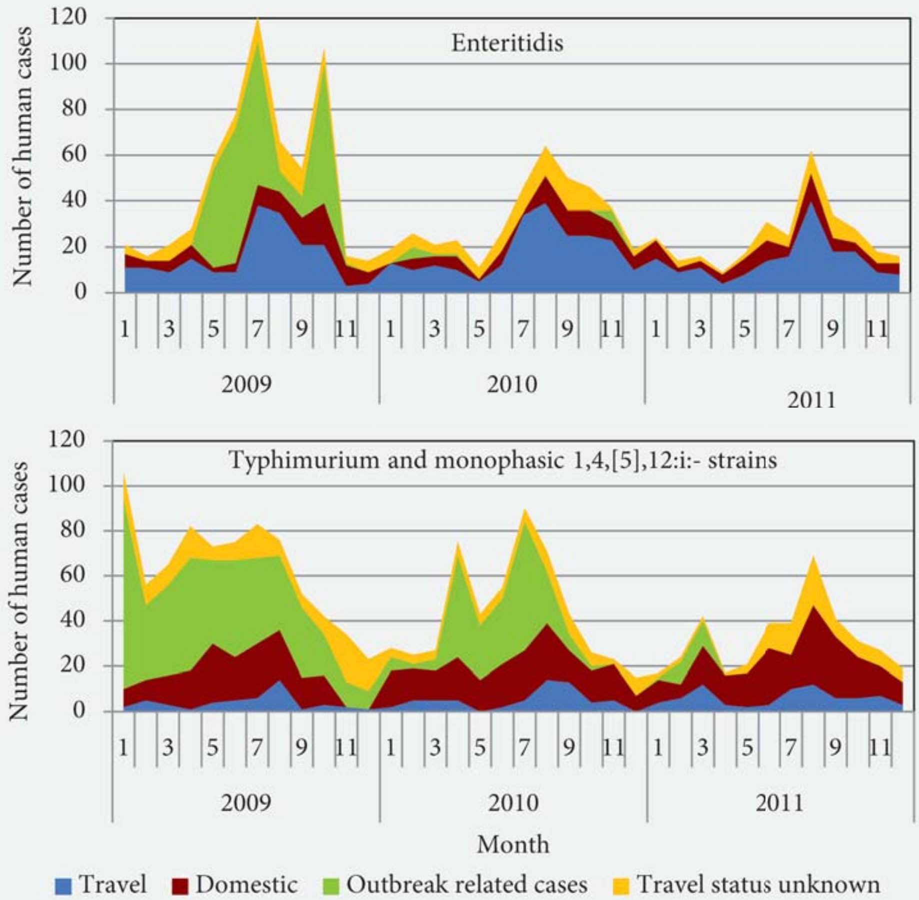
In 2011, only a few relatively small outbreaks due to *Salmonella* was reported compared to the previous years (See chapter 3 for more information and appendix Table A4) and the total number of human salmonellosis cases was the lowest since the mid-eighties and especially the number of cases due to *S.* Enteritidis has decreased the last 10 years.

Table 1.1. Top 10 Salmonella *serotypes in humans and place of infection, 2010-2011*

2011	Number of patients (%)	% patients infected[a] Abroad	Domestic	**2010**	Number of patients (%)	% patients infected[a] Abroad	Domestic
Enteritidis	293 (25.1)	71.7	28.3	Typhimurium	521 (32.6)	14.8	85.2
Typhimurium	245 (21.0)	19.5	80.5	Enteritidis	388 (24.3)	76.4	23.6
Monophasic strains 1,4,[5],12:i:-	141 (12.1)	35.2	64.8	Monophasic strains 1,4,[5],12:i:-	121 (7.6)	34.4	65.6
Strathcona	43 (3.7)	0	100	Dublin	49 (3.1)	11.1	88.9
Dublin	42 (3.6)	7.1	92.9	Infantis	38 (2)	37.1	62.9
Stanley	39 (3.3)	76.7	23.3	Newport	33 (2.1)	68.0	32.0
Agona	22 (1.9)	50.0	50.0	Virchow	32 (2)	76.9	23.1
Infantis	22 (1.9)	50.0	50.0	Stanley	30 (1.9)	73.7	26.3
Kentucky	17 (1.5)	100	0	Java	22 (1.4)	47.4	52.6
Virchow	17 (1.5)	76.9	23.1	Kentucky	17 (1.1)	78.6	21.4
Other serotypes	285 (24.4)	54.5	45.5	Other serotypes	349 (21.8)	62.0	38.0
Total	1,166 (100)	46.8	53.2	Total	1,600 (100)	45.2	54.8

a) Patients with unknown travel information (22.4% of all patients in 2011 and 21.4% of all patients in 2010) were excluded from the percent calculations.
Source: Statens Serum Institut

Figure 1.4. Monthly distribution of S. *Enteritidis,* S. *Typhimurium*, and monophasic S. 1.4.[5],12:i:- *cases, 2009-2011*



Source: Statens Serum Institut

2. Trends and sources in human campylobacteriosis

By Louise Boysen (lobo@food.dtu.dk) and Tine Hald

Campylobacter is the most frequently reported food-borne pathogen in Denmark. In 2011, the registered number of *Campylobacter* cases was 4,068 compared to 1,166 *Salmonella* cases (appendix B, Table A2). Identifying the causative food sources and prioritizing interventions is crucial to reduce the burden of foodborne disease in the population. In 1995, to assist *Salmonella* management strategies, the Danish Zoonosis Centre, National Food Institute, introduced a source attribution model to estimate the contribution of the major animal-food sources to human infections of *Salmonella* (See Chapter 1 for more information). We now present the first Danish source attribution for *Campylobacter* to estimate the importance of different animal reservoirs for domestically acquired human campylobacteriosis.

Sources for human campylobacteriosis are many and the transmission routes of the bacteria from reservoir to humans varies. In Denmark, infections acquired domestically are believed to originate primarily from animal reservoirs through the consumption of meat, or via contaminated water and vegetables, as well as through direct contact with infected animals. Approximately one third of the total number of cases each year is considered to be travel related.

The *Campylobacter* source attribution model concerns *C. jejuni*, which constitutes the vast majority of human campylobacteriosis cases in Denmark (approximately 96%) (1). The model builds on data collected in 2007 and 2008, comprising isolates from 406 human cases (246 from domestic cases, 109 from travel related cases, and 51 from cases without travel history) and 662 non-human isolates (Danish and imported chicken meat, turkey meat, duck meat, cattle, and pigs).

Two different attribution models have been explored; both models are based on the microbial subtyping approach considering sequence types found in human cases and sources. One model (the CAMSA model) is a modification of the original Danish *Salmonella* source attribution model (2), which attributes cases based on exact matches of subtypes, amount of food source available for consumption, the type specific ability to cause infection and the source specific ability to serve as a vehicle for the types. The other model (the Island model) is based on relatedness of cases to groups comprising isolates collected from the respective source, taking into account mutation, recombination and migration rates (3).

The results of the two models are very similar, apportioning the vast majority of cases to the chicken reservoir (>50%) (Figure 2.1). This coincides with the general belief of this reservoir being a major contributor to human campylobacteriosis. A higher proportion of cases were apportioned to Danish chicken compared to imported chicken. This is to some degree supported by a quantitative risk assessment utilizing prevalence and concentration data of monitoring data as well as information on sales data (4). The assessment indicates an elevated risk from Danish meat, compared to imported meat during the period 2007 to 2010.

However, the Danish chicken reservoir also comprises more transmission routes compared to imported chicken, as the production is taking place in the country of concern. Besides meat, animal contact and occupation may be risk factors. Furthermore, Campylobacter may be transferred to the environment during production and further contribute to the exposure of humans.

The cattle reservoir was found to be the second most important reservoir. High *C. jejuni* prevalence has been reported in cattle; however very low occurrence has been found in Danish beef. If cattle should bear the second highest responsibility in relation to human campylobacteriosis, routes other than meat should be considered. This would agree with the results from a Dutch comparative exposure assessment ranking farm animal contact higher than beef with regard to importance of transmission (5). Other specified reservoirs, turkey meat, duck meat and pigs, were found to be of less importance.

With the CAMSA model 10-30% of the cases could not be apportioned to either of the reservoirs and is categorized as unknown. Cases which cannot be attributed are of a sequence type which is not found in either of the reservoirs included in this study.

There are some limitations for the current attribution modelling for campylobacteriosis. *Campylobacter* subtypes are very diverse and widespread between reservoirs. This complicates a strict separation of cases between reservoirs. Furthermore, the results are limited to the reservoirs included in the models. If more reservoirs had been represented, the outcome would have been different.

It was assumed that the collection of isolates from all over the country covered geographical variation. To achieve the best possible attribution, the variation in sequence types within sources should be covered as well. However, the heterogeneity of *Campylobacter* makes it difficult to obtain representative coverage of the full genetic diversity within an animal species. Furthermore, during sampling, only one isolate per sample was obtained, but it is well known that several types can be present in the same animal (6). The genetic diversity of sequence types between animal species and even within the same animal may complicate the source attribution approach for *Campylobacter* leading to uncertain and less robust results.

In conclusion, the results of the *Campylobacter* source attribution modelling indicate that the chicken reservoir is the most dominant single source of human campylobacteriosis, but also that the cattle reservoir may play a significant role. Still, the presented source attribution framework, including the typing applied and the data quality and availability, has limitations and will have to be further developed before it can be used for routine attribution of *Campylobacter* sources.

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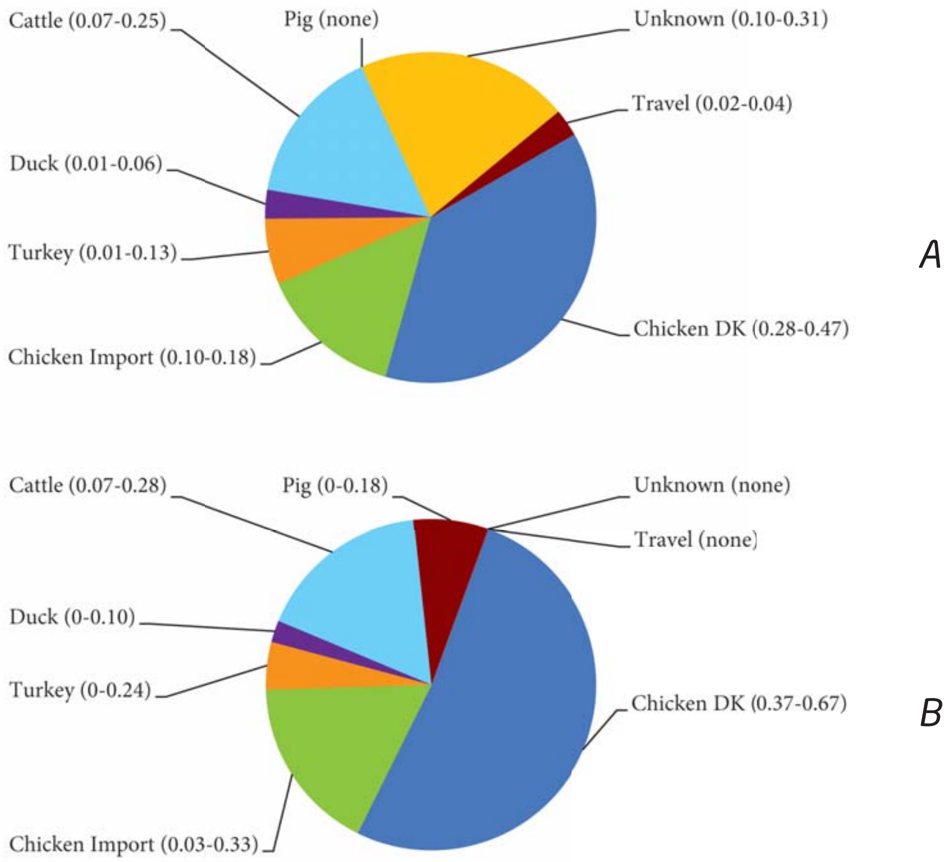
Figure 2.1. Estimated sources of 297 cases of human campylobacteriosis (domestic cases and cases with-out travel history) A) CAMSA model and B) Island model



Note: The results are based on a reservoir model. In order to obtain samples from the different reservoirs, data used as basis for the modelling comprise isolates collected from both meat and live animals. The proportion of human cases attributed to Danish chicken and imported chicken represent the chicken reservoir as a whole. It should be noted that Danish chicken also represents other transmission routes not included in imported chicken as transmission routes prior to slaughter of imported chicken are of no risk to Danes. It is not possible from the source attribution to estimate the proportion of cases caused by handling, preparation and consumption of meat.
Source: Danish Zoonosis Centre, National Food Institute

3. Outbreaks of special interest

By Luise Müller (lum@ssi.dk)

Food- and waterborne outbreaks in Denmark are reported in the Food- and waterborne Outbreaks Database (FUD). Outbreaks that occurred in 2011 are presented in appendix B, Table A4. Figure 3.1 shows the relative distribution of these outbreaks by the different pathogens that caused them. Household outbreaks and clusters that could not be verified as common source outbreaks are not included. The outbreak investigation procedures in Denmark are described in further detail in Chapter 10.2. In total, 86 outbreaks were reported to FUD in 2011. Two of the outbreaks were related to travel. Outbreaks due to norovirus accounted for approximately half of the outbreaks (42 outbreaks), as seen in previous years.

Outbreaks with fruit and vegetables as source

In 2011, several outbreaks have been related to consumption of fresh fruit and vegetables. The most severe outbreak was in Germany in May-July where 2,971 reported cases were infected with a very virulent type of verocytotoxin-producing *Escherichia coli*, VTEC O104:H4 (FUD no. 1086). See the box page 13 for more information. In Denmark, 26 cases were linked to this outbreak and ten cases developed HUS, which also makes it the most severe VTEC outbreak in the Danish history (1).

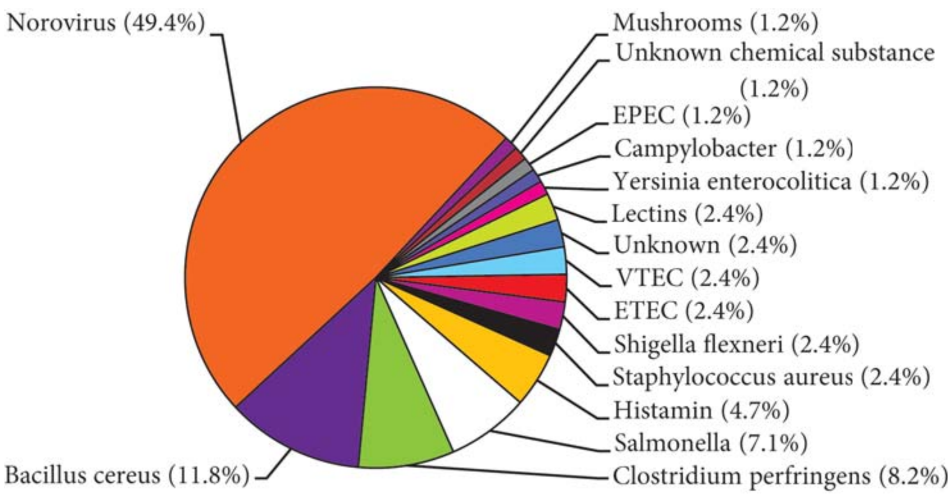
In 2010, several norovirus outbreaks from Serbian raspberries were reported, and in January 2011, two additional outbreaks occurred (2). One was at a hospital in Denmark, where raspberries had been served in a salad in the employee canteen resulting in 113 ill persons suffering from diarrhoea and vomiting (FUD no. 1051). Control measures and increased hygiene were rapidly put in place and successfully prevented the infection in spreading to any patients in the hospital. The same week, another norovirus outbreak occurred including 30 persons out of 120 in a private company (FUD no. 1057). They became ill after eating raspberries from the same batch as the cases in the other outbreak. In total, nine outbreaks in 2011 could be related to frozen raspberries from different countries.

The largest *Salmonella* outbreak in Denmark in 2011 was due to imported tomatoes (FUD no. 1112) (3). The outbreak was caused by a very rare *Salmonella* serotype, Strathcona, which has never been identified in Denmark before and outbreaks with *S.* Strathcona has never been reported worldwide. In total, 43 cases were identified from September to October. The cases were geographically spread in most of the country. Initial interviews showed that cases had shopped in the same supermarket chain and an investigation was undertaken in collaboration with the supermarket to compare food items bought using shopping information linked to credit cards. In the receipt from 8 out of 9 patients the same brand of tomatoes were listed. A case-control study was conducted and supported this brand of tomatoes to be the source.

Outbreak from smoked pork tenderloin

From January to March an outbreak with *S.* Typhimurium resulted in 22 cases (FUD no. 1067) (4). Initial interviews pointed at a specific type of cold cut. This hy-

Figure 3.1. Aetiology of the 86 foodborne disease outbreaks reported with a causative agent in the Food- and waterborne Outbreak Database (FUD), 2011. Percentage of total outbreaks indicated in brackets



Source: Food- and waterborne Outbreaks Database (FUD) pothesis was tested in a case control study, which pointed out smoked pork tenderloin as the source of outbreak. No samples of the product were available for testing for *S.* Typhimurium, but the product was withdrawn from the market as precaution since the epidemiological evidence was very strong.

Waterborne leptospirosis

The 20th of July 2011, Statens Serum Institut was notified about a 62 year old man who died from leptospirosis after cleaning up his basement after a flooding due to an extreme rainfall in Copenhagen on July 2nd . In total, five cases of leptospirosis were notified (5). Leptospirosis is a zoonosis caused by the bacteria *Leptospira*. The disease is primarily transmitted after contact with urine or water contaminated with urine from infected animals. The usual portal of entry is through abrasions or cuts in the skin or via the conjunctiva, but may also take place via intact skin after prolonged immersion in water. Severe complications called Weils disease might occur with multi-organ failure and a mortality of 5-15% (6). In Denmark the infection is very rare with 2-10 cases per year in the period 2005-11. Most of the Danish cases are occupationally exposed (39%) such as sewage workers, farmers and fish farmers (5). Rats are the most important reservoir for *Leptospira* and investigations in rats in the Copenhagen area have shown that 53% of the sewer rats were infected with leptospira (7).

The notification of leptospirosis cases raised the concern that the flooding could have led to increased illness and Statens Serum Institut initiated an epidemiological study among people who had been exposed to the flood water through their occupation (8). Participants were from 25 different firms/organizations and included insurance agents, cleaners, engineers, maintenance workers, garbage workers, pest controllers, fire/rescue workers, and police officers. In total, 56 out of 257 participants (22%) had fell ill after the flood. The main symptoms were diarrhoea, cold/sore throat and head ache. The study showed that not washing hands and/or smoking while being in contact to the flood water were some of the main risk factors associated with being ill.

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The German VTEC outbreak caused by contaminated sprouts

In May-July 2011, Germany experienced the largest outbreak ever seen of verocytotoxin-producing *Escherichia coli* (VTEC). Germany reported 2,971 cases of VTEC O104:H4 and 845 cases of haemolytic uremic syndrome (HUS) (1). In total, 54 deaths was reported due to this outbreak. Additionally, approximately 120 cases were reported from 12 other European countries. Most of them had travelled to Germany during the period. The German authorities conducted several surveys and trace-back investigations in order to reveal the source. The first investigation pointed at tomatoes, lettuce and cucumber as the possible source of infection and the public in North Germany were advised not to consume these food items. However, further investigation – including a separate outbreak in France - established Fenugreek sprouts from seeds originating from Egypt to be the source of the outbreak. In Denmark, 26 cases were identified with the same type of VTEC O104:H4 from May-June 2011 - ten of these developed HUS and no patients died. Investigation showed that 24 of 26 cases had travelled to Germany prior to disease onset. Furthermore, one case was a secondary case infected in Denmark and the place of infection could not be established for the last patient. Interviews were made with all Danish cases and a cohort study was conducted with two groups of travellers who had visited the same restaurant in Schleswig. The Danish investigation identified no common food item consumed by the travellers, however, it did point out three specific places of exposure within Germany that could help the German investigation. Furthermore, the Danish cases could be used for establishing the incubation period of the infection, which turned out to be 8 days, which was surprisingly long as the incubation period for VTEC is usually 3-4 days. In conclusion, this outbreak was very severe and unprecedented. It was difficult to reveal sprouts as the source of infection as sprouts are often used as garnish or add-on in dishes like sandwiches and salads and thus the patients did not recall eating it. International cooperation was important to understand the nature of the infection and to identify the source.

