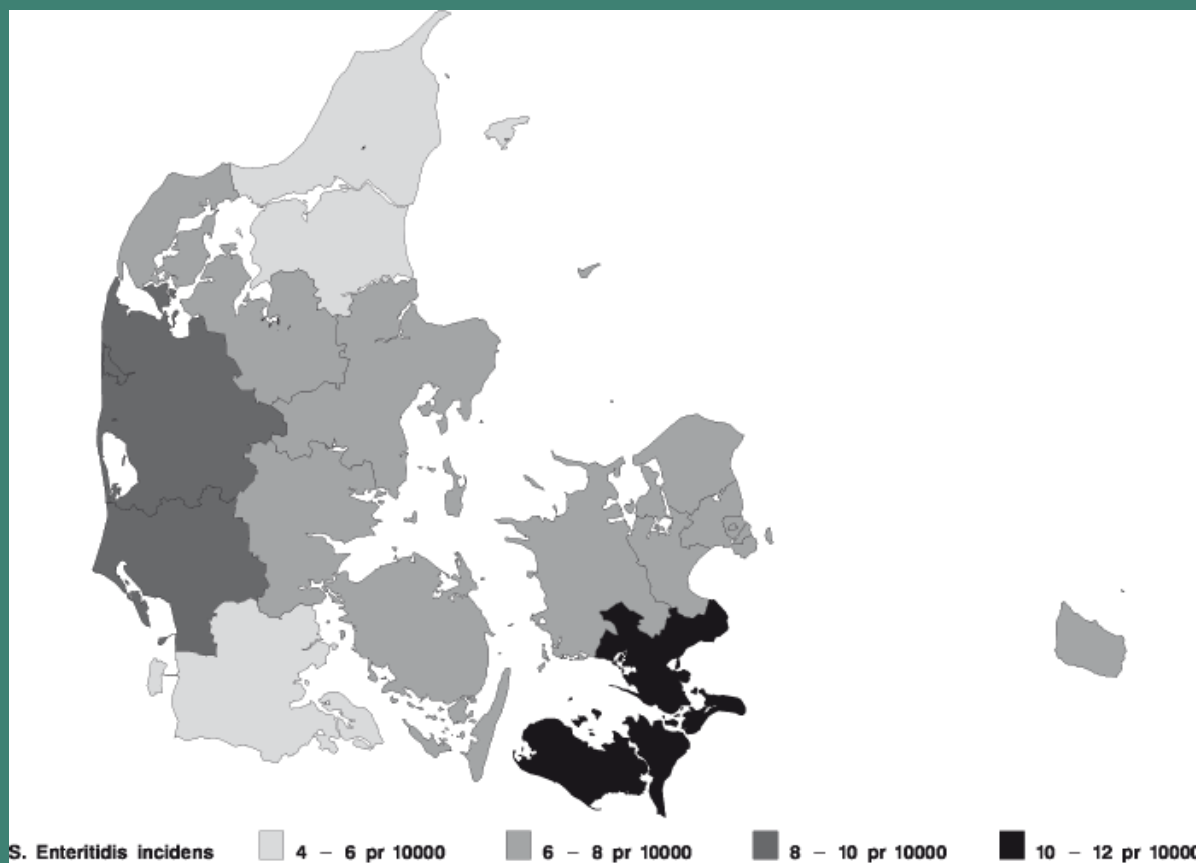




Annual Report on Zoonoses in Denmark 1997



**Annual Report on
Zoonoses in Denmark 1997**

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Introduction

In August 1997, the fourth revision of the Danish plan for implementation of the Zoonosis Directive (hereafter called "the Danish plan") was submitted to the EU Commission. The plan describes the details of the different national programmes for control of zoonoses in Denmark. Thus information about the origin of the data presented in this report can be found in the Danish plan.

Demographic data

<i>Total number of livestock and herds in Denmark, 1996:</i>			<i>Approximate total number of animals slaughtered in 1997:</i>	
	Livestock	Herds	Cattle:	707,000
Cattle	2,093,256	29,417	Pigs:	20.1 million
Pigs	10,841,533	19,821	Broilers:	115 million
Laying hens	4,725,000	9,024		
Broilers	12,907,000	671		
Sheep	170,143	4,975		

Human Population:
 5.3 million
 0.8 million in rural areas
 4.5 million in urban areas

Area of Denmark:
 44,000 sq km

Source: The Statistical Yearbook 1997, Danmarks Statistik.

Source: Danish Veterinary and Food Administration, 7th. Department.

It should be noted that:

- 85% of the production of slaughter pigs takes place in 8,000 holdings
- the majority of the egg production takes place in 429 holdings
- nearly all of the broiler production takes place in 340 holdings

1. Salmonella

Feeding stuffs

All Danish feed compounders are routinely monitored for Salmonella by the Danish Plant Directorate. Monitoring includes routine collection of samples from compound feeds and straight feeding stuffs during feed processing and from raw materials, including raw materials of animal origin. Table 1 shows the overall results of the monitoring in 1997.

Feed processing

Process control is carried out at each plant by inspectors at least four times a year. Samples are collected for microbiological examination at the critical control points

of the production process.

From compounders with heat treatment (more than 81°C) of the feeding stuff, the samples are collected after the heat treatment. When there is no heat treatment, the samples are being collected during the entire process as well as from raw materials.

The plants are inspected in order to determine whether they comply with the national set of rules for good production hygiene and the requirements to record pelleting temperatures every second hour.

Additional inspections of the plants are implemented when Salmonella is detected in the samples or critical

hygiene conditions are reported.

The number of Salmonella positive samples from the process control in 1997 is listed in Table 1. Compared to the previous years, the level of Salmonella contamination declined further (Figure 1).

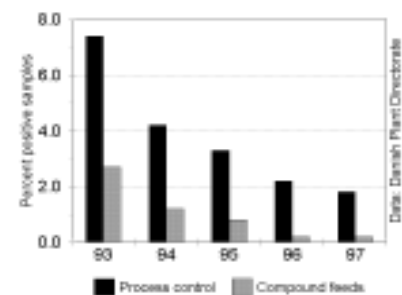


Figure 1. Percent Salmonella positive samples of process control and compound feeds, 1993-1997.

Feeding stuffs

The Danish Plant Directorate collects samples of feeding stuffs from the production plants and re-tailers. The number of samples depends on the size of the production, but is increased if Salmonella is detected.

Level of repeated incidents

In 1997, Salmonella was found in two or more samples in 8% of the plants.

Inspection of compound feeding stuffs

The number of Salmonella in compound feeding stuffs in 1997 is also listed in Table 1. Compared to the previous years the good hygienic quality of feeding stuffs has stabilized at a very low level (Figure 1).

Inspection of straight feeding stuffs and raw materials

During the inspection of straight feeding stuffs and raw materials in 1997, Sal-

monella was found in 12 out of 471 samples corresponding to 2.5% of the samples (Table 1). Salmonella has mainly been found in rape and soybean products.

Serotypes

The serotypes found in feeding stuffs and in the processing lines are listed in Table 1. S. Derby seems to be an emerging problem. It is found mostly in rape seed products.

Summary

The results indicate that the good hygienic quality of feeding stuffs has stabilized. Salmonella was found only in a small percentage of the feeding-stuff samples.

However, the results of the inspection of the feed processing show that the production hygiene at specific compounders can still be improved and the risk of transmission of Salmonella to livestock and humans can be further reduced.

Rendering plants

Control of hygiene at rendering plants is carried out by the animal health section of the Danish Veterinary and Food Administration. The products are routinely examined for Salmonella. In 1997, 2 (2%) samples out of 91 pooled samples of the final products from rendering plants were found to be contaminated with Salmonella. The serotypes found were S. Livingstone and S. Kentucky.

Poultry and poultry products

Implementation of new control programme

In December 1996, The Ministry of Agriculture and Fisheries implemented an intensified plan for the control of Salmonella in Danish poultry.

In contrast to the control of Salmonella in broiler production, Salmonella control in table-egg production had hitherto been based exclusively on a voluntary

Table 1. Control of Salmonella in compound feeds and feed processing in 1997.

	Control of compound feeds			Process control	Control of raw materials and straight feeding stuffs	
	Pig feed	Cattle feed etc. 1)	Poultry feed			
Total number of samples	1,249	825	307	3,225	471	
Salmonella detected	1	4	0	57	12	
Percent positive	0.1%	0.5%	-	1.8%	2.5%	
Serotypes	S. 4.12:b:-	1	S. Agona S. Derby S. Havana	1 2 1	S. 13.23:-aphasic S. 4.12:b:- S. Cubana S. Derby S. Havana S. Newport S. Ohio NT	1 4 2 1 1 1 1 1
		1) Includes feed for cattle, horses and rabbits.		S. 13.23:z29:z27 S. 4.12:b:- S. 4.12:b:subtype I I S. Agona S. Anatum S. Braenderup S. Cubana S. Derby S. Enteritidis S. Hadar S. Havana S. Infantis S. Kintambo S. Mbandaka S. Meleagridis S. Montevideo S. Newport S. Ohio S. Schwarzengrund S. Senftenberg S. Tennessee	1 11 1 7 1 1 2 12 1 1 1 1 1 2 1 1 1 1 1 1 2	1 4 2 1 1 1 1 1

Data: Danish Plant Directorate.

