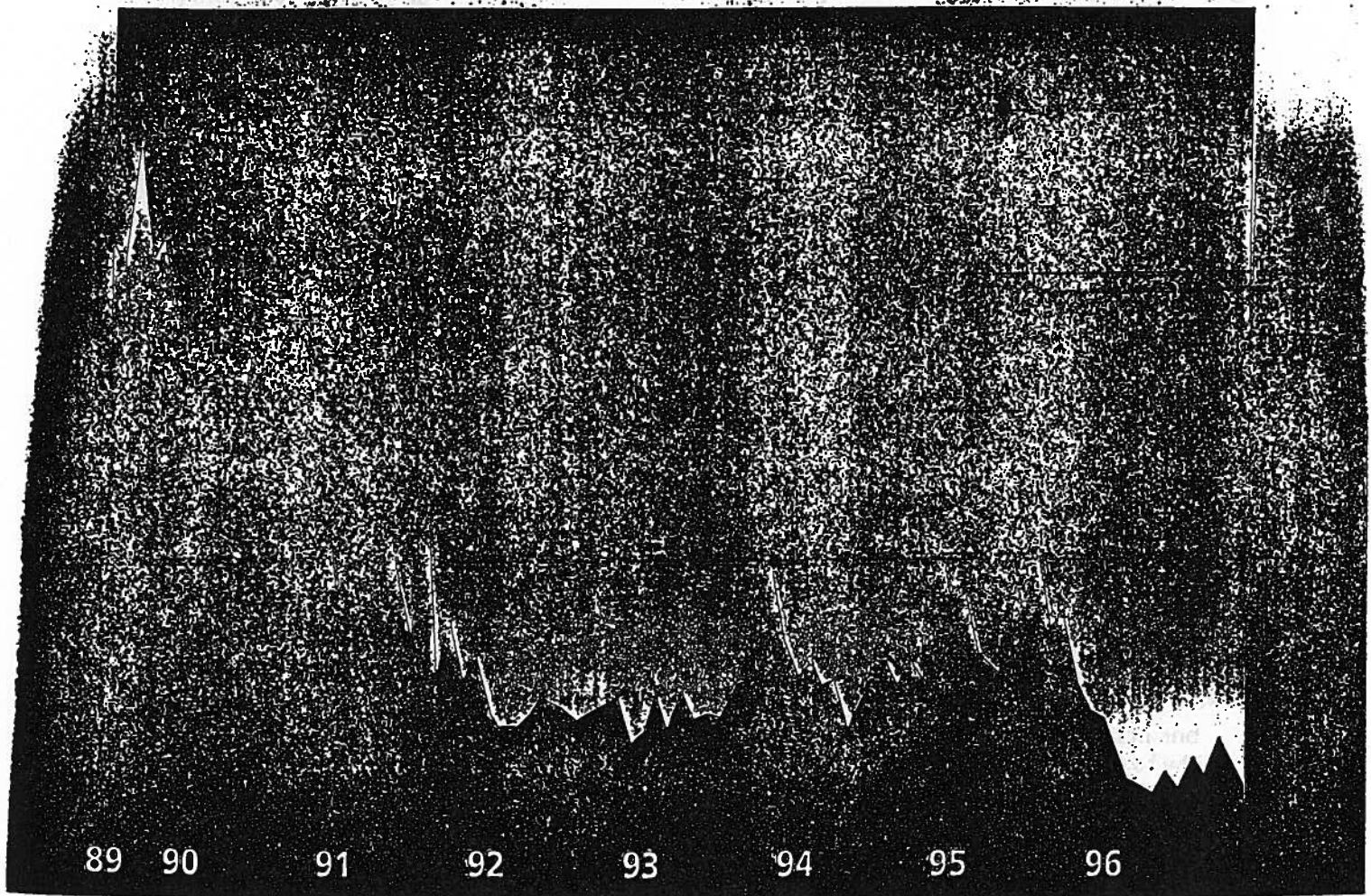




Annual Report on Zoonoses in Denmark 1996



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Ministry of Food, Agriculture and Fisheries

Annual Report on
Zoonoses in Denmark 1996

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Introduction

In March 1995, the third revision of the Danish plan for implementation of the Zoonosis Directive (hereafter called "the Danish plan") was submitted to the Commission. Further information about the origin and method of the collection of the data can be found in the Danish plan.