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4. Monophasic *Salmonella* Typhimurium-like strains in food and production animals

By Karl Pedersen

Monophasic *Salmonella* strains with the antigenic formula *S.* 1,4,[5],12:i:- have emerged in several countries in recent years, both as zoonotic agents and as the cause of infections in humans (1). These *Salmonella* have much in common with *S.* Typhimurium, and investigations in other countries have revealed that they are indeed derivatives of *S.* Typhimurium 1,4,[5],12:i:1,2 (1,2) and they can be phage typed with the *S.* Typhimurium phage typing system. Some strains have lost the gene, *fljB*, encoding the second phase flagellum (genotypic monophasic), while others have merely lost the ability to express it (phenotypic monophasic). These strains constitute a diagnostic problem. A duplex PCR has been developed which can at the same time determine whether a strain is genotypic or phenotypic monophasic and confirm that it a *S.* Typhimurium or monophasic derivative. Monophasic *S.* Typhimurium-like strains were rarely reported before the mid-nineties. Since then, the number of reports on these strains has increased and they now constitute one of the most prevalent *Salmonella* subgroups and thereby being a diagnostic problem. It is clear from phenotypic and genotypic observations that several clonal lineages have emerged in parallel, although one clone is dominant.

Data from the national surveillances

So far there have been no overview reports on food and veterinary monophasic *S.* Typhimurium-like isolates from Denmark. Results from analysis of all isolates with known sources submitted to the Zoonosis Lab at the National Food Institute in 2011 are presented in Table 4.1. Isolates were submitted from the *Salmonella* control programme for pigs and poultry, clinical submissions from pigs and cattle, *Salmonella* surveillance in fresh meat, and export samples from slaughterhouses.

Monophasic *S.* Typhimurium-like isolates were found in the samples from the primary production of pigs, cattle and poultry, but most frequently in pigs, as well as in fresh pork and beef at the slaughterhouse (Table 4.1).

In cattle herds, isolates had caused clinical salmonellosis. In the pig herds, the significance of isolates from clinical samples was more difficult to evaluate. Often the isolates were collected as part of an investigation of clinical disease in the herds, and *Salmonella* was not necessarily the primary cause of disease.

Phage types and resistance profiles of the monophasic isolates

In addition to the isolates collected in 2011, the phage type distribution and resistance profiles 107 monophasic isolates submitted to the Zoonoses Lab during the period 2006-2010 was investigated. Of these, 66 isolates displayed the antigenic formula *S.* 1,4,5,12:i:- (62%) whereas 41 were *S.* 1,4,12:i:- (38%). The strains belonged to several phage types although DT193 was clearly dominant with 61 isolates (57%) followed by DT120 with 12 isolates (11%). In addition, U302 (8 isolates), U311 (5 isolates), DT104b (1 isolate), DT2 (1 isolate) and DT41 (1 isolate) were found. Eighteen isolates could not be assigned a phage type.

The isolates displayed widespread antimicrobial resistance, i.e. only four isolates were susceptible to all compounds while 97% were resistant to one or more compounds, and 76 (71%) were multi-resistant, defined as resistance to four or more antimicrobial agents. The most common resistance pattern was ampicillin-streptomycin-

sulphamethoxazole-tetracycline (ASSuT), found in 72 isolates, either alone (n=66) or in combination with other resistance factors. All isolates were susceptible to colistin, amoxicillin-clavulanic acid, and to the critical compounds cephalosporins (ceftiofur and cefotaxime) and quinolones (nalidixic acid and ciprofloxacin). One isolate was resistant to chloramphenicol , three were resistant to florfenicol, two to apramycin, three to gentamicin, two to neomycin, and five to trimethoprim.

Genotyping by pulsed-field gel electrophoresis revealed several genotypes, but most of the *S.* 1,4,5,12:i:- DT193 belonged to the same clonal lineage. The same clonal lineage has also been described from other countries, indicating an international dispersal of this strain. Most of these strains are genotypic monophasic strains, lacking the *fljB* gene.

Conclusion

Monophasic *S.* Typhimurium-like *Salmonella* strains are common in Danish food and production animals with both the antigenic formulae *S.* 1,4,12:i:- and *S.* 1,4,5,12:i:- being present, as they were found in pigs, cattle and broilers, and in fresh meat of pigs and cattle. These strains may cause clinical salmonellosis in animals, at least in cattle.

Several clonal lineages are present, but one particular *S.* 1,4,5,12:i:- phage type DT193 *fljB* negative clone clearly dominates and this strain has a marked tendency of being multi-resistant, but resistance to the critical antimicrobial agents cephalosporines and fluoroquinolones has not been found in monophasic *S.* 1,4,[5],12:i:- strains in Denmark. Further, some strains possess the fljB flagellar gene but seem not to express it.

In 2010, the European Food Safety Authority published a scientific opinion (2) on monophasic *S.* Typhimurium-like strains in which it was concluded that monophasic *Salmonella* with the antigenic formula *S.* 1,4,[5,]12:i:- should be treated equally to *S.* Typhimurium. All subsequent EU regulations on target or criteria setting for *Salmonella* that cover *S.* Typhimurium therefore include the monophasic strains 1,4,[5],12:i:-. In Denmark, from a legislation and risk management point of view these monophasic strains are treated equaly to *S.* Typhimurium.

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Table 4.1. Monophasic Salmonella *Typhimurium-like isolates from Danish production animals received at the National Zoonosis Lab in 2011*

Species	Source[a]	Total no. of *Salmonella* isolates	Monophasic strains		% monophasic *Salmonella*
			S . 1,4,5,12:i:-	*S* . 1,4,12:i;-	
Cattle	Clinical disease	-	10	1	-
Pigs	Clinical disease	-	6	3	-
Pigs	Coecum samples from slaughter pigs collected at slaughter[b]	144	7	5	8.3
Pigs	Pen feacal samples from slaughter pig herds collected at farm[c,d]	92	9	6	16.3
Pigs	Pen feacal samples from sow herds collected at farm[c]	115	12	7	16.5
Pigs	Pen feacal samples from breeder- og multiplyer herds colleced at farm[c]	29	3	3	20.7
Broilers	Sock samples collected at farm	52	2	1	5.8
Pigs	Carcass swabs collected at slaughter	176	15	7	12.5
Cattle	Carcass swabs collected at slaughter	8	1	0	12.5
Pigs	Carcass swabs collected at slaughter, Export samples	886	124	65	21.3
Cattle	Carcass swabs collected at slaughter, Export samples	53	0	53	0

a) See appendix D, Tables A33, A36 and A37 for descriptions of the surveillance programmes for broilers, cattle and pigs, respectively.
b) Samples collected randomly as part of the DANMAP programme
c) The isolates are biased towards *S.* Typhimurium as the identification of herds to be sampled are based on the resultes from the surveillance of meat juice and blood samples. The ELISA method used mainly detect *S.* Typhimurium antibodies.
d) This sampling stopped in January 2011, when it was replaced by the coecum sampling at slaughter, however the Zoonoses Lab received samples for analysis through out 2011.
Source: National Food Institute

5. *Salmonella* in slaughter pigs 1993-2011

By Anne Wingstrand (awin@food.dtu.dk) and Gitte Sørensen

Since the first monitoring and control programme of *Salmonella* in the Danish pig production was initiated in 1993-1994, a total of five larger surveys on *Salmonella* in slaughter pigs have been conducted. For the present surveillance and control programme on *Salmonella* in pigs and pork see appendix D, Table A37 and for results see appendix C, Table A5-A7, A15 and Figures A1-A3.

The first bacteriological survey on *Salmonella* in Danish slaughter pigs (SCREE1[1]) was a large survey on *Salmonella* in coecum contents conducted in 1993-1994 as one of the first pre-harvest initiatives in the surveillance and control of *Salmonella* in pigs and pork (1). After 5 years of pre- and post harvest surveillance and control (2), a second survey (SCREE2[1]) was conducted in 1998 with the primary aim to screen Danish slaughter pig herds for *S.* Typhimurium DT104 (3). SCREE1 and SCREE2 were large surveys, in which 10 pigs were examined for *Salmonella* by culture of coecum contents in each of 1,363 and 1,962 herds respectively. In the following years numerous changes in the Danish surveillance programme took place, and in 2006-2007 a baseline study on *Salmonella* in intestinal lymph nodes from slaughter pigs in 25 EU Member States was conducted (4). Culture results from the subset of 998 samples from Danish slaughter pigs was included in the present study (EU BASE[2]). One year later, in 2007-2008 the prevalence of *Salmonella* in coecum samples from approximately three slaughter pigs in each of 147 conventional herds was determined in a comparative study on *Salmonella* in different types of slaughter pig productions (QUALYSAFE[3]) (5). Since January 2011, *Salmonella* has been monitored in routine samples of coecum contents from 80 slaughter pigs per month. The results from all samples in 2011 were included in the present study (DANMAP11[4]).

5.1 Observed prevalence

For each study the observed prevalence was calculated for *Salmonella* spp. and the most common serovars *S.* Typhimurium and *S.* Derby (Figure 5.1). Compared to a *Salmonella* spp. prevalence of 6.2% in 1993-1994 (SCREE1), a reduction to 3.4% was observed in 1998 (SCREE2) after which the prevalence steadily increased to 17.3% in 2011.

The observed prevalence of *Salmonella* spp. differed statistically significant between all studies except between EU BASE and QUALYSAFE (Table 5.2). A similar pattern was seen in the observed prevalence of *S.* Typhimurium. The prevalence of *S.* Typhimurium in SCREE2 (2.0%) was significantly lower than in SCREE1 (4.0%), EU BASE (4.6%) and QUALYSAFE (4.5%), and the prevalence in DANMAP11 (6.2%) was significantly higher than in both SCREE1 and SCREE2. Over the years the proportion of *S.* Typhimurium isolates declined, mainly due to an increase in the prevalence of *S.* Derby from 0.3% to 8.4%.

5.2 Comparison of methods

As almost two decades had passed between SCREE1 and DANMAP11, changes in materials and methods used for the studies were expected due to increasing epidemiological knowledge and development and implementation of new methods. As such changes may influence the comparability between studies, it was decided to compare the materials and methods in the surveys and, if possible, assess the influence of the differences and adjust the observed prevalence accordingly.

A thorough investigation of the materials and methods in the five studies (10) was conducted including available information on season, pigs, herds, slaughterhouses, samples, laboratories, handling of samples and microbiological methods. Evaluation of methodological differences and calculation of the adjustment factors was based on publications and reports, data sets and expert opinions mainly from Danish studies (e.g. 1, 3, 5, 6, 7, 8, 9). Several differences in materials and methods were identified which most likely had influenced the observed prevalence and thus affected their comparability (Table 5.1). For each of these differences, a study specific factor was calculated to adjust

1. Initiated by the Ministry of Agriculture (SCREE1) and Ministry of Food Agriculture and Fisheries (SCREE2), conducted by the Danish Veterinary and Food Administration, the Danish Veterinary Laboratory and the Federation of Danish Pig Producers and Slaughterhouses.

2. EU baseline survey on *Salmonella* in slaughter pigs , Commission Decision 2006/668 EF, September 29th 2006.

3. Research project, FFS05-6, Ministry of Food, Agriculture and Fisheries, Directorate for Food, Fisheries and Agri Business, and National Food Institute, Technical University of Denmark.

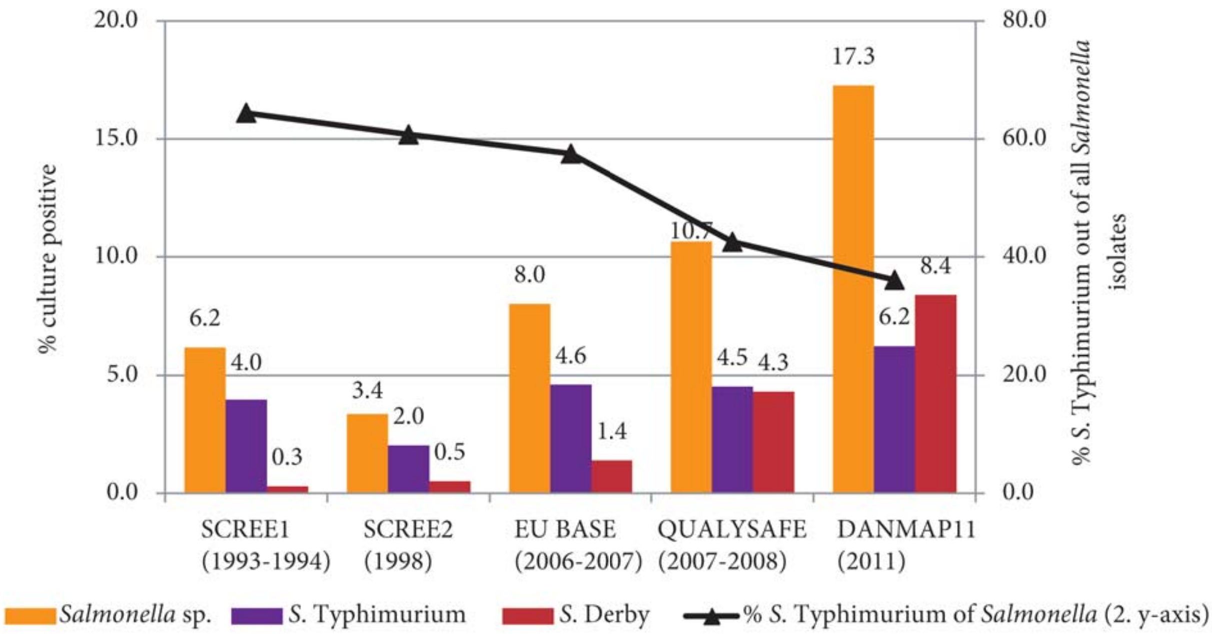
4. DANMAP: The Danish Integrated Antimicrobial Resistance Monitoring and Research Programme. www. DANMAP.org. Culture for *Salmonella* in DANMAP samples continue until 2014., and are funded by the Danish Veterinary and Food Administration.

Table 5.1. Main methodological differences in five bacteriological surveys of Salmonella *in Danish slaughter pigs and their relative effect on the observed* Salmonella *prevalence compared to the other studies: overestimation (O), underestimation (U)*

	SCREE1	SCREE2	EU BASE	QUALYSAFE	DANMAP11
Year	1993-1994	1998	2006-2007	2007-2008	2011
Number of pigs	13,468	17,987	998	441	834
Material and Method (Main reference on effect)					
Season (6)	(U) Winter/ spring	(O) Summer/ autumn	All year	High- and low season	(O) All year except December
Location (1)	All country	All country	All country	(U) One high prevalent region is under-represented	All country
Herd size (3)	(O) No middle-sized, few small	(O) No small	All herd sizes	All herd sizes	All herd sizes
Sample material (7)	Coecum contents	Coecum contents	(O) Intestinal lymph nodes	Coecum contents	Coecum contents
Amount of material in analysis (8)	(U) 5 g	25 g	25 g	25 g	25 g
Time from sampling to analysis (5)	Anticipated like EU BASE	Anticipated like EU BASE	More than 50% within day 1	More than 50% within day 1	(U) Less than 25% within day 1
Selective enrichment media (9)	MSRV[a]	(U) RVS[b]	MSRV[a]	MSRV[a]	MSRV[a]
Plating media (9)	(U) BLSF[c] or RAMBACH[d]	(U) BLSF[c] or RAMBACH[d]	BLSF[c] and XLD[e]	BLSF[c] and XLD[e]	BLSF[c] and XLD[e]

a) MSRV: Modified Semisolid Rappaport Vassiliadis agar.
b) RVS: Rappaport Vassiliadis Broth types (RVS or RV10).
c) BLSF: Brilliant green Lactose Saccharose Phenol red agar.
d) RAMBACH: Rambach agar.
e) XLD: Xylose-Lysin-Desoxycholat-agar
Source: National Food Institute

Figure 5.1. Salmonella *prevalence and relative proportion of* S. *Typhimurium*[a] *in five different studies in Danish slaughter pig herds, 1993-2011*



a) Including the monophasic strains 1,4,[5],12:i:-.
Source: Danish Agriculture and Food Council, National Food Institute, and the Danish Veterinary and Food Administration

Table 5.2. Observed and adjusted prevalence of Salmonella *spp. and* S. *Typhimurium[a] in five studies of* Salmonella *in Danish slaughter pigs 1993-2011*

Study (year)	Observed prevalence		Overall Adjustment factor	Adjusted prevalence	
	Salmonella spp. (%) [95% CI][b]	*S.* Typhimurium (%) [95% CI][b]		*Salmonella* spp. (%)	*S.* Typhimurium (%)
SCREE1 (1993-1994)	6.2 [5.8-6.6]	4.0 [3.7-4.3]	1.83	11.4	7.3
SCREE2 (1998)	3.4 [3.1-3.6]	2.0 [1.8-2.3]	1.30	4.4	2.6
EU BASE (2006-2007)	8.0 [6.4-9.9]	4.6 [3.4-6.1]	0.78	6.2	3.6
QUALYSAFE (2007-2008)	10.7 [7.9-13.9]	4.5 [2.8-6.9]	1.08	11.6	4.9
DANMAP11 (2011)	17.3 [14.8-20.0]	6.2 [4.7-8.1]	1.11	19.2	6.9

a) Include the monophasic strains 1,4,[5],12:i:-.

b) For statistical significant difference see section 5.1.

Source: National Food Institute

the observed prevalence for the varying methodology and thereby improve the comparability (data not shown). For each study an overall adjustment factor was obtained from multiplication of all adjustment factors (Table 5.2).

5.3 Adjusted prevalence

The overall adjustment factors varied between 0.78 due to overestimation of the prevalence in EU BASE and 1.83 due to a marked underestimation in SCREE1 compared to the other studies. The adjustment factors may be improved by inclusion of more sources of information. Adjusted prevalences were obtained from multiplication of the observed prevalence and the overall adjustment factors of the study (Table 5.2). Even after adjustment for methodological differences the prevalence of *Salmonella* spp. in DANMAP11 was higher than the prevalence in 1993 (SCREE1), mainly due to an increase in *S.* Derby. But also the prevalence of *S.* Typhimurium appears to have returned to the level measured in 1993. The occurrence of *Salmonella* spp. and *S.* Typhimurium seems to have increased more than 4.3 fold and 2.6 fold, respectively, since the lowest level detected in SCREE2 in 1998.

This study points to the importance of a consistent methodology if results from surveillance or surveys are to be compared over time, or as an alternative to ensure documentation of the effect of methodological changes on the observed prevalence.

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6. Review of the Danish intensified control of *Salmonella* and *Campylobacter* (case-by-case), 2007-2010

By Anna Irene Vedel Sørensen (anvso@food.dtu.dk), Helle Korsgaard and Annette Perge

Introduction

In 2006, it was decided to initiate the Danish intensified non-discriminatory control of *Salmonella* and *Campylobacter* in fresh meat, also known as the case-by-case control. In the case-by-case control, batches of Danish and imported meat, intended to be marketed as fresh meat, are sampled and analysed by the Regional Veterinary and Food Competent Authorities. Based on the results, each positive batch is subjected to an individual risk assessment at National Food Institute, including an estimate of the relative human risk using mathematical models (1, 2, 3). Based on the results of risk assessments, the Regional Veterinary and Food Competent Authorities decide if the batch should be withdrawn from the market, if already marketed. For batches traded across borders, the relevant batch will be notified in the European Commission's Rapid Alert System on Food and Feed. The legal basis for the case-by-case control is article 14 in Regulation (EC) No 178/2002/EC (4). Article 14 states that food shall not be placed on the market if it is unsafe and allow the competent authorities to take appropriate measures to impose restrictions on food being placed on the market or require its withdrawal from the market, if there are reasons to suspect that the food is unsafe.

The case-by-case control is a cost-intensive initiative and in 2011, it was decided to review the results from the first four years (2007-2010) to consider opportunities for optimization and development of the control.