Table 2. Number of establishments in the broiler production and the table-egg production in 1997.

	No. of establishments	No. of houses	No. of animals
Broiler production			
Central rearing	24	108	1,150,000
Broiler breeders	68	205	1,035,000
Broilers	340	-	115,000,000
Table-egg production			
Central rearing	7	8	80,000
Layer breeders	9	19	72,000
Rearing	129	192	4,000,000
Layers	429	604	3,600,000

Data: Danish Veterinary and Food Administration.

control programme established by the industry. However, more stringent measures were needed as the presence of Salmonella in table eggs was perceived to be the foremost source of human salmonellosis in Denmark.

The new plan includes surveillance of hatching-egg production using new testing techniques in order to achieve greater reliability that all Salmonella infected flocks would be identified and consequently destroyed, and to ensure that no Salmonella infected day-old chickens would be introduced amongst the broiler or table-egg-producing flocks.

All Salmonella infected parent flocks, regardless of serotype, as well as table-egg-layer flocks infected with *S. Enteritidis* or *S. Typhimurium*

were to be destroyed or slaughtered. The plan offered full compensation for consequential losses, except for a fixed deduction and expenses connected with the cleaning and disinfection of buildings.

The initial aim of the plan, was to bring the level of infection in broilers and laying flocks below 5%.

Detection of any Salmonella serotype in parent flocks, *S. Enteritidis* or *S. Typhimurium* in table-egg-layer flocks or positive serological reactions for these in samples from the programme shown in Table 3, placed the flock in question "under suspicion". Consequently the district veterinarian sampled 60 chickens (killed) and 300 samples of droppings (only in breeders) and these were

tested by the Danish Veterinary Laboratory. If the flock was confirmed as being Salmonella infected, it was slaughtered or destroyed, and the houses cleaned and disinfected. No new flocks were permitted in the house until the district veterinarian had inspected and taken swab samples free of Salmonella from the house.

During the first 6 months, 4 flocks of layer breeders were found Salmonella positive. Salmonella infections had not been discovered in this level of the production pyramid during earlier screenings (1994-1996). The basis for the plan hereby changed, and the plan was adjusted in September 1997, whereafter bacteriological examination of rearing and table-egg-producing flocks and destruc-

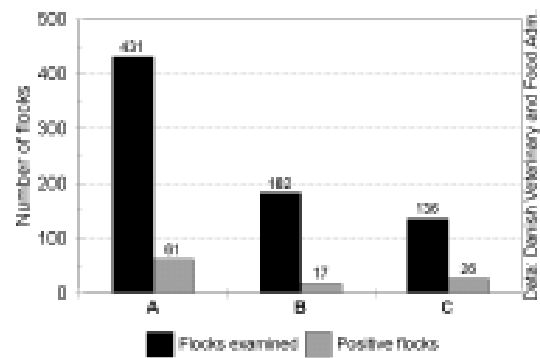


Figure 2. Serological surveillance of A: Table-eggs packed at authorised packing business; B: Table-eggs sold at barn-yard sale; C: Rearing flocks for table-egg production in 1997.

Table 4. Occurrence of Salmonella in the parent stock and rearing flocks to the table-egg production in 1997.

Zoonotic pathogen	Central rearing			Layer breeders			Rearing a)		
	Examined flocks	Positive flocks (%)	% positive birds out of annual stock	Examined flocks	Positive flocks (%)	% positive birds out of annual stock	Examined flocks	Positive flocks (%)	% positive birds out of annual stock
<i>Salmonella spp.</i>	15	2(13)	40	33	5(15)	63	96	26(27)	7.6
<i>S. Enteritidis</i>	-	2(13)	-	-	5(15)	-	-	25(26)	-
<i>S. Typhimurium</i>	-	0	-	-	0	-	-	1(1)	-
<i>Other serotypes</i>	-	0	-	-	0	-	-	0	-

Data: Danish Veterinary Laboratory and Danish Veterinary and Food Administration.
a) Rearing flocks examined only bacteriologically until September 1997.

Table 3. *Salmonella* surveillance of the broiler and table-egg sector. Samples taken before, during implementation of the plan and after September 1997.

Age or Frequency	Samples taken from 1994-96 (1 sample taken by the district veterinarian)	Samples taken according to the new control programme established Dec. 1996.
CENTRAL REARING STATIONS Broiler and table-egg sector		
Day-old	Cratematerial, dead/destroyed chickens	Cratematerial, dead/destroyed chickens
1 week	-	Chickens
2 weeks	-	Chickens
4 weeks	Samples of droppings	Chickens and samples of droppings
8 weeks	-	Samples of droppings
2 weeks prior to moving	Samples of droppings	Samples of droppings and blood (samples taken by the district veterinarian)
BREEDERS (HATCHING-EGG PRODUCTION) Broiler and table-egg sector		
Every 2 weeks (Samples taken by the district veterinarian every 8 weeks)	Chickens or meconium taken from the hatchery	Chickens or meconium taken from the hatchery
Every 4 weeks (Samples taken by the district veterinarian every 3 month)	-	Samples of dropping and blood/eggs taken from the flock
HATCHERY		
Every week	-	Wet dust
REARING - TABLE-EGG PRODUCTION		
Day-old	-	Cratematerial, dead/destroyed chickens ^{a)}
Every 3 weeks	-	Samples of droppings ^{a)}
Every 12 weeks	-	Samples of droppings ^{a) b)} (samples taken by the district veterinarian)
TABLE-EGG PRODUCTION		
On delivery to an authorized egg packing business	-	Samples of droppings ^{a)} and eggs 3 times pr. year
Eggs sold barn-yard sale	-	Samples of dropping ^{a)} and eggs 2 times pr. year

a) These control points were suspended in September 1997.

b) After September 1997, bloodsamples were taken to evaluate the *Salmonella* status of the flock.

tion of infected flocks was discontinued. However, infected breeder flocks were still destroyed, because of the importance of having animals free of *Salmonella* at the top of the production system. The destruction of layers clinically ill with salmonellosis also continued.

Table-egg production

In 1997, *Salmonella* was isolated from 2 central-rearing flocks, 5 layer-breeder flocks and 26 rearing flocks (Table 4).

Prior to September 1997, 48 table-egg-producing flocks were declared "under suspicion" and 40 were confirmed as being salmonella infected. Of these, 38 were infected with *S. Enteritidis* and 2 with *S. Typhimurium*. Figure 2 shows the number of sero-positive rearing and layer flocks found in 1997. In flocks producing table-eggs for authorised packing businesses 61(14%) of 431 examined flocks were sero-positive, whereas the proportion of sero-positive flocks producing table-eggs for barn-yard sale was 9% (N=182). Among rearing flocks, 26 (19%) of 136

Table 5. Occurrence of *Salmonella* and *Campylobacter* in the broiler production in Denmark in 1997.

Zoonotic pathogen	Flock level				Slaughterhouse		Retail - broilers and products of broiler meat				Note:	
	Broiler breeders		Broiler flocks		Neck skin		Not heat treated		Heat treated			
	Flocks examined	% positive flocks	% positive birds out of annual stock	Flocks examined	% positive flocks	N	% positive flocks	N	% positive samples	N		% positive samples
<i>Salmonella</i> spp.	408	2.0	10.6	4,139	12.9	4,378	17.1	404	5.7	624	0	a
<i>S. Enteritidis</i>	-	0.7	-	-	2.8	-	-	-	0.2	-	-	-
<i>S. Typhimurium</i>	-	1.0	-	-	4.2	-	-	-	0.7	-	-	-
Other serotypes	-	0.3	-	-	5.9	-	-	-	4.7	-	-	-
<i>Campylobacter</i> spp.	-	-	-	1,037	37.0	-	-	676	33.0	-	-	b
<i>C. jejuni</i>	-	-	-	-	28.0	-	-	-	-	-	-	-
<i>C. coli</i>	-	-	-	-	5.0	-	-	-	-	-	-	-
<i>C. lari</i>	-	-	-	-	0	-	-	-	-	-	-	-

Data: Danish Veterinary Laboratory and Danish Veterinary and Food Administration

a) Parent flocks examined by samples of droppings every 4th week. Broiler flocks monitored by 60 faecal samples or "sock-samples" 2-3 weeks prior to slaughter and by 50 neck-skin samples at slaughter.

b) Flocks investigated by cloacal swabs collected at slaughter, only one chicken per flock was examined.

examined flocks were sero-positive.