The data of this report have been collected from the institutions and laboratories mentioned above. This report has been edited by the Danish Zoonosis Centre and the Danish Veterinary Service.

Total number of livestock and herds in Denmark, 1995:

	Livestock	Herds
Cattle	2,090,373	30,250
Pigs	11,083,911	21,418
Laying hens	4,297,000	9,079
Broilers	12,585,000	863
Sheep	145,225	4,394

Source: The Statistical Yearbook 1996, Danmarks Statistik.

Approximate total number of animals slaughtered in 1996:

Cattle:	727,000
Pigs:	19.5 million
Broilers:	111.5 million

Source: Danish Veterinary Service, 4th. Department.

It should be noted that the majority of the egg production takes place in 416 holdings; that nearly all of the broiler production takes place in 332 holdings; and that 85% of the production of slaughter pigs takes place in 7,000 holdings.

Denmark covers an area of 44,000 sq km and has a population of 5.2 million people of which nearly 800,000 live in rural areas and the remaining 4.4 million live in urban areas.

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 result of the monitoring in 1996.

Feed processing

Process control is carried out by inspectors at least four times a year, when samples for microbiological examination are collected at the critical control points of the process.

In feed mills using heat treatment of the feeding stuff the samples are collected after heat treatment. When there is no heat treatment, the samples are collected from all processing steps including the raw materials.

The plants are inspected in order to check whether they comply with a national set of rules for good production hygiene, including checks on the mills compliance with the requirements to monitor the temperature of the heat treatment process at least every second hour.

As of December 31 1996, the Danish Plant Directorate carries out the feed processing control for 96 of 132 production plants. The remaining 36 plants are controlled by voluntary arrangements approved and monitored by the Danish Plant Directorate.

Additional inspections of the plants are implemented when Salmonella is detected in the samples or critical breaches of good hygiene are reported.

Feeding stuffs

The Danish Plant Directorate collects samples of feeding stuffs from all the production plants. The number of samples depends on the size of the production, but is increased if Salmonella is detected during the feed processing control or in the feeding stuffs.

Level of repeated incidence

In 1996 Salmonella was found in two or more samples in 12% of the plants corresponding to 2.2% of the total number of samples from the process control.

Compound feeding stuffs

The number of Salmonella in compound feeding stuffs in 1996 is also listed in table 1. Compared to the previous years the low level of Salmonella contamination declined further.

Straight feeding stuffs and raw materials

During the inspection of straight feeding stuffs and raw materials in 1996 Salmonella was found in 15 out of 621 samples corresponding to 2.4 % of the samples (Table 1). Salmonella has mainly been found in rape and soybeans.

Serotypes

The serotypes found in feeding stuffs in 1996 are listed in table 1. Few of the serotypes appear in connection with salmonellosis in livestock, while a proportion of the serotypes listed are isolated from sporadic cases of salmonellosis in humans.

Summary

The results of the Salmonella control by the Danish Plant Directorate indicate that the good hygienic quality of feeding stuffs has improved during the past year. Salmonella was found only in a small percentage of the feeding stuff samples.

Table 1. Control of Salmonella in compound feeds and feed processing 1996

	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	1791	1479	380	3022	621
Salmonella not detected	1789	1474	380	2955	606
Salmonella detected	2	5	0	67	15
Percent positive	0.10%	0.30%	0.00%	2.20%	2.40%
Serotypes	S. 4.12:b:- 2	S. Cubana 1 S. Derby 1 S. Mbandaka 2 Not typable 1		S. Agona 1 S. Amsterdam 2 S. Bareilly 1 S. Havana 8 S. Infantis 2 S. Lexington 1 S. Mbandaka 6 S. Meleagridis 7 S. Montevideo 5 S. Ohio 1 S. Orion 1 S. Senftenberg 8 S. Tennessee 7 S. 4.12:b:- 22 S. 13.3:- 1	S. Infantis 1 S. Lexington 2 S. Livingstone 1 S. Kentucky 1 S. Mbandaka 1 S. Orion var 15+ 1 S. Putten 1 S. Senftenberg 2 S. 4.12:b:- 5 Not typable 1