Occurrence of *Salmonella* and *Campylobacter*

The overall development in the proportion of *Campylobacter* and *Salmonella* positive batches in the period 2007-2010 are illustrated in Figure 6.1 and 6.2. During these years, the proportion of *Campylobacter* positive batches of Danish as well as imported broiler meat has gradually declined. In the case-by-case control, only very few batches of Danish broiler meat have ever been tested positive for *Salmonella*; and in 2009 and 2010, *Salmonella* was not isolated from any batches of Danish broiler meat. The proportion of imported batches of broiler meat testing positive for *Salmonella* decreased from 2007 to 2009, but in 2010 the occurrence increase.

The proportion of *Salmonella* positive batches of pork and beef products has remained relatively stable during these four years, and the difference between the occurrence of *Salmonella* in Danish and imported pork and beef products has been relatively small.

Antimicrobial resistance in *Salmonella*

The occurrence of resistance to antimicrobial agents of critical importance in the treatment of human infections was generally higher in *Salmonella* isolates from imported meat compared to in Danish meat. The occurrence of multi-resistance was highest in imported turkey meat and pork followed by imported broiler meat. For imported pork and broiler meat, there have been a considerable increase in the occurrence of multi-resistance from 2009 to 2010. *Salmonella* isolates resistant to quinolones was primarily isolated from imported meat, as no quinolone-resistant bacteria have been isolated from Danish meat in the case-by-case control since 2008. A very high proportion of the *Salmonella* positive batches of turkey meat contained multi-resistant *Salmonella* isolates (75-89%) or isolates resistant to quinolones (>40%).

Sampling in the case-by-case control

The case-by-case control includes imported and Danish fresh meat, sampled at the entry to Denmark for imported meat and at the last step before it is put on the market for Danish produced meat. For batches of beef, pork, broiler and turkey products 12 pooled samples (consisting of 1-5 samples each) are tested for *Salmonella*, and for batches of broiler and turkey meat, 12 single samples from the same batch are also tested for *Campylobacter* using a quantitative method. Findings of *Salmonella* are serotyped and tested for antimicrobial susceptibility.

Recommendations

During the first four years of the control programme, no batches of turkey meat have been sanctioned due to presence of unacceptably high levels of *Campylobacter*, therefore it was suggested not to test turkey meat for *Campylobacter* in the future. No batches of frozen broiler meat have ever been sanctioned due to the presence of *Campylobacter*. Therefore it could be considered to stop testing this type of meat for *Campylobacter*, if the control programme needs to be reduced. However, the results of the testing of *Campylobacter* isolates for antimicrobial resistance, starting in 2011, need to be taken into consideration when deciding on this matter.

Due to the large seasonal variation in the occurrence of *Campylobacter* in Danish, chilled broiler meat, it could be considered to reduce the number of batches tested during the low-prevalence period from November to May. However, a consequence of this is that data no longer represents a full year, and cannot be used to estimate annual occurrences for the national surveillance.

Case-by-case in the future

The Regional Veterinary and Food Competent Authorities continue the control of fresh meat ready to be placed on the marked using the case-by-case strategy. The effect of the case-by-case control on food safety in Denmark was not intended to be measured as the amount of meat removed from the market, but should rather be attributed to the preventive effect of raising increased awareness of *Salmonella* and *Campylobacter* among importers and producers of fresh meat. Especially for *Campylobacter* and *Salmonella* in poultry meat, the reduced number of positive batches and batches rejected from the market indicates that this strategy has been successful.

During 2011 the case-by-case control was strengthened. The increased focus on antimicrobial resistance has lead to the decision also to test *Campylobacter* isolates for antimicrobial resistance, and the mathematical models used to estimate relative human risks have been updated with more recent data.

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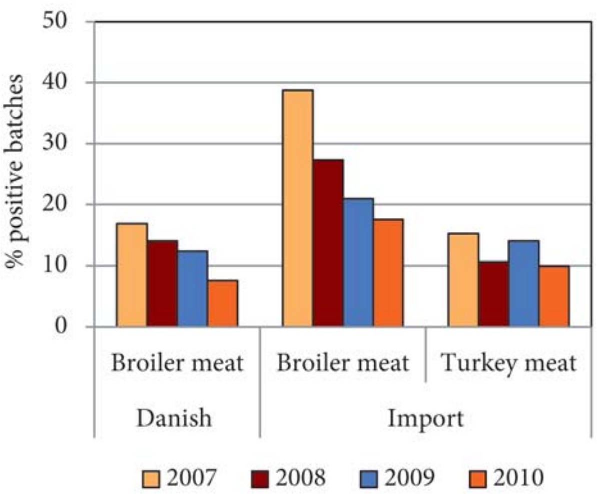
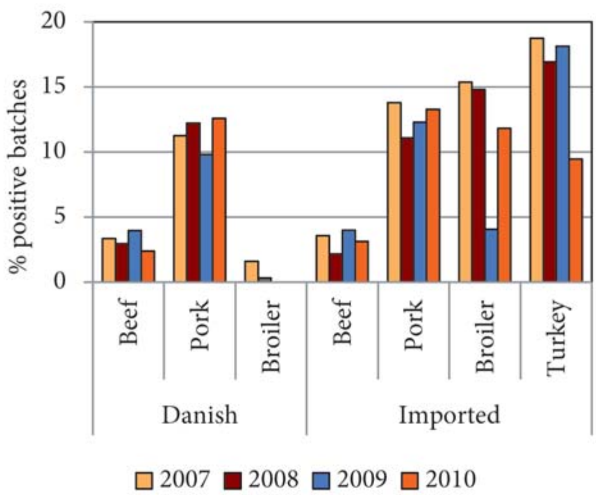
(4) Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety.

Figure 6.1. Proportion of Campylobacter *positive batches in case-by-case, 2007-2010*



Source: Danish Veterinary and Food Administration, and National Food Institute

Figure 6.2. Proportion of Salmonella *positive batches in case-by-case, 2007-2010*



Source: Danish Veterinary and Food Administration, and National Food Institute

7. Evaluation of the Danish action plan against *Campylobacter* in broilers, 2008-2012

By Hanne Rosenquist (haro@food.dtu.dk) and Nicoline Maag Stokholm

In 2008, the current action plan against *Campylobacter* in broilers was adopted (1). This includes a description of management initiatives for the period 2008-2012. The objective of the action plan was to reduce the occurrence of *Campylobacter* in Danish and imported broiler meat. This should be obtained by 1) reducing the prevalence of *Campylobacter* in Danish broiler flocks by e.g. applying fly screens and making the industry code of practice mandatory, 2) scheduling positive flocks to the production of frozen meat to the extent possible, 3) optimizing hygienic measures or applying decontamination during slaughter and 4) continuing the case-by-case control of Danish and imported broiler meat. Further on, consumer education campaigns on *Campylobacter* and safe food handling were part of the strategy to increase the awareness of the public and thereby reducing the human exposure to *Campylobacter* and thus, the burden of illness. No specific targets for the reduction were defined.

In 2011, the action plan was evaluated in cooperation between National Food Institute and the Danish Veterinary and Food Administration (2). The aim of the evaluation was to assess the effect of the implemented initiatives and to discuss the possibility of setting process hygiene criteria and/or microbiological criteria. The evaluation period included the years 2004-2011, four years before the plan started and four years after. Part of the evaluation was included in a PhD Thesis on *Campylobacter* (3).

The evaluation showed that the initiatives directed against the imported meat seem to have had a positive effect on the occurrence of *Campylobacter* at retail since the prevalence (appendix B, Table A13) and the concentration of *Campylobacter* decreased. Thereby, reducing the risk from imported meat to the consumers during the action plan period. This is likely due to the fact that retailers have reinforced the requirements for their suppliers for safer food as a consequence of the case-by-case control (see Chapter 6 for more information).

Contrary, a reduction in the *Campylobacter* occurrence in the Danish broilers and broiler meat was not registered during the action plan period (appendix B, Table A12 and A13). In fact, the concentration of *Campylobacter* in the positive samples collected at slaughterhouse level increased. Consequently, the risk from Danish broiler meat has increased since the action plan was adopted. The increase was driven by an increase in one large slaughter house.

Some of the suggested initiatives have not been implemented during the period e.g. fly screens, and it is believed the missing reduction for Danish broiler meat might be partly explained by this. Other initiatives have not had the expected effect. It should be mentioned that the initiatives were voluntary and have been dependent on industry funding and funding through research projects.

Hence, a new action plan should focus on the Danish broiler production and it could be considered to implement process hygiene criteria or microbiological criteria. Tools to evaluate the impact of microbiological criteria have been developed by the National Food Institute.

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(1) Anonymous (2008). Handlingsplan for *Campylobacter* i slagtekyllinger. Danish Veterinary and Food Administration (in Danish).

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Characterisation of *Campylobacter* isolates from humans and chicken meat

By Mia Torpdahl, Lieke Van Alphen and Gitte Sørensen

The national surveillance at Statens Serum Institut (SSI) showed an increased number of human *Campylobacter* infections during the summer period of 2011 (Figure 7.1). Only a small subset of human isolates is routinely sent to SSI from the local clinical departments and it is therefore difficult to characterize isolates for cluster analysis and discover local and national outbreaks. The increase was discussed in the Central Outbreak Management Group (see section 10.2 for more information) and it was decided that further characterization of *Campylobacter* from humans as well as potential sources was needed.

In Denmark, culture-confirmed cases of *Campylobacter* are notifiable by clinical laboratories to Statens Serum Institut and approximately 250 of isolates from three local clinical laboratories are submitted annually for the surveillance of antimicrobial resistance. When it was seen that an unusual increase in the number of *Campylobacter* infections was occurring in the weeks 28 to 36, one regional clinical laboratory was asked to submit all *Campylobacter* isolates for further characterisation. In total, 2,084 human *Campylobacter* cases were registered in this period and 182 of the isolates were further analyzed by flaA-SVR sequence typing (1), that has been shown useful in previous outbreak investigations (2,3). The 182 human isolates were separated into 57 different flaA-SVR types by assigning allele numbers from the international database (http://pubmlst.org). Several small clusters were found, but only one large cluster was observed that included 26 isolates with the same flaA-SVR nucleotide type 121.

Isolates from broiler meat from the same period were selected at the National Food Institute and send to Statens Serum Institut for *flaA* typing and comparison with the human isolates. The isolates were from the intensified control of *Campylobacter* in fresh broiler meat (the case-by-case control programme, see chapter 6) and a total of 98 isolates were analyzed from Danish broiler meat from 11 different farms as well as broiler meat imported from Germany (4 batches) and France (5 batches). In total, 22 different flaA-SVR types were found and these were farm or batch dependent with only one or two different types found at each farm or batch.

No clear clustering was observed that could indicate why an increase in human cases occurred. As described above, only a subset of human *Campylobacter* cases were available for typing and furthermore these were isolated from a restricted geographical area. The flaA-SVR typing showed that 100% of the Danish and 33% of the German and French broiler meat isolates belonged to types that were found in the human population. Only 28% of the types that were seen in humans were isolated from broiler.

References

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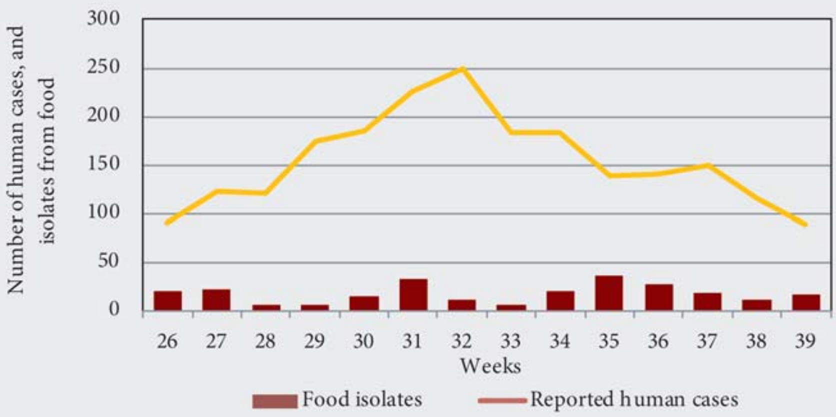
(2) Clark CG, et al. (2005). Use of the Oxford multilocus sequence typing protocol and sequencing of the flagellin short variable region to characterize isolates from a large outbreak of waterborne *Campylobacter* sp. strains in Walkerton, Ontario, Canada. J Clin Microbiol 43(5):2080-91.

(3) Gubbels SM, et al. (2012). A waterborne outbreak with a single clone of *Campylobacter jejuni* in the Danish town of Køge in May 2010. Scand J Infect Dis. Mar 4.

Figure 7.1. Total number of reported human Campylobacter *cases and number of isolates send to Statens Serum Institut for further characterisation, week 26-39 2011*



Source: Statens Serum Institut and National Food Institute

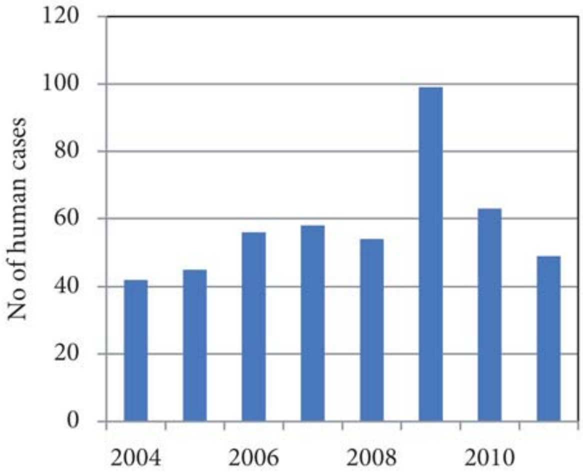
8. Listeria

By Annette Perge (ape@fvst.dk)

During the years 2004-2009 there was a steady increase in the number of listeriosis cases with a peak in 2009 where the number of cases almost doubled compared to 2008. Due to this development new risk management initiatives for *Listeria monocytogenes* in Denmark was started as part of a political agreement for 2011-2014. These initiatives included among other things a survey for *L. monocytogenes* in ready-to-eat (RTE) risk products on the marked. Positive isolates from this survey as well as from other sampling projects should be subtyped to investigate possible sources for listeriosis cases as it previously has been very difficult to attribute specific foodstuffs as source of sporadic cases.

In 2010 and 2011 a declining trend was observed (Figure 8.1).

Figure 8.1 Human cases of listeriosis in Denmark 2004-11



Source: Statens Serum Institut

Survey on *L. monocytogenes*

In 2011, a nationwide survey was carried out on *L. monocytogenes* in ready-to-eat (RTE) products on the market. Samples were collected at retail. The survey should provide information on the impact of temperature abuse on the growth of *L. monocytogenes* in risk products during distribution and retail. The products were pre-packed cheeses, meat and fish products as well as sprouts and mayonnaise salads. Products were collected randomly from the sales area in supermarkets and included both Danish and imported products. An equal distribution between supermarket chains and markets shares was sought. Only products with a shelf life exceeding 2 weeks were sampled except for sprouts. Products close to the expiry date was preferred.

The products were analysed for *L. monocytogenes* at the end of shelf life by a quantitative method. The method used was ISO11290-2 or other equivalent methods. pH and water activity were also measured, but the results are not presented here.

In total, 1,826 samples were taken of which 991 samples were Danish products and 650 were imported products (Table 8.1). For 185 samples, the origin was not stated. In 15 out of 280 (5.3%) samples of smoked and graved fish *L. monocytogenes* was detected by the quantitative method (detecting limit: 10 cfu/g). Nine of these samples (3.2%) exceeded 100 cfu/g. The highest prevalence was observed in cold smoked Greenland halibut (seven out of 88 samples, 8.0%).

In seven samples out of 991 samples from meat products (0.7%) *L. monocytogenes* was detected quantitatively at low levels; no samples exceeded 100 cfu/g. In one sample out of 183 samples of mayonnaise salads (0.05%) *L. monocytogenes* was detected at 10 cfu/g. For cheeses and sprouts no *L. monocytogenes* were detected using the quantitatively method.

The Regulation (EC) No 2073/2005 lays down microbiological food safety criteria for *L. monocytogenes* in RTE foods. The regulation states that *L. monocytogenes* must not be present in levels above 100 cfu/g during the shelf life of RTE products. Results above 100 cfu/g were detected in the group of smoked and gravad fish; especially samples of smoked Greenland halibut. Most of these samples were produced in Denmark, however also products of smoked and graved fish from Poland and Norway exceeded the limit (Table 8.2).

Discussion and conclusion

The results show that cold smoked fish and especially cold smoked Greenland halibut had the highest proportion of samples above 100 *L. monocytogenes* pr. g. 2.1% for cold smoked salmon and 8.0% for cold smoked Greenland halibut, respectively. For cold smoked Greenland halibut the relative high levels of positive samples could be due to a higher pH in this type of product compared to e.g. salmon. Increased pH can be a risk factor for this type of products. Further, the quality of the raw material might also influence the quality of the final product. Results from the

EU baseline project in 2010/2011 and a national survey on smoked fish in 2009/2010 has shown similar high levels of *L. monocytogenes* in smoked Greenland halibut.

The Danish Veterinary and Food Administration (DVFA) has informed the industry and further steps will be taken to investigate possible risk management measures that could lower the contamination rate in these products.

As another risk management initiative the DVFA launched a consumer campaign on *L. monocytogenes* in September 2011. The campaign was directed towards the elderly as the increase in human listeriosis in 2009 mainly occurred in this group. The campaign focused on temperature control in refrigerators in private homes and throwing away RTE foods, which have exceeded the expiring date, as well as awareness that pre-packed RTE food should be eaten within a few days after opening of the package. In 2012, further guidance for the food business operator's control of *L. monocytogenes* will be elaborated and made available on DVFA website.

Since 2009, the authorities have had focus on the risk from *L. monocytogenes* in the food production. This increased awareness from the authorities as well as from food producers, together with the information campaign, may have contributed to reverse the increasing trend for listeriosis cases.

Table 8.1 Results of testing for Listeria monocytogenes *in ready-to-eat food products, 2011*

		Origin			Concentration (cfu/g)			
	N	Danish	Imported	Un-known	<10	10-100	>100-1,000	>1,000
Fish products								
Cold smoked Greenland halibut	88	67	9	12	80	1	2[1]	5[1]
Cold smoked salmon	95	45	36	14	92	1	2	0
Gravad salmon	97	52	34	11	93	4	0	0
Cheese								
Soft cheese	190	73	112	5	190	0	0	0
Semi hard cheese	101	41	54	6	101	0	0	0
Meat products								
Broiler meat	97	50	40	7	97	0	0	0
Pork - heat treated, smoked and cured	94	32	50	12	94	0	0	0
Ham	100	14	75	11	100	0	0	0
Pork - heat treated (roulade)	94	53	38	3	94	0	0	0
Pork - roasted	97	51	39	7	94	3	0	0
Beef - roasted	99	90	0	9	97	2	0	0
Paté	94	62	25	7	93	1	0	0
Sausages	90	38	45	7	90	0	0	0
Meat product	83	26	51	6	83	0	0	0
Sausages - minced meat	90	70	9	11	89	1	0	0
Sausages - fermented, not heat treated or ripened	53	21	20	12	53	0	0	0
Vegetables								
Sprouts	81	52	10	19	81	0	0	0
Other products								
Mayonnaise salads with ham	92	76	2	14	92	0	0	0
Mayonnaise salads with chicken	91	78	1	12	90	1	0	0

1) One sample was tainted.
Source: Danish Veterinary and Food Administration

Table 8.2. Origin of the products for samples positve with Listeria monocytogenes at levels above *10 cfu/g*

	Concentration (cfu/g)	Denmark	Import[1]	Unknown
Cold smoked Greenland halibut	60	-	1	-
	100	1	-	-
	140	-	-	1
	2,200	1	-	-
	3,000	1	-	-
	4,900	1	-	-
	>10,000	-	2[2]	-
Cold smoked salmon	10	-	1	-
	340	1	-	-
	670	-	1	-
Gravad salmon	20	2	-	-
	90	1	1	-
Pork - roasted	10	-	-	1
	50	2	-	-
Beef - roasted	10	1	-	-
	30	1	-	-
Paté	100	1	-	-
Sausage - minced meat	60	1	-	-
Mayonnaise salads - chicken	10	1	-	-
Total		15	6	2

1) Samples were from Poland and Norway.
2) The sample was tainted.
Source: Danish Veterinary and Food Administration

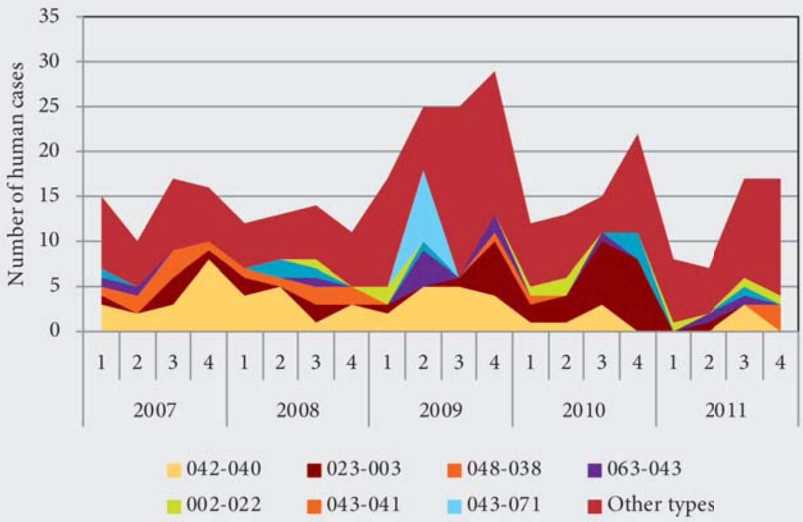
PFGE typing of Listeria isolates from humans

By Eva Møller Nielsen

In 2011, 49 cases of listeriosis were registered (incidence 0.9/100,000 population) (Appendix B Table A2). This is lowest number of cases since 2005. The very large number of cases reported in 2009 included one well-described outbreak of eight cases, but otherwise there was no obvious reason for the sudden increase in number of cases in 2009. The increase in 2009 combined with the generally high incidence of listeriosis in Denmark, prompted the formation of a task force including experts in different aspects of the microbiology and epidemiology of *Listeria*. This working group has coordinated new initiatives regarding prevention of listeriosis as well as control of *Listeria* in food products.