Broiler production

In 1997, *Salmonella* was not isolated from any central-rearing flocks. Among the broiler breeders (hatching-egg production), 8 (2%) flocks were found infected with *Salmonella* (Table 5).

Salmonella was monitored continuously by ante mortem control of all broiler flocks. Until December 1997, 60 faecal samples per flock were collected 3 weeks prior to slaughter. As from December all samples have changed to so-called "sock-samples" i.e. 15 cm pieces of tube gauze mounted on the footwear during inspection of the house. A total of 5 pairs of socks are used per flock. The percentage of positive flocks ranged from 5.3% to 24.1% per month with a mean of 12.9% (Table 5, Figure 3).

Salmonella was detected in a total of 17.1% of the flocks

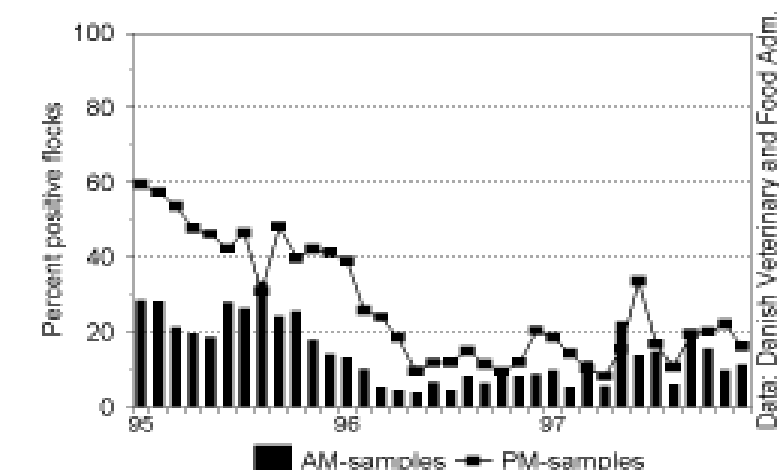


Figure 3. Percent *Salmonella* positive broiler flock detected as a part of the mandatory ante mortem and post mortem inspection, 1995-97.

after slaughter by examination of 5 pooled samples each consisting of 10 neck-skin samples from each slaughter flock (Table 5, Figure 3).

Turkey production

Salmonella was detected in 42 flocks of 355 flocks investigated by the mandatory ante mortem inspection. Of these, 3 flocks were infected with *S. Enteritidis*, 6 flocks

with *S. Typhimurium* and 33 flocks with other serotypes.

Pigs and pork

A serological test on meat juice for detection of *Salmonella* infection in pig herds was implemented in the beginning of 1995. All herds producing more than 100 pigs for slaughter per year are monitored by this test. The herds are assigned to one of

Table 6. Occurrence of zoonotic pathogens in pigs and pork in Denmark 1997.

Zoonotic pathogen	Herd level		Slaughterhouse				Retail				Note:
	Examined		Cuts of pork		Offal	Not heat treated		Heat treated			
	Herds	Animals	% positive herds	% positive samples	% positive samples	% positive samples	% positive samples	% positive samples			
<i>Mycobacterium bovis</i>	19,821	20.1 mill	0	0	0	0	0	0	0	0	a
<i>Brucella abortus</i>	-	-	-	-	-	-	-	-	-	-	b
<i>Trichinella spp.</i>	19,821	20.1 mill	0	0	0	0	0	0	0	0	a
<i>Salmonella spp.</i>	16,268	748,294	5.5	1.1	3.7	9,489	2,235	1.4	5,144	0.06	c
<i>S. Enteritidis</i>	-	-	-	0	0.01	-	-	0.04	-	0.04	-
<i>S. Typhimurium</i>	-	-	-	0.7	2.6	-	-	0.9	-	0	-
Other serotypes	-	-	-	0.4	1.2	-	-	0.5	-	0.02	-
<i>Campylobacter spp.</i>	319	319	59.0	-	-	-	433	1.0	-	-	d
<i>C. jejuni</i>	-	-	2.0	-	-	-	-	-	-	-	-
<i>C. coli</i>	-	-	56.0	-	-	-	-	-	-	-	-
<i>C. lari</i>	-	-	1.0	-	-	-	-	-	-	-	-
<i>E. coli O157(VT+)</i>	-	-	-	-	-	-	300	0	-	-	-
<i>Y. enterocolitica</i>	-	-	-	-	-	-	1,326	2.0	-	-	-

Data: Danish Veterinary Laboratory and Danish Veterinary and Food Administration

a) All slaughter pigs examined in connection with meat inspection

b) Boars examined on admission to AI stations and before leaving the station. No cases found in 1997.

c) Herds are monitored by serological testing. Herds belonging to Level 2 and 3 are defined as *Salmonella* positive.

d) Herds investigated by caecal samples from one animal per herd collected at slaughter.

three levels based on the proportion of samples with a serological reaction. Level 1: a herd with no or very few reactors where intervention is not required; Level 2: a herd with a higher proportion of reactors and the owner is required to seek advice on how to reduce the prevalence of Salmonella; Level 3: the proportion of reactors in the herd is unacceptably high and the owner is required to seek advice and in addition slaughter of pigs from the herd has to be carried out under special hygienic precautions. From August 1996, the requirements to the herds in Level 2 and 3 were increased by an order issued by the Danish Veterinary and Food Administration. These requirements make it mandatory to collect a sufficient number of pen faecal samples in order to clarify the distribution of Salmonella in the herd. Based on the results, an intervention plan must be prepared by the farm advisors.

At the end of 1997, 94.5% of the herds fell within Level 1, 3.8% within Level 2 and 1.7% within Level 3.

A continuous programme

for monitoring of Salmonella in pork at the slaughterhouses was initiated in July 1993. Approximately 2,300

samples are analysed every month. For each slaughterhouse the number of samples collected is determined by the actual number of animals slaughtered, as described in the Danish plan. The number of Salmonella positive fresh meat samples varied between 0.5% and 1.8% with a mean of 1.1% through all of 1997 (Table 6, Figure 4). This is a small reduction compared to 1996 (1.3%). The distribution of Salmonella serotypes and phage types in pork at the slaughterhouses largely reflects the distribution of types in the herds (Table 14 and 15). It is note-

Evaluation of the Danish plan for control of Salmonella in pigs and pork products

In 1997, an independent group of experts evaluated the Danish plan for control of Salmonella in pigs and pork products. The conclusions reached were:

- A unique national control programme has been established covering the entire farm to fork chain. The system is highly automated and flexible, allowing easy adjustments to suit changes in the situation.
- The control programme has reduced the level of Salmonella in Danish pork products and has furthermore reduced the incidence of human salmonellosis associated with consumption of pork.
- The Salmonella levels in pigs and pork products appear to have reached a steady state. Further improvements cannot be expected without adjustments of the plan.
- Some of the adjustments suggested were: Firmer action taken in the top of the production pyramid, notably in breeding herds and sow herds, lower "cut-off" levels for categorisation of pig herds into Levels 1, 2 and 3, and a reduced Salmonella level leading to heat treatment of meat from Level 3 herds.

In January 1998, the group responsible for co-ordinating the control programme produced a set of recommendations for strengthening of the programme drawn along the lines laid out in the evaluation report. It is expected that these changes will lead to a further reduction in the occurrence of Salmonella in pigs and pork products in Denmark.

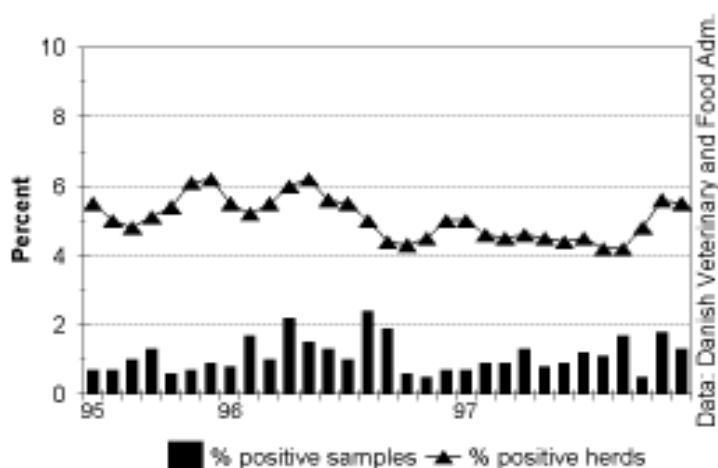


Figure 4. Percent Salmonella positive samples of fresh pork and percent positive herds (Level 2 and 3 herds), 1995-97.