1 Includes feed for cattle, horses, sheep and rabbits

Table 2. Occurrence of zoonotic pathogens in broilers in Denmark in 1996

Category	Zoonosis	Zoonotic pathogen	Flock level		Slaughterhouse		Retail - broilers and products of broiler meat			Note:	
			Examined flocks	% positive flocks	N	% positive flocks	N	Neck skin			% positive samples
								Not heat treated	Heat treated		
I	Salmonellosis	<i>Salmonella</i> spp.	3,963	7.9	4,097	17.4	462	9.5	1,373	0.3	a
		<i>S. Enteritidis</i>	-	0.1	-	-	-	1.5	-	0	
		<i>S. Typhimurium</i>	-	2.6	-	-	-	1.1	-	0.15	
		Other serotypes	-	5.2	-	-	-	6.9	-	0.15	
II	Campylobacteriosis	<i>Campylobacter</i> spp.	1,030	35.3	-	-	274	39.8	303	0.7	b
		<i>C. jejuni</i>	-	30	-	-	-	-	-	-	
		<i>C. coli</i>	-	5	-	-	-	-	-	-	
		<i>C. lari</i>	-	0.3	-	-	-	-	-	-	

Data: Danish Veterinary Laboratory, Danish Veterinary Service, National Food Agency

a) Flocks investigated by 60 faecal samples 2-3 weeks prior to slaughter, and 50 neck skin samples at slaughter.

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

Table 3. Occurrence of *Salmonella* in layers in Denmark 1996

Category	Zoonosis	Zoonotic pathogen	Flocks	Animals	% positive flocks
I	Salmonellosis	<i>Salmonella</i> spp.	422	42,200	3.1
		<i>S. Enteritidis</i>	-	-	2.4
		<i>S. Typhimurium</i>	-	-	0.5
		Other serotypes	-	-	0.2

Data: Danish Veterinary Laboratory

a) Monitoring of flocks of egg layers has been carried out by examining 100 rectal swabs taken a few weeks before slaughter of each flock.

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 Service. The products are routinely examined for *Salmonella*. In 1996, 4 (3%) samples out of 123 pooled samples of the final products from rendering plants were found to be contaminated with *Salmonella*. The serotypes found were *S. Rissen*, *S. 4.12:b:-* (2 samples) and *S. Mbandaka*.

Poultry and poultry products

Samples from rearing and breeding establishments and from hatcheries have been collected according to the requirements of the Zoonosis Directive and examined at the Danish Veterinary Laboratory. The total number of such establishments with hens in the sector providing eggs for consumption is as follows: Rearing establishments: 6, multiplying: 13 and hatcheries: 7. In the sector producing broiler flocks the figures are: Rearing establishments: 32, multiplying: 62 and hatcheries: 9.

During 1996, infection with *S. Typhimurium* was confirmed in 2 flocks, both of which were destroyed. *S. Enteritidis* was not detected in any flock. No further flocks were suspected of infection with *S. Enteritidis* or *S. Typhimurium*.

Salmonella was monitored continuously by ante mortem control of all broiler flocks. Sixty faecal samples were collected per flock 2-3 weeks prior to slaughter. The percentage of positive flocks ranged from 4.1% to 14.6% per month with an average of 7.9% (Table 2, Figure 1).

Salmonella was detected in a total of 17.4% of the flocks after slaughter by investigation of 5 pooled samples each consisting of 10 samples of neck skin from each slaughtered flock (Table 2).

Layers and eggs

In 1996, 13 (3.1%) of 422 flocks investigated by the routine microbiological sampling of 100 cloacal swabs were found positive for *Salmonella* (Table 3).