For surveillance and outbreak detection, the isolates are routinely typed using pulsed-field gel electrophoresis (PFGE) with two enzymes (ApaI and AscI) according to the PulseNet International protocol (1). The surveillance shows that three common PFGE types persistently were prevalent in the years 2007 to 2010 accounting for 23-38 cases per year (up to 50% of the cases). The remaining cases were caused by isolates with a large number of different PFGE-types. The occurrence of the common types decreased to only 7 cases (14%) in 2011. It can be speculated that food products sold in Denmark, e.g. products from specific producers, were contaminated with these persistent types in 2007-10. The striking decrease in human infections caused by these types corresponds with the general decrease in human listeriosis cases in 2011. As we have very limited isolates from food products in the period before 2011, it was not possible to further investigate the sources of these previously common types among human infections. However, since a few persistent types contributed significantly to the high level of human infections, our aim for future surveillance will be to identify such "clones" and specifically search for the food sources of these in order to improve the prevention and control of listeriosis.

Figure 8.2. PFGE typing (combined Apa-AscI profiles) of isolates from human Listeria monocytogenes *infections (one isolate per case). Minor types are represented by 1-7 isolates each during the period (n= 315)*



Reference

(1) One-Day (24-28 h) Standardized Laboratory Protocol for Molecular Subtyping of *Listeria monocytogenes* by Pulsed Field Gel Electrophoresis (PFGE). www.pulsenetinternational.org.

9. EU related topics

9.1 Control of zoonoses in animal populations

9.1.1 EU coordinated monitoring studies

Based on the Zoonosis Directive 2003/99/EC and the Regulation (EC) No 2160/2003, the Commission can initiate harmonised studies in order to generate comparable prevalence data from all Member States with the purpose of setting common EU targets for the reduction of the pathogens in question. So far, eight such baseline studies have been carried out concerning *Salmonella, Campylobacter* and MRSA. The EU results have been published on the EFSA website (www.efsa.eu). The Danish results have been presented in Annual Report 2005-2009.

In 2010 and 2011 a one year study on the prevalence of *Listeria monocytogenes* in certain ready-to-eat producuts was carried out. Samples included smoked fish, meat products as well as soft and semisoft cheeses collected at retail in major cities. The aim of the study was to evaluate compliance with the microbiological criteria for *L. monocytogenes* laid down in Regulation (EC) No 2073/2005 as ammended for products marketed in EU. Additionally, the growth potential for *L. monocytogenes* in smoked fish will be evaluated. The results of the study have not been published yet.

9.1.2 EU harmonised surveillance programmes

Based on the results of baseline studies in flocks of poultry, harmonised regulation on targets and surveillance in the poultry production has been laid down by the Commission.

In 2010, the European Food Safety Authority published a scientific opinion (1) on monophasic *S.* Typhimurium-like strains in which it was concluded that the monophasic *Salmonella* strains with the antigenic formula *S.* 1,4,[5],12:i:- should be treated equal to *S.* Typhimurium. Subsequently EU regulations on target end criteria setting on *Salmonella* have included these types as well (see chapter 4 for more information).

The EU target for breeding and fattening turkey flocks positive with *S.* Typhimurium and *S.* Enteritidis is 1%, according to Regulation (EC) No 584/2008. The targets have to be reached by December 31st 2012. In Denmark, one turkey flock of 38 flocks tested was positive with *S.* Typhimurium DT41 in 2011 (appendix C, Table A11). This is a prevalence of 2.4%, however the Regulation states that Member States with less than 100 flocks may have one positive flock annually.

In breeding flocks of *Gallus gallus*, the target of 1% positive adult flocks had to be reached by the end of 2009 according to Regulation (EC) No 1003/2005. The target was set for *S.* Typhimurium, *S.* Enteritidis, *S.* Hadar, *S.* Infantis and *S.* Virchow. This regulation has been replaced by Regulation (EC) No 200/2010 laying down a permanent target of maximum 1% adult flocks positive for *S.* Typhimurium including the monophasic *S.* 1,4,[5],12:i:- strains, *S.* Enteritidis, *S.* Hadar, *S.* Infantis and *S.* Virchow. In the legislation no distinction is made between breeding flocks from the table egg and broiler production lines. In Denmark, no adult flocks were positive in 2011 (appendix C, Table A8 and A10).

The EU baseline study on table egg laying flocks carried out in 2004 showed large differences in the prevalence between Member States. Therefore, Member States specific targets were set either as an annual 10-40% reduction of positive adult flocks dependant on the prevalence of adult flocks in the Member State the previous year or a maximum of 2% adult flocks positive (Regulation (EC) No 1168/2006). The target was set for *S.* Typhimurium and *S.* Enteritidis and had to be reached by December 31st 2010. This regulation has been replaced by Regulation (EC) No 517/2011 laying down permanent targets for the reduction of *Salmonella* in laying flocks. The regulation continues the previous targets. For Denmark, the target is a maximum of 2% adult flocks positive for *S.* Typhimurium including the monophasic *S.* 1,4,[5],12:i:- strains and *S.* Enteritidis. The prevalence in Denmark has been below 2% since 2004. In 2011, 0.5% of the flocks were positive with the target serotypes and no other serotypes were reported (appendix C, Table A8).

In broiler flocks of *Gallus gallus*, the target of maximum 1% flocks positive for *S.* Typhimurium and *S.* Enteritidis had to be reached by December 31st 2011 according to Regulation (EC) No 646/2007. Denmark has had intensive *Salmonella* control programmes for many years and the target of 1% was reached several years ago. In 2011, 0.2% of the broiler flocks was positive with *S.* Typhimurium including the monophasic *S.* 1,4,[5],12:i:- strains or *S.* Enteritidis (appendix C, Table A10).

9.1.3. Microbiological food safety criterion in food products

The Regulation (EC) No 2073/2005 as amended lays down microbiological food safety criteria for food products. Requirements for implementation and testing of the compliance with these criteria by the producers are defined. The Regulation came into force in 2006.

As of December 2011 a food safety criterion for *Salmonella* in poultry meat was introduced by Regulation (EC) No 1086/2011. Poultry meat included is fresh meat from breeding flocks of *Gallus gallus*, laying hens, broilers, and breeding and fattening flocks of turkeys. The criterion covers only *S.* Enteritidis and *S.* Typhimurium including the monophasic strains *S.* 1,4,[5],12:i:-. It is a food safety criterion which means that it applies during the shelf life of the product and in case of non-compliance the batch in question must be withdrawn.

The establishment of a criterion for poultry meat was foreseen in the Regulation (EC) No 2160/2003 on the control of *Salmonella* and other specified food-borne zoonotic agents. From this regulation it appears that a requirement for absence of *Salmonella* in 25g poultry meat should apply from the end of 2010 and detailed rules for this criterion including sampling plans and analytical method should be established before the end of 2009. The process has been delayed as it has been difficult to reach agreement on a new criterion in the EU. At present, Member States are on different levels in their efforts to control *Salmonella* and introduction of a strict criterion for *Salmonella* would have serious economical impact for the industry in some countries. Therefore, it was agreed to only include *S.* Enteritidis and *S.* Typhimurium including the monophasic strains *S.* 1,4,[5],12:i:- that are responsible for the majority of human cases.

9.2 Antimicrobial Resistance - initiatives

In 2011, the European Medicines Agency published the first report[2] on the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) project aiming at collecting comparable data on the sales and use of antimicrobial agents in animals in the Member States, Norway and Switzerland. The report showed that tetracyclines, penicillins and sulfonamides are the top three antimicrobial classes sold and that prescribing patterns varied greatly between countries. The European Food Safety Authority (EFSA) provided a scientific opinion on resistance caused by bacteria producing extended spectrum cephalosporinases in food and food producing animals[3]. In the opinion EFSA highlighted the usage of 3rd and 4th generation cephalosporins as important risk factors. However the general use of antimicrobial as well as the extensive trade of live animals within the EU are risk factors as well. Also, the Transatlantic Task Force on Antimicrobial Resistance (TATFAR), established following the EU-US summit in 2009, published its recommendations for collaboration in the global fight against antimicrobial resistance[4].

References

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(4) Transatlantic Taskforce on Antimicrobial Resistance (TATFAR) (2009). TATFAR Recommendations for future collaboration between the U.S. and EU. www.ecdc.europa.eu/en/activities/diseaseprogrammes/tatfar/pages/index.aspx.

10. Surveillance and control programmes

The collaboration between national and regional authorities, the industry and non-governmental organizations is presented in Figure 10.1. According to the Danish legislation, 41 infectious diseases are notifiable in Denmark. An overview of the notifiable and non-notifiable human and animal diseases presented in this report is provided in appendix D, Table A30 and Table A31, respectively, including reference to the relevant legislation.

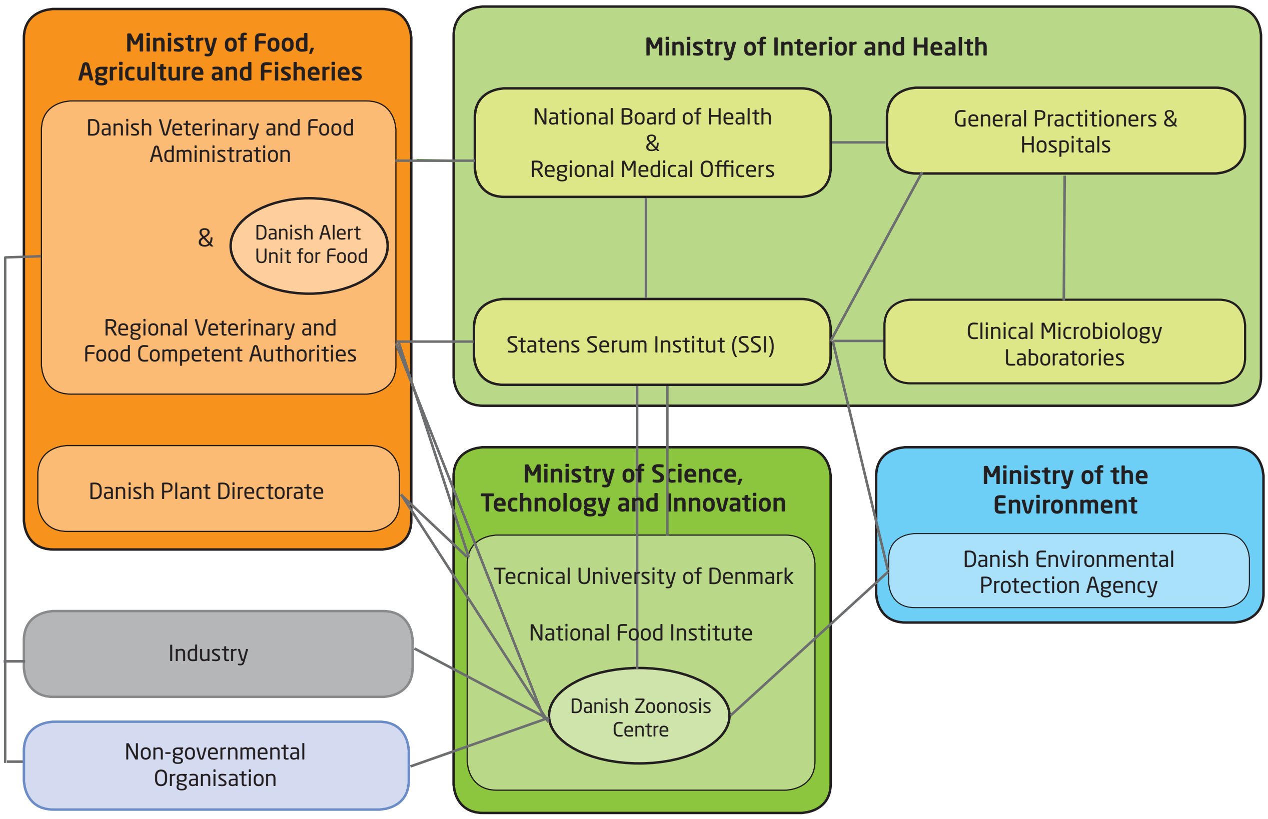
10.1 Surveillance of human disease

Information on human cases due to zoonotic pathogens presented in this report is reported to Statens Serum Institut through different channels depending on the disease:

- Notifiable through the laboratory surveillance system: *Salmonella*, *Campylobacter*, *Yersinia*, Verocytotoxin-producing *E. coli* (VTEC) and *Listeria*
- Individually notifiable zoonotic pathogens: *Chlamydia psittacci* (ornithosis), *Leptospira, Mycobacterium*, Bovine Spongieform Encephalopathy (BSE) prions (var. Creutzfeldt-Jakob Disease), Verocytotoxin-producing *E. coli* (VTEC) and *Lyssavirus* (rabies)
- Non-notifiable zoonotic pathogens: *Brucella, Cryptosporidium, Echinococcus, Toxoplasma* and *Trichinella.*

In Denmark, the physicians report individually notifiable zoonotic diseases to the medical officers and the Department of Epidemiology at Statens Serum Institut. Positive cases diagnosed by a clinical microbiological laboratory are reported through the laboratory surveillance system to the Unit of Gastrointestinal Infections at Statens Serum Institut. Physicians send specimens from suspect cases to one of the clinical microbiology laboratories depending on county of residence of the requesting

Figure 10.1. Overview of the monitoring and outbreak investigation network for reporting infectious pathogens in humans, animals, foodstuffs and feedstuffs in Denmark, 2011



Source: Danish Zoonosis Centre, National Food Institute

physician. The laboratories must report positive results to Statens Serum Institut within one week. Furthermore, all *Salmonella* and VTEC isolates are sent to the reference laboratory at Statens Serum Institut for further sero- and genotyping. The *Salmonella* isolates are sent to the National Food Institute, Technical University of Denmark for phage typing (see appendix D, table A38 for more detailed information on typing methods). The results are recorded in the Register of Enteric Pathogens maintained by Statens Serum Institut. Positive cases are reported as episodes, i.e. each patient-infectious agent combination is only recorded once in any six-month period. Overviews of results from the Register of Enteric Pathogens are presented as follows:

- All laboratory confirmed human cases are presented in appendix B, Table A2
- VTEC O-group distribution in humans is presented in appendix B, Table A3
- The *Salmonella* sero- and phage type distributions are presented in appendix C, Tables A5-A7.

10.2 Outbreaks of zoonotic gastrointestinal infections

In Denmark, local foodborne outbreaks are typically investigated by the Regional Veterinary and Food Competent Authorities in collaboration with the medical officer; often with the participation of the regional clinical microbiology laboratory. Larger outbreaks involving more than one region are typically investigated by Statens Serum Institut, the National Food Institute, and the Danish Veterinary and Food Administration in collaboration. These institutions may also aid in the investigation of local outbreaks. Representatives from these institutions meet regularly in the Central Outbreak Management group to discuss surveillance results, compare the reported occurrence of zoonotic agents in animals, food and feedstuffs with that in humans, and investigate major outbreaks. The formal responsibility of investigating food- or waterborne outbreaks is currently divided between three ministries based on the outbreak source: the Ministry for Interior and Health for infectious diseases; the Ministry of Food, Agriculture and Fisheries for food and animal related diseases; and the Ministry of the Environment (along with the municipalities) for water related diseases.

Outbreaks may be detected in various ways. Individuals who experience illness related to food intake in settings such as restaurants or work place cafeterias may report these incidents directly to the Regional Veterinary and Food Competent Authorities. Physicians are obligated to report all suspected water- and foodborne infections to the regional medical officer, who then reports to Statens Serum Institut. Clusters of cases may be noted in the laboratory or identified at Statens Serum Institut through the laboratory surveillance system of gastrointestinal bacterial infections or through subtyping of bacterial isolates from patients.

A list of verified outbreaks (not including household outbreaks) reported to the Food- and waterborne Outbreak Database (FUD) are presented in appendix B, Table A4 and some of the more notable outbreaks from 2011 are outlined in Chapter 3.

10.3 Surveillance and control of animals and animal products

Salmonella surveillance and control programmes for poultry, pigs and cattle are presented in appendix D, Tables A32-A37. Sample analysis is performed at authorised private laboratories, the Regional Veterinary and Food Competent Authorities, the National Food Institute, and the National Veterinary Institute. *Salmonella* isolates are forwarded to the National Food Institute for serotyping, some isolates are also phage- and genotyped as well as tested for antimicrobial resistance. An overview of the methods used for subtyping is presented in appendix D, Table A38.

Overviews of results from surveillance and control of *Salmonella* are presented as follows:

- Results from the table egg production are presented in appendix C, Tables A5-A9
- Results from the broiler production are presented in appendix C, Tables A5-A7 and A10
- Results from the duck and turkey productions are presented in appendix C, Table A11
- Results from the pig production are presented in appendix C, Tables A5-A7, A15 and Figures A1-A3
- Results from the cattle production are presented in appendix C, Tables A5, A16-A17 and Figure A4
- Results from the feeding stuff production are presented in appendix C, Tables A20-A21
- Results from the rendering plants are presented in appendix C, Table A22
- Results based on suspicion of diseases in pets, zoo animals and wild life are presented in appendix C, Table A24.

Overviews of results from monitoring of *Campylobacter* are presented as follows:

- Results from the poultry production are presented in appendix C, Tables A12-A13
- Results based on suspicion of diseases in pets, zoo animals and wild life are presented in appendix C, Table A24
- Results on the relative distribution of *Campylobacter* species are presented in appendic C, Tables A14 and A18

Pig and cattle carcasses are screened for *Mycobacterium* and *Echinococcus* during meat inspection at the slaughterhouse. Although Denmark is assigned as a region where the risk of *Trichinella* in domestic swine is negligible, all slaughter pigs are still examined for *Trichinella* at slaughter as well as wild boars, and horses slaughtered for human consumption. In addition, boars and bulls are tested for *Brucella* and bulls are tested for *Mycobacterium* at semen collection centres. All positive results for notifiable infectious diseases are reported to the Danish Veterinary and Food Administration. Results are presented in appendix C, Table A15-A16.