Table 7. Isolation of *Salmonella* from outbreaks of clinical disease in pig and cattle herds in 1997.

Serotype	Pig herds	Cattle herds
Derby	2	-
Dublin	-	94
Enteritidis	-	2
Infantis	2	-
Ohio	1	-
Orion 15var	1	-
Typhimurium	68	26
Typhimurium/Indiana	1	-
1.4.12:d-	1	-
4.5.12:-:-	-	1
4.12:b:-	1	-
9.12:-:-	-	3
Total	77	126

Data: Danish Veterinary Laboratory and Danish Veterinary and Food Administration.

worthy that *Salmonella* Choleraesuis is not present in Danish pig herds.

Clinical salmonellosis was recorded in 77 herds (Table 7). This figure was determined by the number of herds submitting material from clinically affected animals to the laboratory. Of these, 29 herds were placed under official veterinary supervision by the district veterinary

officer.

Cattle and beef

Herds of cattle are investigated for *Salmonella* on clinical indications and as a part of a continuous monitoring programme of zoonotic bacteria. Salmonellosis was diagnosed in 126 (0.4%) cattle herds in 1997 (Table 7). Of these, 19 herds were placed under official veterinary supervision by the district veterinary officer. The predominant serotypes

isolated from clinical cases in cattle in 1997 were *S. Dublin* (74%) and *S. Typhimurium* (21%) (Table 14). As part of the surveillance programme, 256 caecal samples were sampled at slaughterhouses. One animal per herd was sampled and the prevalence was 0.8% (Table 8).

At cattle slaughterhouses approximately 280 samples in total are collected each month from a representative sample of the beef cuts and the offal. The number of

positive samples of beef cuts per month has ranged from 0.0% to 1.2% during 1997 with a mean of 0.4% (Table 8), which is comparable with 1996 (0.5%). The predominant serotypes were *S. Dublin* (52%) and *S. Typhimurium* (16%) (Table 14).

Products from retail outlets

A total of 1,028 samples of broilers and broiler products, 7,379 samples of pork and pork products, and 4,588 samples of beef and beef products were examined by the Municipal Food and Environmental Laboratories. (Tables 5, 6 and 8). In raw meat, the prevalences were 5.7%, 1.4%, and 0.5%, respectively. In heat-treated products, the prevalences found were less than 0.2% in all types of meat.

These *Salmonella* prevalences as well as the serotype distribution are similar to those found in 1996. However, the prevalence in broilers and broiler products has decrea-

Table 8. Occurrence of zoonotic pathogens in cattle and beef in Denmark 1997.

Zoonotic pathogen	Herd level			Slaughterhouse				Retail				Note:
	Examined		% positive herds	Cuts of beef		Offal		Not heat treated		Heat treated		
	Herds	Animals		N	% positive samples	N	% positive samples	N	% positive samples	N	% positive samples	
<i>Mycobacterium bovis</i>	-	-	0	All	0	All	0	-	0	0	0	a
<i>Brucella abortus</i>	-	-	0	-	-	-	-	-	-	-	-	b
<i>Salmonella spp.</i>	256	256	0.8	2,194	0.4	1,667	1.4	2,751	0.5	1,837	0.05	c
<i>S. Enteritidis</i>	-	-	0	-	0	-	0.08	-	0	-	0	-
<i>S. Typhimurium</i>	-	-	0.4	-	0.1	-	0.2	-	0.2	-	0	-
<i>S. Dublin</i>	-	-	0.4	-	0.1	-	0.9	-	0.2	-	0	-
Other serotypes	-	-	0	-	0.2	-	0.3	-	0.1	-	0.05	-
<i>Campylobacter spp.</i>	96	96	51.0	-	-	-	-	516	0.7	-	-	c
<i>C. jejuni</i>	-	-	49.0	-	-	-	-	-	-	-	-	-
<i>C. coli</i>	-	-	1.0	-	-	-	-	-	-	-	-	-
<i>C. lari</i>	-	-	1.0	-	-	-	-	-	-	-	-	-
<i>E. coli</i> O157 (VT+)	-	130	3.0	-	-	-	-	1,100	0.1	-	-	-

Data: Danish Veterinary Laboratory and Danish Veterinary and Food Administration.

a) Bulls at AI stations are examined by TB test. Notifiable disease. No cases diagnosed in 1997.

b) Bulls examined on admission to AI stations and annually after entry. Clusters of abortions are notifiable. Notifiable disease in cattle.

c) Herds were investigated by caecal samples from one animal per herd collected at slaughter.

sed from 9.5% in 1996 to 5.7% in 1997.

In 1997, turkeys and ducks have been included in the investigation of products from the retail outlets. In raw products, the Salmonella prevalences were 7.0% (N=257) in turkeys and turkey products and 6.5% (N=46) in ducks and duck products. In heat treated products the prevalences were 0.7% (N=141) and 1.2% (N=83), respectively.

Salmonellosis in humans

Hitherto, the maximum incidence of human salmonellosis caused by zoonotic Salmonella serotypes was observed in 1994 (4,276 registered cases). In 1995 and 1996 the number of cases decreased; a total of 3,259 was registered in 1996. However, in 1997 the annual number of registered cases of human salmonellosis caused by zoonotic Salmonella serotypes rose to a new maximum of 5,015 cases (95 cases per 100,000 inhabitants, Table 11, Figure 5), a 53% increase compared with 1996. The overall increase was entirely due to a higher number of *S. Enteritidis* cases

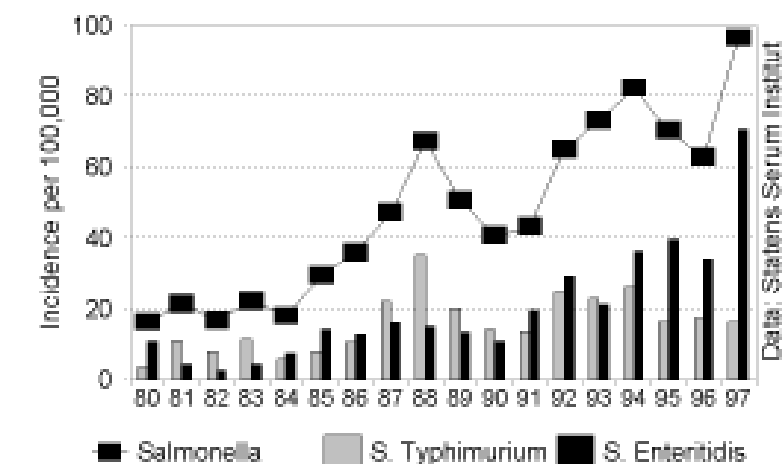


Figure 5. Registered cases of human salmonellosis in Denmark 1980-97.

(3,674 compared with 1,771 in 1996), whereas *S. Typhimurium* decreased to 841 (907 in 1996). The remaining 500 cases were distributed among approximately 100 different serotypes. Among these were *S. Hadar* (58 cases), *S. Virchow* (38 cases), and *S. Infantis* (26 cases). Hence, *S. Hadar* replaced *S. Virchow* as the third most common Salmonella serotype in Denmark in 1997. Table 14 shows the distribution of major serotypes, whereas the phage type distributions of *S. Typhimurium* and *S. Enteritidis* are shown in Table 15 and 16. It is estimated that approximately 85-90% of human salmonellosis are

domestically acquired.

The age-specific incidence of *S. Enteritidis* in 1997 peaked among children 1 to 4 years of age, but was also high among infants. Among adults, the age-specific incidence was relatively steady between 62 to 71 cases per 100,000 (Table 9). The age-specific incidence of *S. Typhimurium* peaked among infants. Throughout childhood, its incidence showed a marked decrease to a minimum among 10 to 19 years old (Table 10). The difference in age-specific incidence of *S. Enteritidis* and *S. Typhimurium*, with a much higher *Enteritidis* to *Typhimurium* ratio among adults compared with young children may be related to

Table 9. Incidence of *S. Enteritidis* infections by age and sex in 1997. Counties of Bornholm, Frederiksborg, Fyn, Ribe, Roskilde, Storstrøm, Vestsjælland and Århus

Age group (years)	Number of cases			Cases per 100,000
	Female	Male	Total	
<1	17	13	30	94.8
1-4	84	102	186	139.2
5-9	53	63	116	76.0
10-19	103	90	193	67.6
20-39	247	218	465	65.5
40-59	280	219	499	70.5
60-79	125	118	243	62.4
80+	27	30	57	63.1
Total	936	853	1,789	71.5

Data: Statens Serum Institut

Table 10. Incidence of *S. Typhimurium* infections by age and sex in 1997. Counties of Bornholm, Frederiksborg, Fyn, Ribe, Roskilde, Storstrøm, Vestsjælland and Århus

Age group (years)	Number of cases			Cases per 100,000
	Female	Male	Total	
<1	8	8	17	53.7
1-4	34	23	57	42.7
5-9	9	10	19	12.4
10-19	10	18	28	9.8
20-39	52	66	118	16.6
40-59	52	54	106	15.0
60-79	23	20	43	11.0
80+	12	4	16	17.7
Total	201	203	404	16.2

Data: Statens Serum Institut

several factors, including age-related food habits and transmission patterns, a relatively high rate of travel associated S. Enteritidis infections among adults and possibly differences in clinical spectrum.

The geographical distribution of the two major serotypes is illustrated in Figures 6 and 7. The relatively large variation in the incidence of S. Enteritidis reflects both differences in diagnostic activities between counties as well as the importance of egg-related outbreaks. In particular, outbreaks were registered in the county of Storstrøm, which had the peak incidence. The incidence of S. Typhimurium was highest in the county of Funen. This county had also the highest S. Typhimurium incidence in 1996, due to a pork associated outbreak.

During 1997, Salmonella

isolates from humans, animals and food were continuously compared by different epidemiological typing methods such as phage typing and DNA fingerprinting.

The results of the epidemiological typing as well as evidence from outbreak investigations suggest that the doubling (+107%) of the incidence of S. Enteritidis was due to increased levels of infection in layers and shell eggs. Though domestically acquired infections from shell eggs was the major source of infection, 10% to 20% of S. Enteritidis infections were travel associated. A less important source of S. Enteritidis infections were poultry meat. Eggs are estimated to account for approximately 60% of all human Salmonella infections in Denmark (Figure 8), an increase compared with previous years.

The overall incidence of S.

Typhimurium decreased slightly (-7%) from 1996 to 1997. However, 170 of the total of 907 cases registered in 1996 was from a single source outbreak (slaughterhouse in Funen). Thus, in 1997 the incidence of sporadic cases due to S. Typhimurium increased slightly to reach the 1995 level. Pork is assumed to be the major source of S. Typhimurium infections (70%) and is estimated to be responsible for 10-15% of all Salmonella infections in Denmark in 1997 (Figure 8).

Table 12 summarises laboratory diagnosed general and family outbreaks registered at Statens Serum Institut in 1997.

Only in case of outbreaks of probable food-borne disease (defined as two or more cases associated with the same potential source of infection), the Municipal Food and Environmental Laboratories will be requested to identify a

Table 11. Zoonoses in humans 1997 - incidence and trends of 5 and 10 years

Agent	Cases per 100.000 inh.	1997		Five years trend					10 years	Note:
		Registered cases	1996	1995	1994	1993	1992	1987		
<i>Mycobacterium bovis</i>	0.2	11	11	9	5	7	9	15	a	
<i>Brucella abortus/melitensis</i>	0	0	0	0	0	0	0	0	a	
<i>Trichinella spiralis/nativa</i>	0	0	0	0	0	0	0	0	a	
<i>Salmonella spp.</i>	95	5,015	3,259	3,654	4,276	3,802	3,379	2,619	b	
<i>S. Enteritidis</i>	69.6	3,674	1,771	2,070	1,876	1,093	1,511	825		
<i>S. Typhimurium</i>	15.9	841	907	848	1,363	1,193	1,289	1,142		
<i>Other serotypes</i>	9.5	500	581	736	1,037	1,516	579	652		
<i>C. coli/jejuni</i>	50.5	2,666	2,973	2,601	2,196	1,776	1,129	1,518		
<i>E. multilocularis/granulosus</i>	0	0	0	0	0	0	0	0	c	
<i>Listeria monocytogenes</i>	0.6	33	39	29	23	27	24	27	d	
<i>Rabies</i>	0	0	0	0	0	0	0	0	e	
<i>Toxoplasma gondii</i>	-	-	-	-	-	-	-	-	f	
<i>Yersinia enterocolitica</i>	8.1	430	532	779	643	710	901	1,143		
<i>Escherichia coli (VTEC)</i>	0.6	33	5	2	10	4	10	7		
<i>O157 (VTEC)</i>	0.2	12	3	2	3	1	6	2		

Data: Statens Serum Institut.

a) Notification not mandatory. Cases of tuberculosis due to reactivation of latent infections in elderly or imported disease.

b) Only first isolations registered.

c) Notification not mandatory. A few imported cases occur.

d) Notification mandatory from 1986.

e) Notification mandatory. No domestical or imported cases.

f) Notification not mandatory. Approximately 1% of the population seroconvert annually.

Danmarkskort indsættes her
(Salmonella Enteritidis 1997)

Danmarkskort indsættes her
(Salmonella Typhimurium 1997)

Figure 6. Geographical distribution and incidence of human cases of *S. Enteritidis* in 1997. Data: Statens Serum Institut.

Figure 7. Geographical distribution and incidence of human cases of *S. Typhimurium* in 1997. Data: Statens Serum Institut.

possible common source. In 1997, 33 outbreaks comprising a total of 667 patients were investigated. The results indicate that eggs were the major source of food-borne outbreaks in 1997 (Table 13).

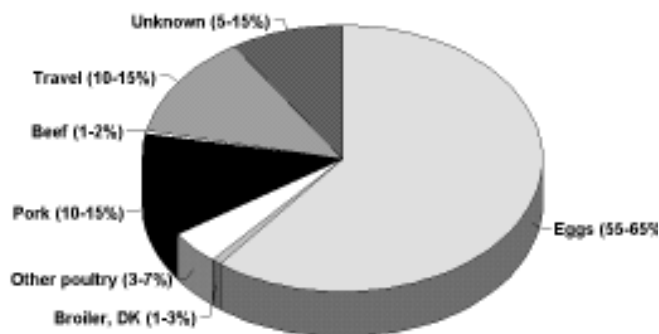


Figure 8. Estimated sources for human salmonellosis in Denmark, 1997. Data: Danish Zoonosis Centre.

Table 12. Registered outbreaks of food-borne zoonotic diseases diagnosed at Statens Serum Institut, 1997.

Zoonotic pathogen	General outbreaks		Suspected source	Family outbreaks		Suspected source
	No. of outbreaks	No. patients involved		No. of outbreaks	No. patients involved	
<i>S. Enteritidis</i>	28	3-700	Homemade ice cream (4), mousse (3), cheese cake (2), eggs (1), bernaise sauce (1), chicken (1), beef (1), unknown (15)	32	4-28	Homemade ice cream (6), buttermilk dish (5), eggs (4), custard(4), chicken (5), duck (1), mousse (1), shrimp salad (1), meat balls (1), unknown (4)
<i>S. Typhimurium</i>	3	4-35	Pork (1), Unknown (2)	1	15	Unknown (1)
Campylobacter	3	3-8	Contaminated water (1), unknown (2)	3	4	Sausages (2), unknown (1)
Others	6 a)	2-14	Homemade ice cream (1), fish (1), unknown (4)	0		
Unknown	11	6-70	Meat balls (1), fish (1), burger (1), unknown (8)	3	7-20	Sausage (1), unknown (2)

a) *S. Berta*, *S. Paratyphi B*, *Shigella sonnei*, *Yersinia enterocolitica*, EPEC O:142, EPEC O:86.

Multiresistant *S. Typhimurium* DT104

Multiresistant strains of *S. Typhimurium* DT104 are in the typical form characterised by resistance to ampicillin, chloramphenicol, tetracyclin, sulfamethaxole and streptomycin. The experience from England and Wales suggests that these strains may easily acquire resistance to other antibiotics, including the quinolones, and that control at herd level is difficult due to a large animal reservoir and the ability of DT104 to persist in the environment. During the 90ies, the incidence of multiresistant types of *S. Typhimurium* DT104 has increased in several countries, in particular England and Wales where it is the second ranking Salmonella phage type in humans after *S. Enteritidis* PT4.

Danish livestock

In Denmark, the results from the national surveillance programmes indicate that the prevalence of DT104 among Danish livestock is very low. In October 1997, an order regarding DT104 was issued by the Danish Veterinary and Food Administration: Detection of DT104 in pig and cattle herds was made notifiable. Infected herds are put under official veterinary supervision including special hygiene slaughter, and epidemiological investigation of the herd and its trade contacts. Two negative herd examinations at 45 days interval are required to lift the sanctions. Sanctions can also be lifted if the herd is destroyed. The order was issued to prevent spread of DT104 between herds as well as from animals to humans. An attempt to eradicate multiresistant *S. Typhimurium* DT104 from infected pig herds was initiated in the beginning of 1997 by the Federation of Danish Pig Producers and Slaughterhouses in co-operation with the Danish Veterinary Laboratory. This programme includes destruction of all pigs and cleaning and disinfection of buildings before introducing new pigs at the farm. Following reestablishment of the production, the herd is monitored intensively in order to determine the success of the eradication.