Results from the surveillance for Bovine Spongiform Encephalopathy (BSE) in cattle, Transmissible Spongiform Encephalopathy (TSE) in sheep/goat are presented in appendix C, Tables A25-A27.

Results from the monitoring of *Coxiella burnetii* (Q fever) in cattle are presented in appendix C, Table A16.

Results based on suspicion of diseases with *Chlamydia psittaci, Cryptosporidium, Trichinella*, classical rabies and European Bat *Lyssavirus* in zoo animals and wild life are presented in appendix C, Table A24.

7.4 Official testing of zoonotic pathogens in foodstuffs

In Denmark, control of zoonotic microorganisms in foodstuffs is mainly carried out as projects which are coordinated at the central level of the Danish Veterinary and Food Administration. Sampling and testing is carried out with the following purposes:

- To verify that food business operators comply with microbiological criteria laid down in the legislation
- To verify the microbiological safety of food for which no microbiological criteria are laid down at Community level
- To monitor the effect of established risk management procedures in order to evaluate if these provide the desired results or need to be reconsidered
- To generate data for the preparation of risk profiles and risk assessments to support microbial risk management
- To discover emerging problems with microbiological contaminants.

Appendix C, Table A28 provides information on the centrally coordinated projects conducted in 2011. Results for the following project are presented:

- Intensified control of *Salmonella* and *Campylobacter* in Danish and imported meat based on a case-by-case risk assessment (appendix C, Table A19)
- Findings of *Campylobacter* in non-heat treated meat cuts from broilers (appendix C, Table A12 and A13)
- Findings of *Listeria monocytogenes* in ready-to-eat products (appendix C, Table A29)
- Findings of *Salmonella*, *Campylobacter* and *E. coli* in ready-to-eat vegetables and herbs (appendix C, Table A23).

For further information consult the webpage of the Danish Veterinary and Food Administration, www.fvst.dk (in Danish).

Appendix A

Trends and sources in human salmonellosis

Table A1. Estimated no. of reported human cases and percentage of cases per major food source, travel or outbreaks, 2009-2011

	2011		2010		2009	
Source	Estimated no. of reported cases (95% credibility interval[a])	Percentage of reported cases	Estimated no. of reported cases (95% credibility interval[a])	Percentage of reported cases	Estimated no. of reported cases (95% credibility interval[a])	Percentage of reported cases
Domestic pork	86 (44-131)	7.4	242 (238-283)	16.4	162 (127-198)	7.6
Domestic beef	6 (0-28)	0.5	12 (0-38)	0.7	4 (3-6)	0.2
Domestic table eggs	11 (2-22)	1.0	28 (18-41)	1.8	262 (245-280)	12.3
Domestic broilers	0	0	8 (4-14)	0.5	7 (0-21)	0.3
Domestic ducks	19 (4-37)	1.7	2 (0-7)	0.1	7 (0-19)	0.3
Imported pork	65 (28-104)	5.6	86 (59-115)	5.4	43 (22-66)	2.0
Imported beef	33 (10-48)	2.8	30 (4-51)	2.0	65 (47-86)	3.1
Imported broilers	24 (2-51)	2.0	5 (0-17)	0.2	30 (8-60)	1.4
Imported turkey	13 (1-38)	1.1	17 (2-37)	1.0	42 (11-74)	2.0
Imported duck	28 (8-54)	2.4	21 (10-37)	1.3	29 (10-50)	1.4
Travels	538 (531-546)	46.2	749 (740-758)	46.9	658 (647-669)	30.9
Unknown source	288 (252-330)	24.7	316 (275-354)	19.8	375 (322-422)	17.6
Outbreaks, unknown source	55[b]	4.3	62	3.9	445	20.9
Total	1,166		1,598		2,129	

a) The model is based on a Bayesian framework which gives 95% credibility intervals.

b) Five cases are known to have been caused by pork, but from unknown origin. In one outbreak with 43 cases the source was tomatoes imported from Italy.

Source: Danish Zoonosis Centre, National Food Institute

Appendix B

Human disease and outbreak data

Table A2. Zoonoses in humans, number of laboratory-confirmed cases, 2002 and 2007-2011

	Incidence per 100,000 inhabitants	Reported no. of cases					
Zoonotic pathogen	2011	2011	2010	2009	2008	2007	2002
Bacteria							
Brucella abortus/melitensis[a,c]	-	7	6	7	8	20	16
Campylobacter coli/jejuni[b]	73.1	4,068	4,035	3,352	3,454	3,868	4,379
Chlamydia psittaci[b]	0.1	7	9	14	6	11	13
Leptospira spp.[b]	0.2	11	10	12	13	10	13
Listeria monocytogenes[b]	0.9	49	62	97	51	58	28
Mycobacterium bovis[b]	0.02	1	2	0	1	1	2
Salmonella total[b]	21.0	1,166	1,598	2,129	3,656	1,647	2,071
S. Enteritidis[b]	5.3	293	388	600	638	566	1,105
S. Typhimurium[b]	4.4	245	521	767	2,002	343	382
Other serotypes[b]	11.3	628	689	762	1,016	740	584
VTEC total[b]	4.0	224	185	165	161	161	143
O157	0.5	27	25	24	15	25	23
other or non-typeable	3.5	197	146	141	143	136	120
Yersinia enterocolitica[b]	4.0	224	192	238	330	270	240
Parasites							
Cryptosporidium spp.[a,c]	-	31	25	35	92	49	-
Echinococcus multilocularis[a,d]	-	4	1	0	0	3	-
Echinococcus granulosus[a,d]	-	31	10	11	5	9	-
Toxoplasma gondii[a,e]	-	-	-	-	-	-	12
Trichinella spp.[a,c,d]	-	0	0	0	0	1	-
Viruses							
Lyssavirus[b]	-	0	0	0	0	0	0

a) Not notifiable hence the incidence cannot be calculated.
b) Notifiable.
c) Data presented are from one laboratory (Statens Serum Institut) only, representing a proportion of the Danish population (approximately 1/3 in 2011). The proportion of the population represented varies from year to year, thus results from different years are not comparable. Testing for these pathogens is carried out only if specifically requested on the submission form.
d) The cases were imported.
e) The nation-wide neonatal screening for congenital toxoplasmosis stopped in 2007.
Source: Statens Serum Institut

Table A3. VTEC *O-group distribution in humans[a], 2011*

O-group	Number of episodes	O-group	Number of episodes
O157	27	O177	8
O104	25	O117	8
O103	22	O128	7
O26	15	O111	7
O146	13	O-rough	12
O145	10	Notification[b]	12
	Continued in the next column	Other O-groups or not-typed	58
		Total	224

a) All O-groups that resulted in five or more episodes are listed.
b) The cases are reported through the notification system, isolates not available for analysis.
Source: Statens Serum Institut

Table A4. Foodborne disease outbreaks[a] reported in the Food- and waterborne Outbreak Database (FUD) (n=86), 2011

Pathogen	No. of patients	Patients laboratory confirmed	Setting	Source	FUD no.
Bacillus cereus	30	.	Canteen	Stew	1129
Bacillus cereus	12	.	Hotel	Composite meal	1128
Bacillus cereus	4	.	Other	Rice	1151
Bacillus cereus	3	.	Restaurant	Parsley sauce	1122
Bacillus cereus	18	.	Restaurant	Composite meal	1109
Bacillus cereus	52	.	Canteen	Spice (pepper)	1097
Bacillus cereus	2	.	Restaurant	Bulgur	1106
Bacillus cereus	1	.	Restaurant	Composite meal	1104
Bacillus cereus	15	.	School	Stew	1077
Bacillus cereus	11	.	Restaurant	Composite meal	1064
Campylobacter	14	4	Scout camp	Unknown	1181
Clostridium perfringens	40	.	Hotel	Composite meal	1124
Clostridium perfringens	3	.	Restaurant	Stew	1121
Clostridium perfringens	12	.	Canteen	Stew	1120
Clostridium perfringens	4	.	Restaurant	Sandwiches	1108
Clostridium perfringens	37	.	Canteen	Stew	1090
Clostridium perfringens	3	.	Restaurant	Stew	1076
Clostridium perfringens	10	.	Canteen	Composite meal	1055
VTEC 103	7	2	Canteen	Composite meal	1098
EPEC	13	1	Private party	Buffet meals	1095
ETEC	51	5	Shop	Unknown	1138
ETEC	87	4	Canteen	Sugar peas imported	1081
Salmonella spp.	4	1	Restaurant	Buffet meals	1074
S. Typhimurium DT104	.	5	Shop	Pork products (imp/dk)	1116
S. Typhimurium DT120	.	22	National	Pork products (imp)	1067
S. Aberdeen	20	6	Private party	Buffet meals	1101
S. Strathcona	.	43	National	Tomatoes ((imp)	1112
Staphylococcus aureus	26	.	Restaurant	Composite meal	1149
Staphylococcus aureus	6	.	Restaurant	Stew	1063
Shigella flexneri	38	1	Private party	Buffet meals	1088
Shigella flexneri	32	10	Private party	Buffet meals	1087
Yersinia enterocolitica	30	.	National	Unknown	1093
Norovirus	50	1	Restaurant	Composite meal	1139
Norovirus	22	.	Canteen	Buffet meal	1137
Norovirus	11	.	Institution	Composite meal	1136
Norovirus	22	1	Shop	Composite meal	1135
Norovirus	8	4	Hotel	Buffet meals	1131
Norovirus	15	.	Hospital	Sandwiches	1150
Norovirus	11	.	Restaurant	Composite meal	1127
Norovirus	20	.	Restaurant	Buffet meal	1126
Norovirus	36	3	Shop	Composite meal	1123
Norovirus	17	.	Restaurant	Buffet meals	1125
Norovirus	40	1	Hotel	Buffet meals	1114
Norovirus	12	.	Private home	Raspberries frozen (imp)	1152
Norovirus	25	.	Hotel	Raspberries frozen (imp)	1113
Norovirus	40	3	Hotel	Cake	1110

Continued on the next page

Table A4. Foodborne disease outbreaks[a] reported in the Food- and waterborne Outbreak Database (FUD), 2011 (Continued from previous page)

Pathogen	No. of patients	Patients laboratory confirmed	Setting	Source	FUD no.
Norovirus	5	4	Private party	Raspberries frozen (imp)	1111
Norovirus	37	2	Canteen	Buffet meals	1102
Norovirus	15	2	Private home	Raspberries frozen (imp)	1094
Norovirus	6	1	Private party	Raspberries frozen (imp)	1091
Norovirus	16	.	Private party	Cakes	1080
Norovirus	18	.	Restaurant	Buffet meals	1105
Norovirus	32	.	Private party	Unknown	1148
Norovirus	27	.	Institution	Composite meal	1079
Norovirus	21	3	Restaurant	Cake	1078
Norovirus	14	5	Private party	Cake	1070
Norovirus	14	.	Hotel	Sweets	1073
Norovirus	23	.	Restaurant	Sandwiches	1069
Norovirus	8	2	Restaurant	Buffet meals	1065
Norovirus	120	2	Other	Buffet meals	1053
Norovirus	30	.	Canteen	Buffet meals	1075
Norovirus	20	.	Hotel	Buffet meals	1068
Norovirus	19	2	Restaurant	Buffet meals	1072
Norovirus	5	4	Restaurant	Raspberries frozen (imp)	1059
Norovirus	2	.	Canteen	Raspberries frozen (imp)	1058
Norovirus	60	.	School	Buffet meals	1050
Norovirus	30	2	Canteen	Raspberries frozen (imp)	1057
Norovirus	34	1	Hotel	Composite meal	1061
Norovirus	8	3	Private party	Cake	1049
Norovirus	113	13	Canteen	Raspberries frozen (imp)	1051
Norovirus	35	2	Canteen	Buffet meals	1056
Norovirus	16	.	Shop	Composite meal	1047
Norovirus	2	.	Restaurant	Sandwiches	1054
Norovirus	11	.	Private party	Oysters (imp)	1048
Histamin	8	.	Shop	Fish (Escolar) (imp)	1132
Histamin	2	.	Restaurant	Fish (Canned tuna) (imp)	1107
Histamin	4	4	Shop	Fish (Blue Marlin) (imp)	1089
Histamin	2	.	Restaurant	Fish (Canned Tuna) (imp)	1071
Lectins	24	.	Restaurant	Elderberries	1118
Lectins	16	.	Canteen	Dried beans	1062
Mushrooms	7	.	Restaurant	Mushrooms	1119
Unknown chemical substance	25	.	Canteen	Pine nuts (imp)	1134
Unknown	15	.	Hotel	Buffet meals	1099
Unknown	250	.	Institution	Unknown	1066
Outbreaks related to travel					
VTEC O104:H4	26	24	Travel (Restaurant, Germany)	Fenugreek sprouts	1086
S. Enteritidis	31	3	Travel (Hotel, Turkey)	Unknown	1103
Total	2,051	192			

Note: (Imp)= imported product

a) In addition, 1 confirmed household outbreak involving 2 cases was registered (FUD 1060). It was caused by Norovirus in frozen raspberries (imp).

Source: Food- and waterborne Outbreak Database (FUD)

Appendix C

Monitoring and surveillance data

Table A5. Top 10 (humans) serotype distribution (%) of Salmonella *from humans, animals, carcasses and imported meat, 2011*

	Human	Pig[a] herds	Pork[b] batches	Beef[b] batches	Layer[c] flocks	Broiler[c] flocks	Duck[c] flocks	Turkey[c] flocks	Imported meat (batch)				
									Pork[d]	Beef[d]	Broiler[d]	Turkey[d]	Duck[e]
Serotype	N=1,166	N=144	N=178	N=20	N=2	N=47	N=72	N=1	N=34	N=3	N=18	N=38	N=132
Enteritidis	25.1	0.7	0	0	50.0	4.3	0	0	0	0	28.2	2.6	3.8
Typhimurium	21.0	27.8	16.3	0	50.0	8.5	1.4	100	11.8	0	0	2.6	34.1
Typhimurium (monophasic)[f]	12.1	8.3	11.8	0	0	6.4	0	0	17.7	0	0	10.6	2.3
Strathcona	3.7	0	0	0	0	0	0	0	0	0	0	0	0
Dublin	3.6	0	0	25.0	0	0	0	0	0	66.7	0	0	0
Stanley	3.3	0	0	0	0	0	0	0	0	0	0	0	0
Agona	1.9	0	0	0	0	0	1.4	0	0	0	0	2.6	0
Infantis	1.9	3.5	5.0	0	0	4.3	0	0	2.9	0	5.6	0	0
Virchow	1.5	0	0	0	0	0	0	0	0	0	0	0	0
Kentucky	1.5	0	0	0	0	6.3	0	0	0	0	0	5.3	0
Others	24.1	56.2	38.8	0	0	70.2	94.4	0	64.7	0	72.2	73.7	54.5
Unknown	0.3	3.5	28.1	75.0	0	0	2.8	0	2.9	33.3	0	2.6	5.3
Total	100	100	100	100	100	100	100	100	100	100	100	100	100

a) Isolates collected from coecum samples taken randomly at slaughter.
b) Sampling of beef and pork carcasses at slaughterhouses according to surveillance programmes (Tables A36 and A37).
c) Sampling in production flocks prior to slaughter according to surveillance programmes (Tables A32-A34).
d) Case-by-case control of imported meat. For further information regarding case-by-case control programme, see Annual Report on Zoonoses in Denmark 2007.
e) Imported duck meat sampled at retail (centrally coordinated studies, Table A28).
f) Typhimurium (monophasic) includes the *Salmonella* strains 1,4,[5],12:i:-.
Source: Danish Veterinary and Food Administration, Statens Serum Institut, and National Food Institute

Table A6. Top 10 (human) phage type distribution (%) of S. Typhimurium and the monophasic strains 1,4,[5],12:i:- from humans, animals and imported meat, 2011

	Human	Pig[a]	Pork[b]	Layer[c]	Broiler[c]	Duck[c]	Turkey[c]	Imported meat (batch)		
		herds	batch	flocks	flocks	flocks	flocks	Pork[d]	Turkey[d]	Ducks[e]
Phagetype	N=386	N=52	N=50	N=1	N=7	N=1	N=1	N=10	N=5	N=48
DT 193	26.2	7.7	20.0	0	29.0	0	0	50.0	80.0	0
DT 120	18.9	17.3	24.0	100	29.0	0	0	20.0	0	2.1
RDNC	9.3	7.7	12.0	0	29.0	0	0	0	0	4.2
U292	5.4	0	0	0	0	0	0	0	0	0
DT 104	4.1	0	4.0	0	0	0	0	0	20.0	0
DT 104B	3.6	1.9	4.0	0	0	0	0	10.0	0	0
DT 1	3.6	0	0	0	0	0	0	0	0	0
DT 12	3.4	7.7	4.0	0	0	0	0	0	0	0
DT 8	2.8	0	0	0	0	0	0	0	0	72.9
DT 135	2.6	1.9	0	0	0	0	0	0	0	0
Others	14.2	38.5	16.0	0	14.0	0	100	0	0	20.8
Unknown	5.7	17.3	16.0	0	0	100	0	20.0	0	0
Total	100	100	100	100	100	100	100	100	100	100

a-e) See footnotes a-e in Table A5.
Source: Danish Veterinary and Food Administration, Statens Serum Institut, and National Food Institute

Table A7. Top 10 (human) phage type distribution (%) of S. Enteritidis from humans, animals and imported meat, 2011

	Human	Pig[a]	Layer[c]	Broiler[c]	Imported meat (batch)		
		herds	flocks	flocks	Broiler[d]	Turkey[d]	Ducks[e]
Phagetype	N=293	N=1	N=1	N=2	N=4	N=1	N=5
RDNC	5.8	0	0	0	0	0	0
PT 8	5.1	0	100	0	25.0	0	0
PT 4	4.4	100	0	0	25.0	100	100
PT 1	4.1	0	0	0	0	0	0
PT 13A	3.8	0	0	0	0	0	0
PT 21	3.4	0	0	0	0	0	0
PT 14B	2.7	0	0	0	0	0	0
PT 3	2.4	0	0	0	0	0	0
PT 9C	2.1	0	0	0	0	0	0
PT 11	1.7	0	0	0	0	0	0
Others	5.5	0	0	50	50.0	0	0
Unknown	59.0	0	0	50	0	0	0
Total	100	100	100	100	100	100	100

a-e): See footnotes a-e in Table A5.
Source: Danish Veterinary and Food Administration, Statens Serum Institut, and National Food Institute

Table A8. Occurrence of Salmonella *in the table egg production[a], 2002-2011*

	Rearing period (parent flocks)		Adult period (parent flocks)		Pullet-rearing flocks		Table egg layer flocks	
	N	Positive	N	Positive	N	Positive	N	Positive
2002	15	0	22	0	330	9	619	15
2003	24	0	15	0	367	4	611	10
2004	9	2	9	0	368	1	641	5
2005	16	0	9	0	355	6	655	7
2006	17	0	11	0	289	2	565	2
2007	11	0	12	0	326	0	510	5
2008	10	0	6	0	258	1	508	4
2009	13	0	6	0	253	0	454	8
2010	15	0	9	0	225	0	455	8
2011	8	0	9	0	195	0	410	2[b]

a) See Tables A32 and A34 for description of the surveillance programmes.
b) One flock positive with *S.* Enteritidis PT 8 and one with *S.* Typhimurium DT 120.
Source: Danish Agriculture and Food Council, and Danish Veterinary and Food Administration

Table A9. Occurrence of Salmonella *in the table egg layer flocks sorted by type of production, 2001-2011*

	Deep litter		Free range		Organic		Battery	
	N	Positive	N	Positive	N	Positive	N	Positive
2002	123	1	49	4	130	4	127	7
2003	191	2	71	2	173	1	167	9
2004	214	0	72	2	175	1	177	2
2005	217	3	70	0	178	0	175	4
2006	185	0	62	0	164	2	148	0
2007	155	2	56	0	146	2	146	1
2008	151	0	61	2	145	1	135	1
2009	133	1	78	0	130	4	110	3
2010	117	0	45	2	136	1	157	5
2011	109	0	40	0	130	1[a]	131	1[b]

a) One flock positive with *S.* Typhimurium DT 120.
b) One flock positive with *S.* Enteritidis PT 8.
Source: Danish Agriculture and Food Council, and Danish Veterinary and Food Administration

Table A10. Occurrence of Salmonella *in the broiler production*[a]*, 2002-2012*

	Rearing period (parent flocks)		Adult period (parent flocks)		Broiler flocks		Slaughterhouse (flocks/batches)	
	N	Positive	N	Positive	N	Positive	N	Positive
2002	241	2	330	2	4,443	68	1,667	92
2003	265	2	182[c]	4	4,414	77	1,552	77
2004	275	1	155[c]	6	4,246	64	1,472	24
2005	214	0	185[c]	0	4,034	87	1,174	27
2006	190	0	282	5	3,621	71	875[d]	17
2007	152	0	258	3	3,703	60	884	10
2008	146	0	293	2	3,845	43	518[e]	3
2009	140	0	225	4	3,767	35	375	3
2010	126	0	200	5	3,773	43	346	1
2011	114	0	213	0	3,795[f]	47[g]	306	0

a) See Tables A32 and A33 for description of the surveillance programmes.
c) In 2003-2005, only one flock per house was registered per year although there may have been more than one flock in the house, however all flocks were sampled according to the surveillance programme.
d) From 2006, data cover only samples taken following the *Salmonella* programme. Verification samples taken once a week by producers of poultry meat approved to market *Salmonella*-free poultry meat are not included. Collection of verification samples started in the middle of 2005.
e) From 2008, all AM positive flocks are heat treated at slaughter. Sampling is now carried out as verification of the AM results of the negative flocks.
f) Data include 65 organic flocks.
g) Include four flocks positive with *S.* Typhimurium, two flocks with *S.* 1,4,5,12:i:- , one flock with *S.* 1,4,12:i:- and two flocks with *S.* Enteritidis.
Source: Danish Agriculture and Food Council, and Danish Veterinary and Food Administration

Table A11. Occurrence of Salmonella *in turkey and duck flocks*[a]*, 2006-2011*

	Duck flocks		Turkey flocks	
	N	% pos	N	% pos
2006	266	80.5	11	0
2007	-	-	13	0
2008	68	64.7	10	10.0
2009	85	63.5	15	0
2010	108	56.5	24	4.2
2011	95	58.1[b]	38	2,6[c]

a) See Table A35 for description of the surveillance programmes. The two major turkey and duck slaughterhouses in Denmark closed down in 2004 and 2007, respectively. Therefore, most commercially reared duck and turkey flocks are transported abroad for slaughter.
b) Include one flock positive with *S.* Typhimurium.
c) One flock positive with *S.* Typhimurium DT 41.
Source: Danish Agriculture and Food Council

Table A12. Occurrence of Campylobacter *in broiler flocks and in fresh meat at slaughter, 2004-2011*

	Broiler flocks				Chilled broiler meat[a]			
	N	% pos	N	% pos	N	% pos	N	% pos
2004	5,157	27.0	-	-	1,603	17.8	-	-
2005	4,952	30.4	-	-	1,689	12.3	-	-
2006	4,522	30.8	-	-	959	7.9	-	-
2007	4,527	26.8	-	-	439	8.2	-	-
2008	4,950	26.3	-	-	484[b]	14.7[b]	-	-
2009[c]	4,591	29.4	-	-	-	-	1,179	15.4
2010[d]	-	-	3,132	16.5	-	-	1,177	10.4
2011	-	-	3,379	14.4	-	-	1,095	12.7

a) Centrally coordinated studies (see section 10.4 for describtion). Detection limit <10 cfu/g.
b) Data are not compareable with other years as they represent the last two quarters of the year, which is the high prevalent period.
c) From 2009, results from chilled broiler meat are not directly comparable to results from previous years, as additional small slaughterhouses has been included in the monitoring. The prevalence are now weighted according to the Danish market share.
d) From 2010, results from broiler flocks are not comparable to results from previous years, as the sampling method changed from cloacal swabs at slaughter to boot swabs collected in the stable 7-10 days before slaughter according to Regulation No. 1469 of 15/12/2010 as ammened.
Source: Danish Agriculture and Food Council, Danish Veterinary and Food Administration, and National Veterinary Institute

Table A13. Occurrence of Campylobacter *in non-heat treated broiler meat at retail[a], 2003-2011*

	Chilled broiler meat (samples)				Frozen broiler meat (samples)			
	Denmark		Import		Denmark		Import	
	N	% pos[b]	N	% pos[b]	N	% pos[b]	N	% pos[b]
2003-2004	334	27.2	170	65.7	566	10.9	272	19.6
2004-2005	517	31.1	299	73.2	937	12.2	391	25.9
2005-2006	401	29.8	854	56.3	1,087	13.5	698	31.3
2006-2007	363	31.0	1,128	51.1	897	19.0	812	33.9
2007-2008	1,058	32.8	1,067	53.9	655	29.6	577	44.4
2008-2009	1,459	33.8	1,316	46.7	847	26.1	773	27.7
2009-2010	1,469	35.6	1,292	46.9	1,026	32.4	676	23.6
2010-2011	1,596	38.9	1,015	52.9	906	36.5	296	31.5

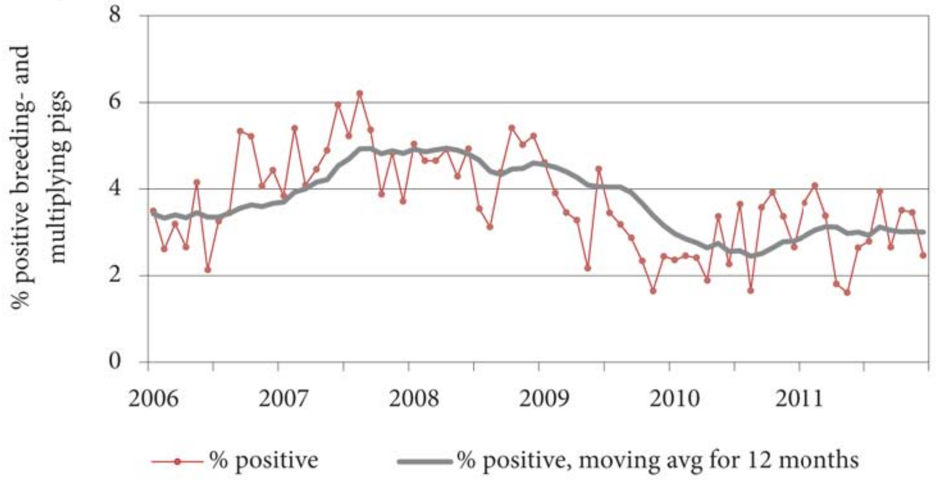
a) Centrally coordinated studies (see section 10.4 for describtion). Detection limit <0.1 cfu/g.
b) The prevalence is calculated as a mean of quarterly prevalences based on the sum of data from the two years specified.
Source: National Food Institute

Table A14. Relative distribution of Campylobacter *species (%) in broilers before slaughter*[a]*, 2003-2009 and 2011*

	N	*C. jejuni*	*C. upsaliensis*	*C. coli*	NT/other
2003	113	92.9	0	6.2	0.9
2004	101	94.1	0	5.9	0
2005	109	90.8	2.8	0	6.4
2006	113	92.0	0.9	7.1	0
2007	111	91.9	5.4	0.9	1.8
2008	100	90.5	2.8	0	6.6
2009	105	89.0	0	11.0	0
2010	-	-	-	-	-
2011	46	95.7	0	4.3	0

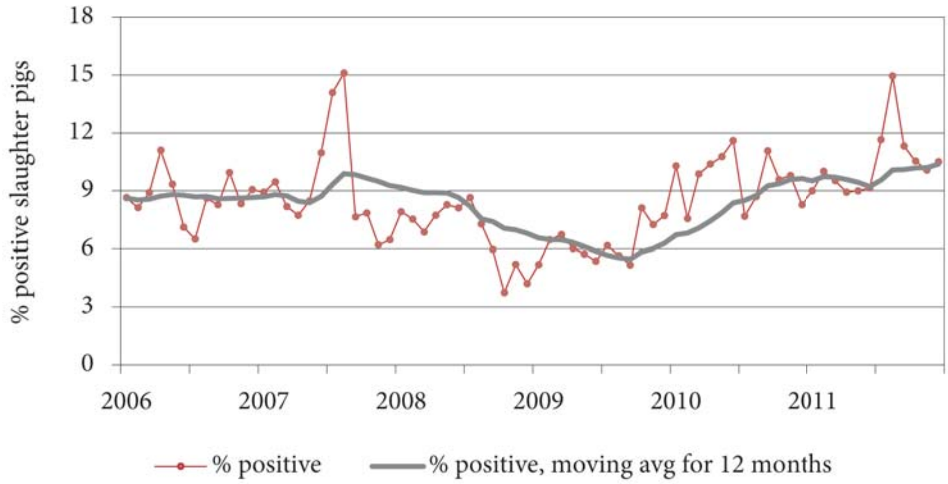
a) Positive isolates collected as part of the DANMAP programme was examined using conventional microbiological methods.
Source: National Food Institute

Figure A1. Serological surveillance of Salmonella *in breeding and multiplying pigs*[a] *based on monthly testing of blood samples, 2006-2011*



a) For more information about the surveillance programme, see Table A37.
Source: Danish Agriculture and Food Council

Figure A2. Serological surveillance of Salmonella *in slaughter pigs*[a]*, 2006-2011. Percentage of seropositive meat juice samples (first sample per herd per month)*[b]



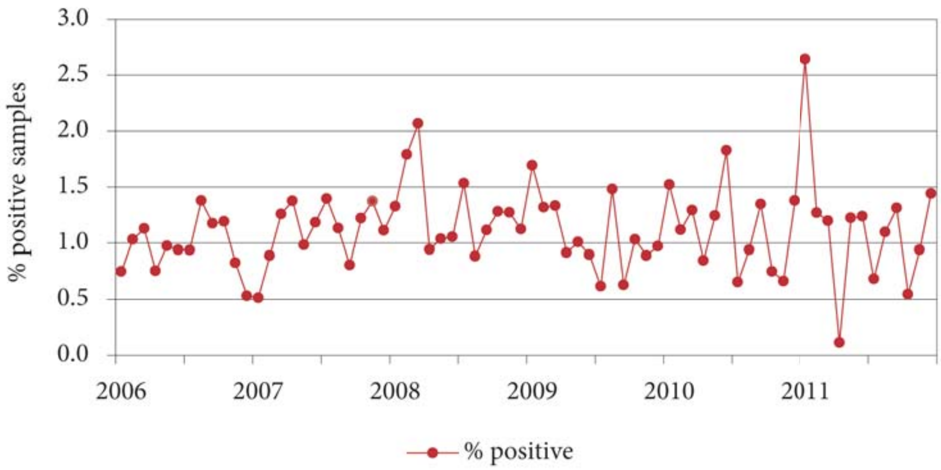
a) For more information about the surveillance programme, see Table A37.
b) The peak in late summer 2007, and the very low level during 2008 were due to technical problems in the laboratory. Peaks in April 2006, January 2010 and August 2011 were due to data transfer problems.
Source: Danish Agriculture and Food Council

Table A15. Occurrence of zoonotic pathogens in pigs and pork in Denmark, 2011

	Herds		Animals/Samples		
Zoonotic pathogen	N	Pos	N	Pos	% pos
At farm					
Brucella abortus[a]	-	-	31,000	0	0
Leptospira[b]	59	2	100	3	3.0
At slaughterhouse (slaughter pigs)					
Salmonella spp.[c,d]	7,427	358	-	-	-
Salmonella spp.[c,e] (slaughtering >50 pigs/month)	-	-	22,025	-	1.3[f]
Salmonella spp.[c,e] (slaughtering 50 or less pigs/month)	-	-	140	-	0.7
Salmonella spp.[c,g]			834	144	17.3
Trichinella spp.[h]	-	-	20,693,556	0	-
Mycobacterium bovis[i]	-	-	20,290,046	0	-
Echinococcus granulosis/multilocularis[i]	-	-	20,290,046	0	-

a) Including samples from boars (examined at pre-entry, every 18 month, and prior to release from semen collection centres) (14,351 samples), samples collected in connection with export (16,509 samples), import (22 samples) or diagnostic samples (20 samples). 5-8 ml blood samples were analysed using either the SAT, RBT, CFT or ELISA methods.
b) Sampling is based on suspicion of leptospirosis due to increased abortions or other reproductive problems in a herd. Samples are investigated using immunoflourescence techniques.
c) See Table A37 for describtion of the *Salmonella* surveillance programme.
d) Data are from December 2011. Slaughter pig herds monitored using serological testing of meatjuice samples collected at slaughter. Herds belonging to level 2 and 3 were defined as *Salmonella* positive.
e) Swab samples from four designated areas of the half-carcass were collected at the slaughterhouse after min. 12 h chilling. Sample size is 4x100 cm^2. Samples from five animals were pooled, except at slaughterhouses where 50 pigs or less were slaughtered per month, in which case samples were analysed individually.
f) When estimating the prevalence of *Salmonella*, both the loss of sensitivity and the probability of more than one sample being positive in each pool are taken into consideration. A conversion factor has been determined on the basis of comparative studies, as described in Annual Report 2001.
g) Coecum samples are randomly collected from slaughter pigs at slaughter.
h) Samples collected from slaughter pigs at slaughter were examined using the method described in Directive 2075/2005/EEC. In 2007, Denmark achieved official status as region with negligible risk of *Trichinella*, according to EU Regulation (EC) No 2075/2005.
i) Slaughter pigs were examined by meat inspectors at slaughter.
Source: Danish Veterinary and Food Administration, National Veterinary Institute, and National Food Institute

Figure A3. Salmonella *in pork, monitored at slaughterhouses[a], 2006-2011*



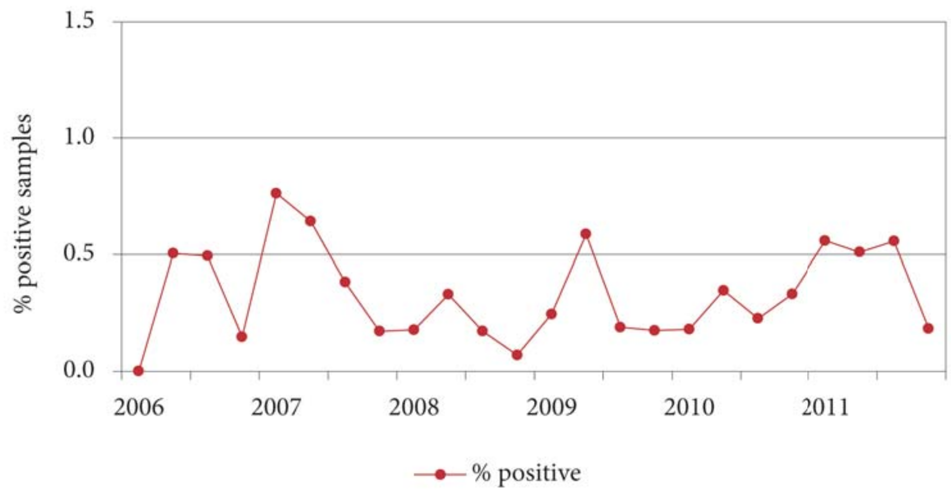
a) For more information about the surveillance programme, see Table A37.
Source: Danish Veterinary and Food Administration

Table A16. Occurrence of zoonotic pathogens in cattle and beef in Denmark, 2011

	Herds		Animals/Samples		
Zoonotic pathogen	N	Pos	N	Pos	% pos
At farm					
Brucella abortus[a]	-	-	2,236	0	-
Mycobacterium bovi[b, c]	-	-	4,084	0	-
Coxiella burnetii	47[d]	36	178[e]	13	7.3
At slaughterhouse					
Salmonella spp.[f] (slaughtering >50 cattle/month)	-	-	7.635	-	0.4[g]
Salmonella spp.[f] (slaughtering 50 or less cattle/month)	-	-	242	-	0
Mycobacterium bovis[b, h]	-	-	517,503	0	-
VTEC O157[i]	237	4	-	-	-
Echinococcusus granulosis/multilocularis[h]	-	-	517,503	0	-

a) Denmark has been declared officially brucellosis free since 1979. The last outbreak was recorded in 1962. Including samples from bulls (examined at pre-entry, every year, and prior to release from semen collection centres) (1,476 samples), samples collected in connection with export (676 samples), import (5 sample) or diagnostic samples (76 samples). 5-8 ml blood samples were analysed using either the SAT, RBT, CFT or ELISA methods.
b) Denmark has been declared officially tuberculosis free since 1980. The last case of TB in cattle was diagnosed in 1988.
c) Analysis using the tuberculin test. Including samples from bulls (examined at pre-entry, every year, and prior to release from semen collection centres) (1,450 samples), samples collected in connection with export (2,634 samples)
d) Bulk tank milk samples taken for diagnostic testing and analysed using an ELISA method.
e) Serum samples taken for diagnostic testing and analysed using an ELISA method. An additional 6 samples from placenta was analysed using the FISH method, two sample was positive.
f) See Table A36 for describtion of the surveillance programme. Swab samples from four designated areas of the half-carcass were collected at the slaughterhouse after min. 12 h chilling. Sample size is 4x100 cm^2. Samples from five animals were pooled, except at slaughterhouses where 50 cattle or less were slaughtered per month, in which case samples were analysed individually.
g) When estimating the prevalence of *Salmonella*, both the loss of sensitivity and the probability of more than one sample being positive in each pool are taken into consideration. A conversion factor has been determined on the basis of comparative studies, as described in Annual Report 2001.
h) Slaughtered cattle were examined by the meat inspectors at slaughter.
i) Caecal content are tested from one animal per herd, collected at slaughter (DANMAP programme). A 25 g faecal sample from one slaughter calf per herd is examined using overnight enrichment, immunomagnetic separation method and plating on CT-SMAC plates for O157.
Source: Danish Veterinary and Food Administration, Danish Agriculture and Food Council, National Veterinary Institute, and National Food Institute

Figure A4. Salmonella *in beef, monitored at slaughterhouses*[a]*, 2006-2011*



a) For more information about the surveillance programme, see Table A36.
Source: Danish Veterinary and Food Administration

Table A17. Cattle herds in the S. *Dublin surveillance programme[a], January 2011*

			Non-milk producing herds		Milk producing herds	
Salmonella Dublin level			N	%	N	%
Level 1	1a	On the basis of milk samples	793	5.9	3,333	90.0
	1b	On the basis of blood samples	11,724	87.3	25	0.7
	Total	Probably *Salmonella* Dublin free	12,517	93.3	3,358	90.6
Level 2	2	Titer high in blood- or milk samples	64	0.5	89	2.4
	2R	Titer high, official restrictions	329	2.5	244	6.6
	2	Contact with herds in level 2 or 3	291	2.2	12	0.3
	Total	Non *Salmonella* Dublin free	684	5.1	345	9.3
Level 3	Total	Salmonellosis, official supervision	0	0	2	0.1
Unknown		Too few blood samples	221	1.6	0	0
Total number of herds sampled			13,422	100	3,705	100

a) See Table A36 for description of the surveillance programme.
Source: Danish Agriculture and Food Council

Table A18. Relative distribution of Campylobacter *(%) in pig and cattle herds[a], 2002-2009 and 2011*

	Pigs				Cattle			
	N	*C. coli*	*C. jejuni*	other/unknown	N	*C. coli*	*C. jejuni*	other/unknown
2002	193	97.9	2.1	0	57	0	96.5	3.5
2003	242	-	-	100	56	-	-	100
2004	152	98.0	1.3	0.7	43	2.3	97.7	0
2005	158	97.5	2.5	0	31	0.0	100	0
2006	154	97.4	2.6	0	99	15.2	84.8	0
2007	205	97.6	2.4	0	93	4.3	95.7	0
2008[b]	198	97.5	2.5	-	103	4.9	95.1	-
2009	160	85.6	14.4	-	110	2.7	97.3	-
2010	-	-	-	-	-	-	-	-
2011	168	96.4	3.6	-	123	8.1	91.9	-

a) Samples were collected as part of the DANMAP programme. Caecal content was tested from one animal per herd.
b) From 2008, samples are only tested for *C. coli* and *C. jejuni*.
Source: National Food Institute

Table A19. Results from the intensified control of Salmonella *and* Campylobacter *in fresh meat based on a case-by-case risk assessment, 2011*

		No. of batches tested	No. of batches positive	No. of batches sanctioned	Mean prevalence in positive batches[a]	Mean relative human risk in positive batches
Campylobacter						
Danish	Broiler	265	34	3	36.3%	3.4
Imported	Broiler	212	53	2	34.4%	2.8
	Turkey	214	21	0	12.3%	0.8
Salmonella[a]						
Danish	Beef	110	3	3	22.2%	261.0
	Pork	259	25	4	10.4%	5.8
	Broiler	96	1	1[b]	3.6%	0.4
Imported	Beef	110	2	1	16.8%	174.3
	Pork	256	27	7	7.4%	25.1
	Broiler	212	12	9	44.6%	5.1
	Turkey	214	27	4	14.3%	21.6

a) The *Salmonella* prevalence in each batch is based on the proportion of positive pooled samples (12 pools per batch) and number of subsamples per pool.
b) The batch was sanctioned due to the Danish zero tolerance to *Salmonella* in broiler meat.
Source: Danish Veterinary and Food Administration, and National Food Institute

Table A20. Feed business operators own sampling of Salmonella *in compound feeds, feed processing and feed material (batch-based data), 2009-2011*

	2011		2010		2009	
	N	Positive	N	Positive	N	Positive
Feed processing plants (process control)[a]:						
Ordinary inspections - clean zone	7,359	10[d]	7,963	12	7,781	3
Ordinary inspections - dirty zone	767	72[e]	548	58	340	28
Compound feed, farm animals	386	0	390	0	384	0
Feed materials, farm animals[b]	1,849	60[f]	1,285	49	1,051	85
Transport vehicles, clean zone/hygiene samples[c]	835	0	963	0	1,176	1
Transport vehicles, dirty zone/hygiene samples[c]	273	0	224	1	29	0

a) Presence of *Salmonella* in compound feed is indirectly monitored by environmental samples collected during feed processing.
b) Predominantly soy bean meal and rapeseed cake.
c) Samples from transport vehicles (hygiene samples) prior to loading of feed compounds.
d) *S.* 1,4,12:b:-, *S.* Mbandaka and *Salmonella* spp..
e) *S.* 1,4,12:b:-, *S.* Falkensee, *S.* Havana, *S.* Infantis, *S.* Liverpool, *S.* Livingstone, *S.* Meleagridis, *S.* Montevideo and *Salmonella* spp..
f) *S.* Agona, *S.* Amsterdam, *S.* . Banana, *S.* California, *S.* Cerro, *S.* Derby, *S.* Havana, *S.* Infantis, *S.* Kingston, *S.* Lexington, *S.* Lexington car 15,34, *S.* Mbandaka, *S.* Minnesota, *S.* Orion, *S.* Putten, *S.* Rissen, *S.* Soerenga, *S.* Typhimurium and *S.* Yoruba.
Source: Danish Plant Directorate and the feed business operators. From October 1st 2011 the Danish Plant Directorate merged with the Danish Veterinary and Food Administration.