Until now (April 1998), a total of 20 pig herds have been found infected with *S. Typhi-*

murium DT104. These herds have primarily been identified through the serological surveillance programme, and by trace back from infected herds. The voluntary programme for destruction of pigs and cleaning and disinfection of buildings has so far been established in 15 herds. At the time of writing, new pigs have been introduced into 4 of these herds, of which 2 herds have been examined monthly for six months and are now declared free of DT104 infection. One herd was reinfected shortly after repopulation and the destruction and cleaning procedures were repeated. This herd had, as well as the remaining herd, at the time writing housed new slaughter pigs for 3-4 month without any detection of Salmonella. These preliminary results indicate that the voluntary control programme is working satisfactorily.

Further, DT104 has been isolated from two Danish cattle herds and from pigs imported into Denmark from an international breeding company in Scotland. Both infected cattle herds were found at farms that also housed infected pigs. At slaughterhouse and retail level, DT104 has been isolated from a single sample of Danish pork and from imported beef and poultry products.

Human infections

Throughout 1997, all human strains of *S. Typhimurium* were phage typed and tested for antibiotic resistance in order to get reliable data on the occurrence of multiresistant strains of DT104. Until now, of a total of 841 *S. Typhimurium* isolates, 621 have been phage typed. Forty-four (7.1%) were multiresistant strains of DT104. These data should be compared with the results from a sample of 398 *S. Typhimurium* from 1995 where 24 (6.0%) were multiresistant DT104 strains. There is no indication of an increase in the incidence or the proportion of multiresistant strains of DT104 in Denmark. An interview based follow-up of the Danish cases from 1997 suggested that the vast majority of the infections were domestically acquired, but no specific food items have been incriminated.

Table 13. Outbreaks of food-borne zoonotic diseases registered by the Municipal Food and Environmental Laboratories in 1997.

Zoonotic agent	No. patients involved	Suspected source	Confirmed by culture
S. Enteritidis	10	Egg	No
do.	7	Egg	No
do.	65	Egg	Yes
do.	11	Egg	Yes
do.	100	Egg	Yes
do.	4	Egg	No
do.	18	Egg	No
do.	35	Egg	Yes
do.	16	Egg	No
do.	3	Egg	No
do.	4	Egg	Yes
do.	6	Egg	No
do.	7	Egg	Yes
do.	18	Egg	No
do.	7	Egg	Yes
do.	2	Egg	No
do.	4	Egg	Yes
do.	11	Egg	No
do.	17	Egg	No
do.	10	Egg	No
do.	13	Egg	Yes
do.	40	Egg	No
do.	20	Egg	No
do.	40	Smoked salmon, turkey	Yes
do.	5	Tuna mousse	No
do.	16	Egg	No
do.	38	Egg	Yes
do.	20	Egg	No
do.	35	Egg	Yes
do.	20	Paté, salmon	No
do.	34	Salmon	Yes
S. Enteritidis + Campylobacter	11	Egg	No
Campylobacter	20	Poultry	No

Data: Danish Veterinary and Food Administration.

Table 14. Serotype distribution of Salmonella from animals, meat at slaughterhouses and humans in Denmark, 1997.

Serotype	Humans	Pigs herds	Pork a)	Cattle herds	Beef a)	Broiler b) flocks	Layer flocks	Turkey b) flocks	Duck flocks
S. Enteritidis	73.3	0.8	0.2	1.6	4.0	21.4	87.8	7.1	21.5
S. Typhimurium	16.8	79.8	66.0	21.1	16.0	32.3	5.1	14.3	3.1
S. Hadar	1.2	0.2	-	-	-	4.5	-	2.4	33.8
S. Virchow	0.8	-	-	-	-	0.6	-	-	-
S. Infantis	0.5	4.6	9.3	-	8.0	16.7	4.1	-	-
S. Agona	0.5	0.5	0.5	-	-	0.2	-	40.5	-
S. Newport	0.5	-	-	-	-	-	-	-	-
S. Stanley	0.4	0.2	-	-	-	-	-	-	-
S. Java	0.4	-	-	-	-	-	-	-	-
S. Dublin	0.3	-	-	74.2	52.0	-	-	-	-
S. Heidelberg	0.3	0.1	-	-	-	-	-	2.4	-
S. Oranienburg	0.2	0.1	-	-	-	0.2	-	-	-
S. Saintpaul	0.2	0.1	-	-	-	-	-	-	4.6
S. Braenderup	0.2	-	-	-	-	-	-	-	-
S. Indiana	0.2	0.4	-	-	-	4.9	-	-	6.2
S. Panama	0.2	-	-	-	-	-	-	-	-
S. Blockley	0.2	-	-	-	-	-	-	-	-
Others incl. not typable	4.0	13.2	24.0	3.2	20.0	19.2	3.0	33.3	30.8
Total	100	100	100	100	100	100	100	100	100
Number typed	5,015	1,186	559	128	25	533	98	42	65

Data: Danish Veterinary Laboratory and Statens Serum Institut.

- a) Representative meat samples from the surveillance programme at slaughterhouses.
b) Representative faecal or sock samples from the mandatory ante-mortem inspection.

Table 15. Phage type distribution (%) of S. Typhimurium from humans, animals and meat at slaughterhouses, 1997.

Phage type	Humans	Pigs	Pork a)	Cattle	Beef	Broilers	Layers
12	58.8	55.1	56.3	60.7	68.4	-	-
104	7.1	1.1	0.3	3.6	21.1	-	-
66	3.5	6.9	5.0	3.6	-	11.1	-
U288	3.4	1.8	2.2	7.1	-	-	-
135	2.4	2.1	0.8	-	-	3.7	11.1
193	2.3	5.9	6.7	3.6	-	-	-
110	1.8	2.0	1.0	3.6	5.3	29.6	33.3
15a	1.6	2.1	1.9	3.6	-	-	-
120	1.6	1.0	1.8	-	-	-	11.1
17	1.0	4.7	4.6	7.1	5.3	-	-
41	1.0	2.0	-	-	-	29.6	11.1
107	0.6	1.6	1.9	-	-	-	-
Others incl. not typable	14.9	13.7	17.8	7.1	-	26.0	33.4
Total	100	100	100	100	100	100	100
Number typed	621	1,001	1,024	28	19	27	9

Data: Danish Veterinary Laboratory.

- a) Incl. non-representative samples from HACCP-control at slaughterhouses.

Table 16. Phage type distribution (%) of S. Enteritidis from humans and poultry, 1997.

Phage type	Humans	Broilers	Layers
6	39.1	-	11.5
8	33.3	67.9	66.4
4	13.3	-	4.9
1	4.2	10.7	-
21	4.2	-	1.6
6a	0.9	-	-
Others incl. not typable	5.0	21.4	15.6
Total	100	100	100
Number typed	660	28	122

Data: Danish Veterinary Laboratory.

2. Campylobacter jejuni/coli

Poultry, pigs and cattle

As part of a continuous surveillance programme of zoonotic bacteria in broilers, pigs and cattle, caecal contents/cloacal swabs were sampled at slaughterhouses and examined for thermotolerant campylobacters. One animal per herd and one bird per flock was sampled. In broilers the prevalence was 37% (Table 5), in pigs 59% (Table 6) and in cattle 51% (Table 8). In broilers a distinct seasonal variation is observed (Figure 9). This seasonal variation coincide with human campylobacteriosis in Denmark. However, the increase in broilers seems to appear slightly later than the increase in humans.

Wild mammals and birds

In 1997, a total of 323 mammals and birds were examined for infection with *Campylobacter spp.* A total of 8% tested positive (Table 17). It is interesting to note that four new-born seal (*Phoca vitulina*) puppies housed *C. jejuni* or *C.*

hyointestinalis in their rectal contents. Judged from the otherwise sparse contents in the stomach and intestines it might be hypothesized that they acquired the infection from ingestion of infected coastal waters.

Products from retail outlets

A nationwide survey on thermotolerant *Campylobacter* in foods from retail outlets were conducted in 1997. The foods represented in the survey include raw and light processed chicken and turkey, raw beef and pork, shellfish, vegetables and fruits. In total 3,000 samples have been analysed. The results regarding chicken, pork and beef are listed in Tables 5, 6 and 8 respectively.

In raw turkey from retail outlets the prevalence found was 25 % (N=311) in 1997 compared to 24 % (N=103) in 1996. In other birds (incl. ducks, pigeons, quails and ostrich) the prevalence was 26 % (N=285) in 1997 compared to 40 % (N=171) in 1995/

1996.

Thermotolerant *Campylobacter* have not been detected (< 1 CFU / 25 gr) in shellfish (N=146), vegetables (N=123) and fruits (N=103).