Table A21. Control of Salmonella *in compound feeds, feed processing and feed material (batch-based data), 2008-2011*

	2011		2010		2009		2008	
	N	Positive	N	Positive	N	Positive	N	Positive
Feed processing plants (process control)[a]:								
Ordinary inspections[c]	377	12[d]	558	5	907	18	1,085	18
Feed materials, farm animals[b]	68	3[e]	379	24	186	4	174	12

a) See footnote a) to Table A20. Companies are sampled one to four times per year.

b) See footnote b) to Table A20.

c) Primarily findings of *Salmonella* in the dirty zone.

d) *S.* Agona, *S.* Cerro, *S.* Hartford, *S.* Havana, *S.* Infantis, *S.* Mdandaka, *S.* Putten, *S.* Senftenberg.

e) *S.* Havana, *S.* 1,4,12:b:- and one non typeable.

Source: Danish Plant Directorate. From October 1st 2011 the Danish Plant Directorate merged with the Danish Veterinary and Food Administration.

Table A22. Salmonella *in three categories of meat and bone meal by-products not intended for human consumption[a], 2011*

Category of processing plant		Own-check samples N	Own-check samples Positive	Product samples N	Product samples Positive
1+2	By-products of this material cannot be used for feeding purposes	522	0	-	-
2	By-product of this material may be used for feed for fur animals	57	0	15	0
3	By-products from healthy animals slaughtered in a slaughterhouse. Products of these may be used for petfood[b] and for feed for fur animals	1,349	11	979	7
	Total	1,928	1,100	994	7

a) Regulation No. 1774 of 03/10/2002.

b) For cats and dogs. Only by-products from pigs are used in this petfood.

Source: Danish Veterinary and Food Administration

Table A23. Pathogens in ready-to-eat vegetables and herbs[a], 2011

	Salmonella		*Campylobacter*		*E. coli* (>100 cfu/g)	
Type of sample	N	Pos	N	Pos	N	Pos
Vegetables						
Baby corn	18	0	18	1[i]	18	6
Cucumber	29	1[d]	29	0	29	0
Pepper	27	0	27	0	27	0
Salad	54	0	54	2[j]	54	1
Sprouts	27	0	27	0	27	1
Sugar peas	36	0	36	1[k]	36	1
Tomato	30	0	30	0	30	0
Other vegetables[b]	35	0	35	0	35	0
Herbs						
Coriander	9	1[e]	9	0	9	1
Lemon Grass	1	0	1	0	1	0
Parsley	26	1[f]	26	0	26	0
Rosemary	2	1[g]	2	0	2	1
Sage	1	0	1	0	1	0
Spearmint	7	0	7	0	7	0
Spring onions	18	0	18	1[l]	18	1
Tarragon	2	1[h]	2	0	2	0
Other herbs[c]	20	0	20	0	20	0
Total	342	5	342	5	342	12

a) Centrally coordinated study (see section 10.4 for describtion) to control and investigate *Salmonella, Campylobacter* and *E. coli* in Danish and imported ready-to-eat vegetables, sprouts and herbs.
b) Cauliflower (6 batches), spring cabbage (6), broccoli (5), celery (4), cabbage (3), brussels sprouts (2), red cabbage (2), zucchini (2), aspargus (1), beans (1), chili (1), fennel (1), and onions (1)
c) Chives (8 batches), basil (4), thyme (3), dill (2), chervil (1), pepper corns (1), and watercress (1).
d) *Salmonella* sp. in a batch from Spain.
e) *S.* Weltevreden in a batch from Vietnam.
f) *S.* Kasenyi in a batch from Italy.
g) *S.* Newport in a batch from Uganda.
h) *S.* Montevideo in a batch from Israel.
i) From Thailand.
j) One batch from Italy and one batch from France.
k) From Kenya.
l) From Thailand.
Source: Danish Veterinary and Food Administration

Table A24. Occurrence of zoonotic pathogens in pets, zoo animals and wild life in Denmark[a], 2011

	Pet animals						Zoo animals				Wildlife			
	Dogs		Cats		Others		Mammals & reptiles		Birds		Mammals		Birds	
Zoonotic pathogen	N	Pos	N	Pos	N	Pos	N	Pos	N	Pos	N	Pos	N	Pos
Salmonella spp.	3	0	0	-	0	-	11	0	3	0	11[c]	4[d]	12[e]	0
Campylobacter spp.	2	0	0	-	0	-	2	0	0	-	0	-	0	-
Brucella canis/abortus	0	-	0	-	0	-	2	0	0	-	0	-	0	-
Chlamydia psittaci	0	-	0	-	443	16[b]	1	0	0	-	0	-	6	0
Cryptosporidium spp.	8	0	4	3	0	-	12	1	0	-	53[f]	13[g]	3[h]	0
Echinococcus	0	-	0	-	0	-	0	-	0	-	105[i]	0	0	-
Trichinella spp[j]	0	-	0	-	0	-	0	-	0	-	332	0	0	
Lyssavirus (classical)	1	0	2	0	2[k]	0	0	-	0	-	0	-	0	-
European Bat *Lyssavirus*	0	-	0	-	0	-	0	-	0	-	18[l]	0	0	-

a) All samples are analysed based on suspicion of disease and does not reflect the country prevalence.
b) 13 birds of 368 tested in a survey.
c) One fitchew, five badgers, four hedgehogs and one raccoon dog.
d) Four hedgehogs.
e) Two swans, one greylag goose, two Carduelis chloris and seven pigeons.
f) Three fallow deer, 19 raccoon dogs and 31 roe deer.
g) One fallow deer, three raccoon dogs and nine roe deer.
h) Two phesants and one sea eagle.
i) Two raccoons, 58 raccoon dogs and 71 foxes.
j) In 2007, Denmark achieved official status as region with negligible risk of *Trichinella*, according to EU Regulation (EC) No 2075/2005. 300 fox, 18 mink, five raccoon dog, five other predatin mammals and four badger,
k) One cow and one sheep.
l) 18 bats.
Source: National Veterinary Institute, and Danish Veterinary and Food Administration

Table A25. The Bovine Spongiform Encephalopathy (BSE) surveillance programme[a] for cattle, 2011

Type of surveillance	N[b]	Positive
Active surveillance		
Healthy slaughtered animals (>48 months)	99,140	0
Risk categories:		
Emergency slaugthers (>48 months)	595	0
Slaughterhouse antemortem inspection revealed suspicion or signs of disease (>48 months)	0	0
Fallen stock (>48 months)	22,280	0
Animals from herds under restriction	0	0
Passive surveillance		
Animals suspected of having clinical BSE	5	0
Total	122,020	0

a) According to the EU Regulation (EC) 999/2001 as amended, Commission Decision 2009/719/EC as amended and Danish Order no. 499 of 26/05/2011 as amended.
b) Samples (brain stem material) are tested using a IDEXX technique or Prionics-Check PrioStrip. Confirmatory testing is carried out using Western blot (definitive diagnosis if positive case), else with histopathology or immunohistochemistry. Further confirmation on autolysed material is performed at the European Union TSE reference laboratory.
Source: National Veterinary Institute, and Danish Veterinary and Food Administration

Table A26. The Transmissible Spongiform Encephalopathy (TSE) surveillance programme[a] for sheep and goats, 2011

Type of Surveillance	N[b]	Positive
Active surveillance		
Fallen stock (>18 months)	7,738	0
Animals from herds under restriction	4	0
Passive surveillance		
Animals suspected of having clinical TSE	1	0
Total	7,743	0

a) According to the EU Regulation (EC) 999/2001 as amended and Danish Order no. 1288 of 20/12/2011.
b) Samples (brain stem material) are tested using a IDEXX technique or Prionics-Check PrioStrip. Confirmatory testing is carried out using Western blot (definitive diagnosis if positive case), else with histopathology or immunohistochemistry. Further confirmation on autolysed material is performed at the European Union TSE reference laboratory.
Source: National Veterinary Institute, and Danish Veterinary and Food Administration

Table A27. Distribution[a] (%) of prion protein genotype of sheep randomly selected, 2011

	Genotype	Sheep n=100
NSP 1	ARR/ARR	14.0
NSP 2	ARR/AHQ	5.0
	ARR/ARQ	31.0
	ARR/ARH/Q	2.0
NSP 3 (ARQ/ARQ)	ARQ/ARQ	44.0
NSP 3 (Other)	AHQ/AHQ	1.0
	AHQ/ARQ	0
	ARH/ARH	1.0
	ARH/ARQ	1.0
	ARQ/ARH	0
	ARQ/AHQ	0
NSP4	ARR/VRQ	1.0
NSP5	ARQ/VRQ	0
	AHQ/VRQ	0
Total		100

a) The genotypes were grouped in the NSP classification system according to their different susceptibility: NSP 1: Genetically most resistant, NSP 2: Genetically resistant, NSP 3: Genetically little resistance, NSP 4: Genetically susceptible, and NSP 5: Genetically highly susceptible.
Source: National Veterinary Institute

Table A28. Centrally coordinated studies conducted in 2011

Title of project	No. of samples	Pathogen surveyed	Futher information
DANMAP, antimicrobial resistance in Danish and imported broiler, beef and pork	1,000	*Salmonella* spp., *Campylobacter, E. coli, Enterococcus faesium, Enterococcus faecalis*	Results are presented in the DANMAP Report 2011
Listeria monocytogenes, *Salmonella* spp., *E. coli* and *Staphylococci* in fish goods from Greenland	100	*Salmonella* spp., *E. coli, Staphylococci, L. monocytogenes*	Results are being processed
Microbiological classification of mussel production areas in Denmark 2011	50	*Salmonella* spp., *E. coli*	Results are being processed
MRSA[c], ESC[d] and *Clostridium difficile* in pigs, broilers and cattle	1,250	*E. coli, Staphylococcus aureus, Clostridium difficile*	Continues in 2012
Campylobacter spp. in fresh, chilled Danish broiler meat	1,200	*Campylobacter* spp.	Appendix C, Table A12
Campylobacter spp. in fresh, chilled and frozen Danish and imported broiler meat	1,800	*Campylobacter* spp.	Appendix C, Table A13
Salmonella spp. and *Campylobacter* spp. in fresh imported duck and turkey meat	800	*Campylobacter* spp., *Salmonella* spp.	Appendix B, Tables A5-A7 (only data on ducks)
Intensified control for *Salmonella* spp. and *Campylobacter* spp. in fresh Danish and imported meat	1,245[a]	*Salmonella* spp., *Campylobacter* spp.	Appendix C, Table A19
Salmonella spp. in pork during cutting/ retail	900	*Salmonella* spp.	Results are being processed
Salmonella spp. in table eggs - trade	150	*Salmonella* spp.	Results are published on DVFA website www.fvst.dk
Salmonella spp. in dry snack nuts and fruits	300	*Salmonella* spp.	Results are being processed
Listeria monocytogenes -meat companies- environmental samples	400	*L. monocytogenes*	Continues in 2012
Listeria monocytogenes -consumer exposure	2,000	*L. monocytogenes*	Results are being processed
Microbiological quality in minced meat - retail	1,000	Total viable count, *Salmonella* spp., *E.coli*	Results are being processed
Microbiological quality of ice for chilling	100	Total viable counts, coliforms and *E. coli*	Results are being processed
EU-baseline, *Listeria monocytogenes*	160	*L. monocytogenes*	Results are being processed
Salmonella spp. and *E. coli* in raw, frozen scallop from Greenland	50	*Salmonella* spp., *E. coli*	Results are being processed
Pathogens in Danish and imported ready-to-eat vegetables	1,400	*Salmonella* spp., *E. coli, Campylobacter* spp.	Results are being processed
Slaughter hygiene -small slaughterhouses	500	Total viable counts, *Salmonella spp., Escherichia coli*	Results are published on DVFA website www.fvst.dk
Milk and dairy, pathogens and hygiene	800	*Salmonella* spp., *L. monocytogenes, S. aureus, Enterobacteriaceae/E. coli*	Results are being processed

Continued on the next page

Table A28. Centrally coordinated studies conducted in 2011 (Continued from previous page)

Title of project	No. of samples	Pathogen surveyed	Futher information
Pathogens in imported cheese	250	*Salmonella* spp., *L. monocytogenes, S. aureus*	Results are being processed
Pathogens in salad bars	750	*Salmonella* spp., *L. monocytogenes, E. coli*	Results are being processed
Pathogens in cut salat	100		Results are being processed
Salmonella -pork meat- retail	300	*Salmonella*	Results are being processed
Salmonella -pork meat- wholesale	350	*Salmonella*	Results are being processed
ESC and *E. coli* in poultry meat	3,000	*ESC, E. coli*	Continues in 2012
Listeria monocytogenes -meat products-retail	750	*L. monocytogenes*	Continues in 2012
Listeria monocytogenes -meat products-wholesale	400	*L. monocytogenes*	Continues in 2012
Salmonella in herbs (importcontrol)	50	*Salmonella*	Continues in 2012
MRSA[c], ESC[d] in pigs at slaughterhouse	1,600	*S. aureus, E. coli*	Continues in 2012
MRSA[c], ESC[d] in herds	960	*S. aureus, E. coli*	Results are being processed
Salmonella in swineherds -litter samples	100	*Salmonella*	Continues in 2012

a) Batches.
b) Verotoxin-producing *Escherichia coli*.
c) MRSA: Methicillin-resistant *Staphylococcus aureus.*
d) ESC: Expanded-Spectrum Cephalosporin-Resistant Strains.
Source: Danish Veterinary and Food Administration, and National Food Institute

Table A29. Listeria monocytogenes *in Danish produced ready-to-eat foods[a], 2011*

		Samples analysed by a qualitative method[b]				Samples analysed by a quantitative method			
		Batches[c]		Single samples		Batches[c]		Single samples	
Food category	Sampling place	N	Pos	N	Pos	N	Pos	N	Pos
Cheese, RTE	At processing	63	0	9	0	31	1[d]	1	0
	At retail	5	0	2	0	5	0	125	0
Milk and dairy products, RTE	At processing	73	0	10	0	29	0	2	0
	At retail	0	0	0	0	1	0	3	0
Products made from broiler meat, RTE	At processing	0	0	0	0	12	4[e]	0	0
	At retail	2	0	0	0	0	0	109	0
Products made from other poultry meat, RTE	At processing	1	0	0	0	0	0	0	0
	At retail	0	0	0	0	3	0	5	0
Products made from pork, RTE	At processing	44	3	24	0	88	2[f]	19	1[df]
	At retail	11	1	11	4	66	1[f]	1,021	5[g]
Products made from beef, RTE	At processing	8	0	0	0	10	0	1	0
	At retail	2	0	0	0	25	0	124	2[f]
Fruit, RTE	At processing	2	1	0	0	6	0	5	0
	At retail	0	0	2	0	0	0	2	0
Vegetables, RTE	At processing	5	0	12	0	31	0	51	0
	At retail	3	0	2	0	4	0	333	0
Fish and Fishery products, RTE	At processing	30	6	10	1	40	2[d]	10	0
	At retail	4	0	0	0	0	0	397	15[h]
Shellfish and products there off, RTE	At processing	14	0	0	0	68	0	4	0
	At retail	0	0	0	0	0	0	8	0
Other RTE products	At processing	5	0	3	0	19	0	4	0
	At retail	7	1	1	0	7	1[d]	234	1[f]

a) Samples are collected by the Regional Veterinary and Food Competent Authorities according to EU Regulation (EC) No 2073/2005.
b) *Listeria monocytogenes* present in a 25 g sample of the product.
c) 5 samples from each batch, analysed individually.
d) >100 cfu/g detected in the samples. cfu: Coloni forming units.
e) 10-100 cfu/g detected in one sample, >100 cfu/g detected in three samples.
f) 10-100 cfu/g detected in the samples.
g) 10-100 cfu/g detected in four samples, >100 cfu/g detected in one sample.
h) 10-100 cfu/g detected in six samples, >100 cfu/g detected in nine samples
Source: Danish Veterinary and Food Administration

Appendix D

Monitoring and surveillance programmes

Table A30. Overview of notifiable and non-notifiable human diseases presented in this report, 2011

Patogen	Notifiable	Notification route
Bacteria		
Brucella spp.	no	-
Campylobacter spp.	1979[a]	Laboratory[b]
Chlamydophila psittaci (Ornithosis)	1980[a]	Physician[c]
Listeria monocytogenes	1993[a]	Physician
Leptospira spp.	1980[a]	Physician
Mycobacterium bovis/ tuberculosis	1905[a]	Physician (and laboratory[d])
Coxiella burnetii	no	-
Salmonella spp.	1979[a]	Laboratory
VTEC	2000[a]	Physician and laboratory
Yersinia enterocolitica	1979[a]	Laboratory
Parasites		
Cryptosporidium spp.	no	-
Echinococcus multilocularis	no	-
Echinococcus granulosus	no	-
Toxoplasma gondii	no	-
Trichinella spp.	no	-
Viruses		
Lyssavirus (Rabies)	1964[a]	Physician (via telephone)
Prions		
BSE/Creutzfeld Jacob	1997[a]	Physician

a) Danish order no. 277 of 14/04/2000. Cases must be notified to Statens Serum Institut.
b) The regional microbiological laboratories report confirmed cases.
c) The physician report individually notifiable infections.
d) The laboratories voluntarily report confirmed cases.
Source: Statens Serum Institut

Table A31. Overview of notifiable and non-notifiable animal diseases presented in this report, 2011

Patogen	Notifiable	EU legislation	Danish legislation
Bacteria			
Brucella spp.	1920[a]		
Cattle	OBF in 1979[b]	Decision 2003/467/EC	Order no 305 of 3/5 2000
Sheep and goats	ObmF in 1995[c]	Decision 2003/467/EC	Order no. 739 of 21/8 2001
Pigs	Last case in 1999	Directive 2003/99/EC	Order no. 205 of 28/3 2009
Campylobacter spp.	no	-	-
Chlamydophila psittaci	1920	-	
Birds and poultry			Order no. 871 of 25/8 2011
Listeria monocytogenes	no	-	-
Leptospira spp. (only in production animals)	2003	-	Act no. 432 of 09/06/2004
Mycobacterium bovis/tuberculosis	1920[a]		
Cattle	OTF in 1980[d]	Decision 2003/467/EC	Order no. 1417 of 11/12 2007
Coxiella burnetii	2005	-	Act no. 432 of 09/06/2004
Salmonella spp.	1993[e]	-	
Cattle			Order no. 1723 of 22/12/2010
Swine			Order no. 1722 of 22/12/2010
Poultry			Order no. 1462 of 16/10/2009
VTEC			
Yersinia enterocolitica	no	-	-
Parasites			
Cryptosporidium spp.	no	-	-
Echinococcus multilocularis	2004	Council Directive 64/433/EC	Act no. 432 of 09/06/2004
Echinococcus granulosus	1993	Council Directive 64/433/EC	Act no. 432 of 09/06/2004
Toxoplasma gondii	no	-	-
Trichinella spp.	1920[a]	Regulation 2075/2005/EC	Order no. 412 of 28/05/2008
Viruses			
Lyssavirus	1920	-	Order no. 330 of 14/04/2011
Prions			
TSE			
Sheep and goats	yes	Regulation 999/2001/EC (as amended)	Order no. 1288 of 20/12/2011
BSE			
Cattle	yes	Regulation 999/2001/EC (as amended)	Order no. 499 of 26/05/2011 (as amended)

a) Clinical cases, observations during the meat inspection at the slaughterhouse, positive blood samples or finding of agens are notifiable.
b) Officially Brucellosis Free (OBF) according to Council Directive 64/432/EC as amended and Commision Decision 2003/467/EC. No cases in cattle since 1962.
c) Officially *B. melitensis* Free (ObmF) according to Council Directive 91/68/EC and Commision Decision 2003/467/EC. Never detected in sheep or goat.
d) Officially Tuberculosis Free (OTF) according to Council Directive 64/432/EC as amended and Regulation (EC) No 1226/2002, and Commission Decision 2003/467/EC. No cases in cattle since 1988 or in deer since 1994.
e) Only clinical cases notifiable.
Source: Danish Veterinary and Food Administration

Table A32. Salmonella *surveillance programme for the rearing flocks and adult flocks of the grandparent and parent generation of the broiler and table egg production, 2011*

Time	Samples taken	Material	Material
Rearing flocks		*Grandparent generation*	*Parent generation*
Day-old[a,b]	Per delivery	5 transport crates from one delivery: crate liners (>1m² in total) or swab samples (>1m² in total). Analysed as one pool.	5 transport crates from one delivery: crate liners (>1m² in total) or swab samples (>1m² in total). Analysed as one pool.
1st & 2nd week[b, c]	Per unit	-	2 pairs of boot swabs (analysed as one pooled sample) or 1 faeces sample of 60g.
4th week[a,c]	Per unit	5 pairs of boot swaps (analysed as two pooled samples), or 1 faeces sample consisting of 2x150g.	2 pairs of boot swabs (analysed as one pooled sample) or 1 faeces sample of 60g.
8th week[b,c]	Per unit	2 pairs of boot swabs (analysed as one pooled sample). Cage birds: 60x1g samples of fresh droppings. Analysed as one pool.	2 pairs of boot swabs (analysed as one pooled sample). Cage birds: 60x1g samples of fresh droppings. Analysed as one pool.
2 weeks prior to moving[a,d]	Per unit	5 pairs of boot swabs (analysed as two pooled samples), or 1 faeces sample consisting of 2x150g.	2 pairs of boot swabs (analysed as one pooled sample) or 1 faeces sample of 60g.
Adult flocks		*Grandparent generation*	*Parent generation*
Every two weeks[a,b] (Every 16th week)[e]	Per flock	Hatcher basket liners from 5 baskets (>1m² in total) or 10g of broken egg-shells from each of 25 hatcher baskets (reduced to 25g sub-sample). Analy-sed as one pool.	Hatcher basket liners from 5 baskets (>1m² in total) or 10g of broken eggs-hells from each of 25 hatcher baskets (reduced to 25g sub-sample). Analysed as one pool.
After each hatch[b]	Per hatch	Wet dust samples. Up to four hatchers of the same flock can be pooled.	Wet dust samples. Up to four hatchers of the same flock can be pooled.
Every week[b]	Per unit	-	2 pairs of boot swabs (analysed as one pooled sample) or 1 faeces sample of 60g.
0-4 weeks after moving, 8-0 weeks before slaughter[b,d]	Per unit	5 pairs of boot swabs (analysed as two pooled samples), or 1 faeces sample consisting of 2x150g.	5 pairs of boot swabs (analysed as two pooled samples), or 1 faeces sample consisting of 2x150g.
After positive findings[b,d]	Per unit	5 pairs of boot swabs (analysed as two pooled samples), 2 dust samples (250 ml) and 5 birds (analysed for antimi-crobial substances.	5 pairs of boot swabs (analysed as two pooled samples), 2 dust samples (250 ml) and 5 birds (analysed for antimi-crobial substances).

a) Sampling requirements set out by Regulation (EC) No 2160/2003.
b) Samples collected by the food business operator.
c) Order no 1463 of 16/12/2009.
d) Samples collected by the Regional Veterinary and Food Competent Authorities.
e) When eggs from a flock exceed the capacity of one incubator, each incubator should be sampled as described.
Source: Danish Veterinary and Food Administration

Table A33. Salmonella and Campylobacter surveillance programme for the broiler flocks, 2011

Time	Samples taken	Material
Salmonella		
15 - 21 days before slaughter[a,c,d]	Per flock	5 pairs of boot swabs. Analysed individually.
7 - 10 days before slaughter[b,e]	Per flock	5 pairs of boot swabs. Analysed individually.
After slaughter[b,c]	Per batch	300x1g neck skin , analysed in pools of max. 60 grams. Sampling size depends on whether the slaughterhouse slaughters only AM-negative flocks or AM-negative as well as AM-positive flocks.
Campylobacter		
7 - 10 days before slaughter[b,e]	Per flock	1 pair of boot swabs.

a) Regulation (EC) No 2160/2003.
b) Order no 1462 of 16/12/2009.
c) Samples collected by the food business operator.
d) Once a year, one pair of socks is collected by the Regional Veterinary and Food Competent Authorities.
e) Samples are collected by a representative of the slaughterhouse, laboratorium or the Regional Veterinary and Food Competent Authorities.
Source: Danish Veterinary and Food Administration

Table A34. Salmonella *surveillance programme for the pullet-rearing, table egg layer and barnyard/hobby flocks in the table egg production, 2011*

Time	Samples taken	Material
Pullet- rearing		
Day-old[a,d]	Per delivery	5 transport crates from one delivery: Crate liner (> 1 m^2 in total) or swab samples (> 1 m^2 in total) (Analysed as one pooled sample).
4 weeks old[b,d]	Per flock	5 pairs of boot swabs (analysed as two pooled samples) or 5 faeces samples of 60 gram.
2 weeks before moving[a,c]	Per flock	5 pairs of boot swabs (analysed as two pooled samples) or 5x60 g faeces samples. 60 blood samples (serology).
Table egg layers (Production for certified packing stations)		
24 weeks old[a,c]	Per flock	2 pairs of boot swabs (analysed as one pooled sample) or 1 faeces sample consisting of 2x150 g. 250 ml (100 g) dust or 1 pair of boot swabs. 60 eggs[b] (serology).
Every 9 weeks[a,d,e]	Per flock	2 pairs of boot swabs (analysed as one pooled sample) or 1 faeces sample consisting of 2x150 g. 60 eggs[b] (serology).
After positive serological findings[c]	Per flock	5 pairs of boot swabs (analysed as two pooled samples) or 5x60 g faeces samples, and 60 hens.
After positive findings of other serotypes than *S.* Enteritidis, *S.* Hadar, *S.* Infantis, *S.* Virchow or *S.*Typhimurium including the monophasic strains *S.* 1,4,[5],12:i:-[c]	Per flock	5 pairs of boot swabs (analysed as two pooled samples) or 5 faeces samples consisting of 60 gram each.
Barnyard and hobby flocks		
Every 18 weeks[b,d]	Per flock	Egg samples.

a) Sampling requirements set out by Regulation (EC) 2160/2003.
b) Order no 1260 of 15/12/2008.
c) Samples collected by the Regional Veterinary and Food Competent Authorities.
d) Samples collected by the food business operator.
e) According to Regulation (EC) 2160/2003 sample collection must be carried out every 15 weeks as a minimum.
Source: Danish Veterinaty and Food Administration

Table A35. Salmonella surveillance programmes[a] for the duck and turkey flocks, 2011

Time	Samples taken	Material
Duck production		
Max. 21 days before slaughter[b]	Per flock	2 pairs of boot swabs. Analysed individually.
Turkey production		
Max. 21 days before slaughter[b]	Per flock	2 pairs of boot swabs. Analysed individually.

a) Order no 1260 of 15/12/2008.
b) Samples collected by the food business operator.
Source: Danish Veterinary and Food Administration

Table A36. Salmonella surveillance programme[a] for the cattle production, 2011

No. of samples	Samples taken	Comment
Milk producing herds		
4 samples distributed over 18 months	Bulk tank samples	Calculation of herd level[b]
10 samples	Blood samples	If the owner wants a herd moved from level 2 to 1b
Non-milk producing herds		
1 sample every 180 days at slaughter[c]	Blood samples	Calculation of herd level[b]
4-8 samples	Blood samples	Consecutive negative samples required for level 1b[d]
Beef carcasses at the slaughterhouse		
5 samples daily, pooled into one analysis	Swab samples from 4 designated areas after 12 hours chilling ($4x100cm^2$)	Slaughterhouses slaughtering more than 200 cattle per day
5 samples per 200 slaughtered cattle, pooled into one analysis	Swab samples from 4 designated areas after 12 hours chilling ($4x100cm^2$)	Slaughterhouses slaughtering more than 200 cattle per month but 200 or less cattle per day
5 samples every 3rd month, pooled into one analysis	Swab samples from 4 designated areas after 12 hours chilling ($4x100cm^2$)	Slaughterhouses slaughtering 50-200 cattle per month
1 sample every 3rd month	Swab samples from 4 designated areas after 12 hours chilling ($4x100cm^2$)	Slaughterhouses slaughtering less than 50 cattle per month

a) Order no. 143 of 22/2/2012 as ammended. In 2010, the programme for eradication of *Salmonella* Dublin from the Danish cattle production was intensified. This implies a new category of level 2 (level 2R) where the most contagious herds in this level are placed under official restrictions by the veterinary authorities.
b) Herd levels based on serological testing (blood and milk):
Level 1a: Milk producing-herd assumed free of infection (based on bulk tank samples),
Level 1b: Non-milk producing-herd or milk producing-herd assumed free of infection (based on blood samples),
Level 2: Herd not assumed free of infection,
Level 3: Herd infected,
Unknown level: insufficient number of blood samples have been taken from herd and no samples had antibody levels above the limit value.
c) No samples are taken, if the herd has been tested for *S.* Dublin within the last 180 days or 8 samples have been tested within the last 24 months.
d) Number of samples equals total number of animals in the herd minus 2 (max. 8 animals, min. 4 animals).
Source: Danish Agriculture and Food Council, and Danish Veterinary and Food Administration

Table A37. Salmonella surveillance programme[a] for the pig production, 2011

Time	Samples taken	Purpose
Breeding and multiplier herds		
Every month	10 blood samples per epidemiological unit	Calculation of *Salmonella*-index based on the mean from the last three months with most weight to the result from the more recent months (1:3:6)
Max. twice per year	Herds with *Salmonella*-index 5 or above: Pen-faecal samples[b, d]	Clarify distribution[c] and type of infection in the herd
Sow herds		
When purchaser of piglets is assigned to level 2 or 3, max. twice per year	Pen-faecal samples	Clarify distribution[c] and type of infection in the herd, and clarify possible transmission from sow herds to slaughter pig herds
Herds positive with *S.* Typhimurium, *S.* Infantis and *S.* Derby are considered positive for the following 5 years[f]	No samples are collected at the farm during the 5 year period when the herd is considered positive, unless the herd are proven negative	Reduce repeated sampling in positive herds infected with a persistent serotype
Slaughter pigs, herds		
At slaughter	Meat juice, 60-100 samples per herd per year. Herds in RBOV[d, e]: one meat juice sample per month	Calculation of slaughter pig index based on the mean from the last three months with most weight to the result from the most recent month (1:1:3). Assigning herds to level 1-3 and assigning herds to risk-based surveillance (RBOV)[e]
Slaughter pigs, animals		
At slaughter	Coecum samples, 80 samples per month, 11 month per year	Random collection of samples for monitoring of the distribution of serotypes and antimocrobial resistance .
Pork carcasses at the slaughterhouse		
5 samples daily, pooled into one analysis	Swab samples from 4 designated areas after 12 hours chilling ($4x100cm^2$)	Slaughterhouses slaughtering more than 200 pigs per day
5 samples per 200 slaughtered pig, pooled into one analysis	Swab samples from 4 designated areas after 12 hours chilling ($4x100cm^2$)	Slaughterhouses slaughtering more than 200 pigs per month or 200 or less pigs per day
5 samples every 3rd month, pooled into one analysis	Swab samples from 4 designated areas after 12 hours chilling ($4x100cm^2$)	Slaughterhouses slaughtering more than 50 pigs per month or less than 200 pigs per month
1 sample every 3rd month	Swab samples from 4 designated areas after 12 hours chilling ($4x100cm^2$)	Slaughterhouses slaughtering less than 50 pigs per month

a) Order no. 1722 of 22/12/2010.
b) Herds with index above 10 have to pay a penalty for each pig sold.
c) Pigs from herds in Level 3 must be slaughtered under special hygienic precautions.
d) The herd owner must inform buyers of breeding animals about the infection level and type of *Salmonella*.
e) RBOV: risk-based surveillance where the sample size in herds with a SP-index of zero (no positive samples in the previous three months) are reduced to one sample per month.
f) These serotypes are primarily spread by live trade, and are known to persist in herds.
Source: Danish Veterinary and Food Administration

Table A38. Typing methods used in the surveillance of foodborne pathogens in Denmark, 2011

Methods	Human	Food	Animal
Salmonella enterica			
Serotype	All	All	All
Phage type[a]	*S.* Typhimurium and *S.* Enteritidis	Few *S.* Typhimurium and *S.* Enteritidis	Few *S.* Typhimurium and *S.* Enteritidis
Antimicrobial resistance	All	Almost all isolates	Almost all isolates
MLVA	*S.* Typhimurium and *S.* Enteritidis	*S.* Typhimurium (outbreak investigations), research	*S.* Typhimurium (outbreak investigations), research
PFGE	Outbreak investigations	Outbreak investigations	Outbreak investigations
Campylobacter coli/jejuni			
Antimicrobial resistance	Isolates from 3 districts for DANMAP surveillance	Only for DANMAP surveillance purposes	Only for DANMAP surveillance purposes
FlaA-SVR	Outbreak investigations	Outbreak investigations	None
MLST	Outbreaks investigaions, research	None	None
VTEC			
Serotype	All	All	All
Virulence profile	All	All	All
PFGE	All	None	None
Listeria			
Serogroup	All	None	None
MLVA	All	All	None
PFGE	All	All	All
Yersinia enterocolitica			
O-group	Isolates from one district	None	None

a) For the *Salmonella* source account and outbreak investigations.
Source: Statens Serum Institut, and Danish Zoonosis Laboratory, National Food Institute

Appendix E

Population and slaughter data

Table A39. Human population, 2011

Age groups (years)	Males	Females	Total
0-4	163,640	155,563	319,203
5-14	341,497	325,758	667,255
15-24	361,086	345,514	706,600
25-44	716,136	708,274	1,424,410
45-64	749,214	745,750	1,494,964
65+	435,203	532,881	968,084
Total	2,766,776	2,813,740	5,580,516

Source: Statistics Denmark

Table A40. Number of herds/flocks, livestock and animals slaughtered, 2011

	Herds/flocks[a]	Livestock[a] (capacity)	Number slaughtered
Slaughter pigs (>27 kg)	7,577	6,670,634	20,290,046
Cattle	20,700	1,624,000	517,503
Broilers	291	19,222,000	106,074,000
Layers (excl. barnyard)	426	4,766,243	-
Turkeys	44	512,941	1,392
Sheep & lambs	7,800	160,000	80,649
Goats	3,500	23,900	2,169
Horses	-	-	2,169

a) March 2012.
Source: The Central Husbandry Register, Statistics Denmark, and Danish Veterinary and Food Administration

Table A41. Number of farms in the broiler production, 2011

	No. of holdings	No. of houses/flocks	Livestock (capacity)
Rearing period (grandparent)	4	14	90,000
Adult period (grandparent)	4	7	80,000
Rearing period (parent)	15	90	130,000
Adult period (parent)	44	146	720,000
Hatcheries	5	-	-
Broilers	242	592	-

Source: Danish Veterinary and Food Administration and Danish Agriculture and Food Council

Table A42. Number of farms in the table egg production, 2011

	No. of holdings	No. of houses/flocks	Livestock (capacity)
Rearing period (parent)	5	6	20,000
Adult period (parent)	9	10	50,000
Hatcheries	5	-	-
Pullet-rearing	80	136	1,440,000
Layers (excl. Barnyard)	170	229	2,910,000

Source: Danish Veterinary and Food Administration, and Danish Agriculture and Food Council

Table A43. Distribution of import, export and production of fresh and frozen meat and the production of table eggs in Denmark, 2007-2011[a]. Data is presented in tons

	Year	Pork	Beef	Broiler meat[a]	Turkey meat	Duck meat[c]	Table eggs[c]
Import	2007	40,201	80,287	30,390	8,423	3,845	-
	2008	83,057	81,427	32,480	8,264	4,494	-
	2009	83,265	88,818	30,321	7,000	4,251	-
	2010	89,565	100,528	43,746	8,728	4,863	-
	2011	96,063	98,430	45,339	7,368	6,132	-
Export	2007	1,263,169	61,374	105,741	1,692	454	-
	2008	1,386,849	66,690	109,725	2,345	772	-
	2009	1,321,820	78,572	108,377	1,564	534	-
	2010	1,399,397	88,169	115,674	2,921	810	-
	2011	1,493,316	87,355	82,308	3,074	1,133	-
Danish production	2007	1,447,894	134,374	168,354	34	2,956	66,800
	2008	1,602,648	149,744	157,543	49	37	67,900
	2009	1,508,640	163,068	159,723	93	-	60,600
	2010	1,584,503	184,979	171,210	78	-	63,200
	2011	1,669,186	187,757	165,168	48	-	66,000
Consumption[e]	2007	224,925	153,287	93,003	6,765	6,347	-
	2008	298,857	164,481	80,298	5,968	3,722	-
	2009	270,084	173,314	81,667	5,529	3,717	-
	2010	274,671	197,338	99,283	8,728	4,053	-
	2011	271,932	198,832	128,199	7,368	5,002	6,600

a) Data from 2011 are extracted on March 23[rd] 2012. Data from 2011 are preliminary and will be updated in the 2012 report.
b) Natural-marinated chicken is included.
c) Mixed products of ducks, geese and guinea fowl are not included.
d) Consumption of table eggs is assumed to be roughly the same as the production, since import and export of table eggs is minimal.
e) Consumption = Production + import - export.
Source: Statistics Denmark

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