Campylobacteriosis in humans

The incidence of human *Campylobacter* infections decreased from 2,973 cases in 1996 to 2,666 in 1997 (50 per 100,000, Table 11, Figure 10). However, because some 110 of the cases in 1996 were associated with a waterborne outbreak in Northern Jutland, the incidence of sporadic cases of *Campylobacter* infections should be regarded as more or less stable in the last two years. In 1996, Statens Serum Institut changed from using Skirrows medium to direct plating on mCCDA. Hereby the sensitivity was improved and the real reduction in the number of cases may actually be larger than the observed. As emphasized in the 1996 report, the incidence has more than doubled since 1992, which is a major

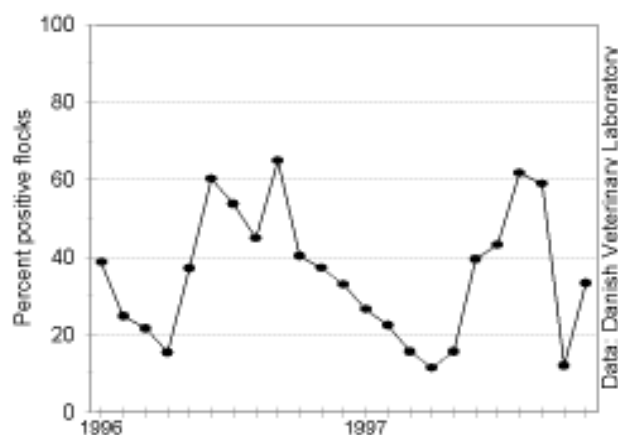


Figure 9. Percent *Campylobacter* positive broiler flocks, 1996-97.

Table 17. Occurrence of thermotolerant *Campylobacter spp.* in wild mammals and birds, 1997.

Animal group	number of samples	%positive samples
Deer	24	0
European Hare	38	3
Red fox	29	14
Marine mammals	11	55
Other mammals	180	6
Water birds	16	14
Other birds	25	12
Total	323	8

Data: Danish Veterinary Laboratory.

Table 18. Incidence of campylobacteriosis by age and sex. Counties of Bornholm, Frederiksborg, Fyn, Ribe, Roskilde, Storstrøm, Vestsjælland and Århus, 1997.

Age group (years)	Number of cases			Cases per 100,000
	Female	Male	Total	
<1	13	22	35	3.2
1-4	67	101	168	125.8
5-9	27	38	65	42.6
10-19	71	86	157	55.0
20-39	266	262	528	74.4
40-59	132	128	260	36.7
60-79	71	58	129	33.1
80+	13	13	26	28.8
Total	660	708	1,368	54.7

Data: Statens Serum Institut.

cause of concern.

The age-specific incidence of Campylobacter infections was remarkably low in infants but peaked among children 1 to 4 years of age (126 cases per 100,000, Table 18). A second peak was noted among young adults 20 to 39 years old (74 cases per 100,000). There was a large variation in the geographical distribution of Campylobacter infections in 1997 (Figure 11). Beside the fact that diagnostic practices and methods differ between some of the counties, this variation remains largely unknown. Some of the geographical differences may be attributed to differences in diagnostic methods.

Serotyping of campylobacters

C. jejuni and *C. coli* isolates were serotyped according to the "Penner serotyping scheme" (heat-stable antigens). This system is based on antisera raised against 66 reference strains (47 *C. jejuni* and 19 *C. coli*) and the assay is performed by passive haemagglutination in microtiter plates. The full serotyping system has been used since

the beginning of 1997 at the Danish Veterinary Laboratory on isolates of animal and human origin.

Serotyping was performed on clinical isolates from human patients and on isolates from the continuous programme monitoring campylobacters in poultry, cattle and pigs (Table 19 and 20). In addition, *C. jejuni* and *C. coli* isolates from poultry products sampled at the retail level and a few *C. jejuni* isolates from healthy dogs were serotyped. Among human isolates, serotype O:2,

O:1,44 and the O:4-complex accounted for 57% of the *C. jejuni* isolates. Other important serotypes were O:3, O:6,7 and O:11, whereas a large number of other serotypes were represented at 3% or less. Serotype O:2 was also common in all other sources, except pigs that rarely harbour *C. jejuni*. In general, broilers, poultry products and to a lesser extent cattle had a serotype distribution that showed a large overlap with the human isolates. *C. coli* is the dominant Campylobacter species

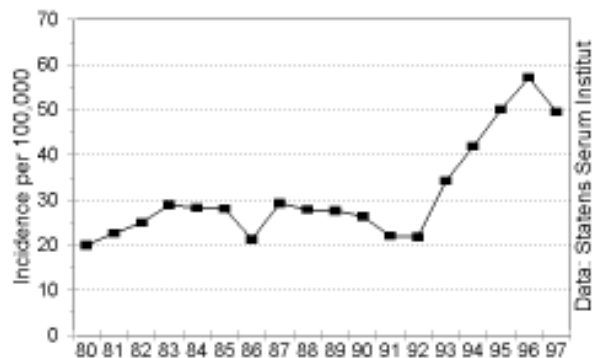


Figure 10. Incidence per 100,000 of human campylobacteriosis in Denmark 1980-97

Danmarkskort indsættes her
(Campylobacter incidens 1997)

Figure 11. Geographical distribution and incidence of human campylobacteriosis in 1997. Data: Statens Serum Institut.

Table 19. Serotype distribution (%) of *Campylobacter jejuni* from animals and human patients.

Serotype	Human	Broilers	Cattle	Poultry retail level	Healthy dogs
1,44	13	24	4	10	14
2	26	16	13	25	23
3	6	1	2	2	-
4-complex*	18	6	28	7	23
5	2	2	-	2	9
6,7	5	10	2	6	-
11	4	5	7	2	-
12	2	1	-	3	-
19	2	1	11	4	-
21	3	5	2	1	5
23,36	2	4	7	2	-
29	1	-	7	1	-
37	3	1	-	1	-
Others	13	24	17	34	28
Number typed	373	82	42	137	22

* 4-complex: Reaction with one or more of the following antisera: 4, 13, 16, 43, 50, 64, 65. Strains from humans, dogs and poultry at retail level were isolated in 1996, strains from other sources were isolated during 1997.

Table 20. Serotype distribution (%) of *Campylobacter coli* from animals and human patients.

Serotype	Human	Broilers	Swine	Poultry retail level
5	-	10	15	-
24	14	5	11	14
30	36	5	16	5
46	-	20	12	14
48	7	15	2	-
54	7	-	6	5
59	-	15	5	19
Others	36	30	33	43
Number typed	14	20	185	21

All typed strains from humans, dogs and poultry at retail level were isolated in 1996. Strains from pigs were isolated during 1997.

in pigs, whereas only 1-5% of the campylobacters in humans, broilers and cattle are *C. coli*. In conclusion, on the basis of the species and serotype distribution of campylobacters, both chickens and cattle could be major sources of human campylobacteriosis.

Genotyping of campylobacters

DNA-based typing methods are being used at the Danish Veterinary Laboratory in order to elucidate the sources of sporadic campylobacteriosis in humans. To this end, the high-resolution method of macrorestriction profiling by pulsed-field gel electrophoresis (MRP-PFGE) has been used to characterize approximately 200 *C. jejuni* isolates from human diarrhoea and from poultry, cattle and pig samples taken as part of the continuous surveillance programme for zoonoses. An initial study, encompassing a number of serotypes, shows that certain strains of *C. jejuni* found in humans also occur in poultry and cattle. Preliminary results from a similar investigation of 80 Penner serotype 2 isolates indicate that approximately one-third of strains belonging to this serotype represent clones distributed among humans, poultry, cattle and pigs. These data indicates a link between sporadic human *Campylobacter* infection and food stuffs.

Additional studies concerning the epidemiology of campylobacters in poultry, and the development and application of other high-resolution genomic typing methods, are presently underway.

3. Yersinia enterocolitica

Products from retail outlets

During 1997, a survey of human pathogenic *Yersinia enterocolitica* in pork products in the retail sector was performed. The survey included a total of 1,326 samples of raw meat and meat products that are not heat treated. The results of the survey are shown in Table 21.

Y. enterocolitica was detected in all the categories investigated. The highest prevalence was found in minced meat (3.5%). Even preserved pork products, i.e. salted and smoked pork products, was shown to harbour culturable *Y. enterocolitica*, though at a low prevalence. It has been well documented that culture-

based detection methods lack sensitivity as compared to DNA-based methods as for example colony hybridisation. Therefore it may be assumed that the prevalences found in the present survey are vastly underestimated.

Yersiniosis in humans

A total of 430 cases of infections with *Y. enterocolitica* was registered in 1997 (Table 11, Figure 12). The vast majority, 426, was serotype O:3. In 1996, 529 cases of *Y. enterocolitica* O:3 were registered. In other words, the incidence decreased by 19%,

which is a continuation of a rather steady decrease since 1985. We have no explanation for this reduction. Because most Danish slaughter pigs are assumed to harbour *Y. enterocolitica* serotype O:3 biotype 4, the primary source of yersiniosis is thought to be pork.

Table 22 shows the age- and sex-specific incidence of *Y. enterocolitica* infections in 1997. Approximately 50% of the cases are among children less than five years of age. Figure 13 shows the geographical distribution of human yersiniosis.

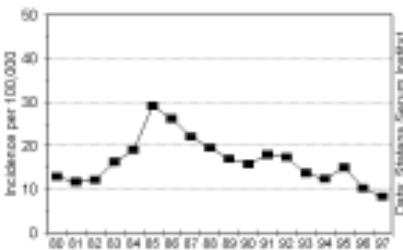


Figure 12. Incidence per 100,000 of human yersiniosis in Denmark, 1980-97.

Danmarkskort indsættes her (Yersinia incidens 1997)

Figure 13. Geographical distribution and incidence of human yersiniosis in 1997. Data: Statens Serum Institut.

Table 21. Humanpathogenic *Yersinia enterocolitica* (biovar 4, serovar O:3) in the retail sector in 1997.

Type of product	no. of samples	no. of positive samples (%)
Raw pork:		
Cuts	279	4 (1.4)
Minced meat	398	14 (3.5)
Processed minced meat	128	2 (1.6)
Preserved, not heat treated pork products (ex. bacon, filet of pork)	508	6 (1.2)
Total	1,326	26 (2.0)

Data: Danish Veterinary and Food Administration.

Table 22. Incidence of yersiniosis by age and sex. Counties of Bornholm, Frederiksborg, Fyn, Ribe, Roskilde, Storstrøm, Vestsjælland and Århus, 1997.

Age group (years)	Number of cases			Cases per 100,000
	Female	Male	Total	
<1	7	6	13	41.1
1-4	49	54	103	77.1
5-9	7	54	22	14.4
10-19	7	15	19	6.7
20-39	19	12	35	4.9
40-59	13	17	30	4.2
60-79	6	5	11	2.8
80+	1	0	1	1.1
Total	109	125	234	9.4

Data: Statens Serum Institut

4. *Listeria monocytogenes*

In 1997, 33 sporadic cases of *Listeria monocytogenes* infections were registered (Table 11, Figure 14). This is a decrease compared with 1996 where 39 sporadic cases were identified. Table 23 shows the age distribution of the 33 cases. Nineteen of the strains belonged to serogroup 4 and 14 to serogroup 1.

Table 23. Incidence of listeriosis by age in Denmark, 1997.

Age group (years)	Number of cases
<4 weeks	3
4 weeks- 10yrs	3
10-19yrs	0
20-39yrs	0
40-59yrs	6
60-79yrs	17
80+yrs	4
Total	33

Data: Statens Serum Institut.

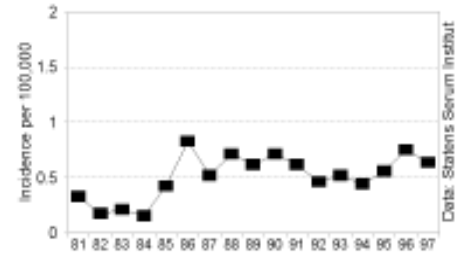


Figure 14. Incidence per 100,000 of human listeriosis in Denmark, 1981-97.

5. *Escherichia coli* (VTEC)

Cattle

A continuous surveillance programme to monitor the incidence of verotoxigenic *Escherichia coli* O157 in Danish cattle was initiated by The Danish Veterinary Laboratory in June 1997. Faecal samples are obtained every month from all major slaughterhouses.

Verotoxigenic *E.coli* O157 was found in 3% of samples (Table 8).

Products from retail outlets

During a nationwide screening survey in 1997, the Danish Veterinary and Food Administration and the Municipal Food and Environmental Laboratories investigated approximately 1,900 retail samples of fresh meat for *E. coli* O157. Nine *E. coli* O157 were recovered (0.5%). Five of the nine strains were verotoxin (VT) producing and all nine strains harboured the *eae* gene which

confers the ability to cause attaching and effacing lesions on epithelial cells.

Five of approximately 1,100 beef samples were positive (0.5%). One (0.1%) of these bovine isolates were VT positive (Table 8). VT-producing *E. coli* O157 were recovered from 2 of approximately 200 investigated samples of meat from deer (1%) and from 2 of approximately 300 investigated samples of lamb meat (0.7%). It was not possible to recover *E. coli* O157 from approximately 300 pork samples (Table 6).

Human infections

The problem of zoonotic *E. coli* infections remains low in Denmark, and no domestically acquired food associated outbreaks have been identified. Before 1997, VTEC was only looked for rarely in humans. In 1997, laboratories processing more than 2/3 of the stool cultures performed in Denmark changed their diagnostic practice and started to look for VTEC

in all stools from patients with grossly bloody diarrhoea and in all stools from patients 4 years of age or less with a history of bloody diarrhoea. Additionally, stools from patients with a history of persistent diarrhoea or travelling have been cultured for VTEC. The methods used were a combination of colony hybridisation using probes for verotoxin and *EaeA* genes, and live slide agglutination of suspect colonies with O-antisera against the most common VTEC serotypes. This approach resulted in the identification of a total of 33 VTEC infections (Table 11). Before 1997, approximately 5 cases have been diagnosed annually. Of the 33 cases in 1997, 5 developed renal failure (haemolytic uraemic syndrome, HUS): 3 were infected with O157, one with serotype O103 and one with O145. There were no deaths. Twelve (36%) were *E. coli* O157 VTEC (Table 11).

6. *Mycobacterium bovis*

In accordance with Commission Decision 80/984/EEC, Danish cattle herds are declared officially free from bovine tuberculosis (TB) since 1980. TB in cattle is a notifiable disease in Denmark. Monitoring is performed by meat inspection, which means that all slaughter animals are examined for lesions indicative of TB. Bulls at AI-stations are subject to pre-entry and annual intradermal tuberculin testing. The last case of TB in cattle was diagnosed in 1988.

In 1997, 11 cases (0.2 cases per 100,000 inhabitants, Table 11) of human tuberculosis caused by *M. bovis* were registered. One of these cases were imported, whereas six were diagnosed in Danish patients. The latter cases are regarded as reactivation of a latent infection acquired before the eradication of bovine TB in cattle. Bovine tuberculosis in humans is no longer a notifiable disease in Denmark.

7. *Brucella abortus/melitensis*

In accordance with Commission Decision 79/837/EEC Denmark has been regarded officially free from brucellosis in cattle since 1979. Brucellosis is a notifiable disease, and clusters of abortions are notifiable. Monitoring is performed by examination of abortion material. Cattle are examined serologically for brucellosis every year and boars at AI-stations are tested at least every 18 months and before they leave the station.

No domestically acquired

human cases but a few imported cases occur each year. The infection in humans is not notifiable in Denmark.

8. *Trichinella spiralis/nativa*

All carcasses of slaughter pigs are examined for *Trichinella* in accordance with Council Directive 64/433/EEC, Annex 1, Chapter VIII. *Trichinella* has not been found in Danish pigs since 1930. During 1997, 20.1 mill. pigs were examined at slaughter with a negative result (Table 6).

A national programme for screening of *Trichinella* infection in wild foxes was initiated in 1995. In 1997 and the two first months of 1998, a total of 4,366 forelegs of foxes were collected by hunters across the country. At the time of writing, 700 forelegs had been examined for *Trichinella*, all with a negative result. The screening was terminated by the end of February 1998.

No domestically acquired cases of human trichinosis were recorded in 1997. A few imported cases occur annually. The infection in humans is not notifiable.

9. *Echinococcus granulosus/multilocularis*

Echinococcus granulosus infections in all animals are

reportable. Surveillance for *Echinococcus* is performed through meat inspection. In 1997, no cases of *Echinococcus* infections were reported.

No domestically acquired human cases but a few imported cases occur annually. The infection in humans is not notifiable.

10. *Toxoplasma gondii*

Toxoplasmosis in humans is not a notifiable disease in Denmark, and the incidence of toxoplasmosis in humans is unknown. It is estimated that approx. 1% of the human population seroconvert annually.

11. *Cryptosporidium parvum*

Cryptosporidiosis is not a notifiable disease in Denmark. It is estimated that approximately 180 human cases are diagnosed in Denmark annually. Most of these are acquired abroad.

12. Rabies

Rabies is a notifiable infection in both humans and animals. No domestically acquired cases were reported in 1997, but a total of 9 people were treated by prophylactic vaccination after exposure to bat bites. In 1997, 8 bats were found infected with rabies. One of the infected bats had bitten a boy.