On December 16 1996, 3 orders concerning *Salmonella* control and eradication in hens were issued by the Danish Veterinary Service. One

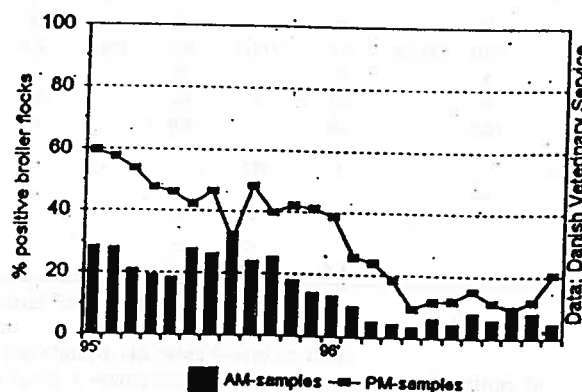


Figure 1. Percent *Salmonella* positive broiler flocks detected as a part of mandatory ante mortem and post mortem inspection 1995-96

concerning all *Salmonella* serotypes in all flocks producing eggs for hatching, one concerning *S. Enteritidis* and *S. Typhimurium* in flocks producing table eggs, and one concerning compensation for the value of hens and eggs destroyed and for consequential losses. The main changes compared to the order implementing the requirements of the zoonosis directive concerning *Salmonella* in multiplier flocks of hens since January 1994, are that the monitoring of multiplier flocks will be intensified and that infected multiplier flocks will be destroyed irrespective of serotype found. Furthermore all flocks involved in production of table eggs for sale must be monitored and flocks found to be infected with *S. Enteritidis* or *S. Typhimurium* will be destroyed.

Turkeys

Salmonella was detected in 66 pooled samples of 209 turkey flocks investigated by mandatory ante mortem inspection identical to the inspection of broilers. In contrast to broilers all products originating from flocks infected with *Salmonella* are heat treated.

Pigs and pork

A serological test for detection of *Salmonella* infection in pig herds was implemented during 1995. All herds producing more than 100 pigs for slaughter annually are monitored by this test. The herds are divided into three levels based on the number of samples with a serological reaction: Level 1 (no or very few reactors, intervention in the herd not required), level 2 (a higher proportion of reactors, the owner of the herd receives advice on how to reduce the prevalence of *Salmonella* in the herd) and level 3 (the proportion of reactors is too high, the

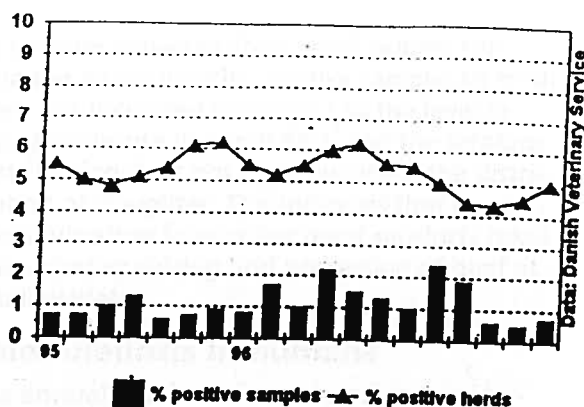


Figure 2. Percent *Salmonella* positive samples of fresh pork and percent positive herds, 1995-96

owner is required to seek advice, and in addition slaughter of pigs from the herd has to be carried out under special hygienic precautions). At the end of 1996 95% of the herds fell within level 1, 3.5% within level 2 and 1.5% within level 3.

A continuous programme for monitoring of *Salmonella* in pork at the slaughterhouses was initiated in July 1993. A total of 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 from 2.3% in August to 0.5% in November with an average of 1.3% through all of 1996 (Figure 2, Table 4). This is an increase compared to 1995 (0.8%). The distribution of *Salmonella* serotypes and phage types in pork at the slaughterhouses largely reflects the distribution of types in the herds (Table 9 and 11). It is noteworthy that *Salmonella* Choleraesuis is not present in Danish pig herds.

Table 4. Occurrence of zoonotic pathogens in pigs and pork in Denmark 1996

Category	Zoonosis	Zoonotic pathogen	Herd level		Slaughterhouse			Retail			Notes			
			Herds	Animals	% positive herds	Cuts of pork		Offal	Not heat treated			Heat treated		
						N	% positive samples		N	% positive samples*			N	% positive samples**
I	Tuberculosis	<i>M. bovis</i>	21,418	19mill	0	-	0	-	0	-	0	a		
	Brucellosis	<i>B. abortus</i>	-	-	0	-	-	-	-	-	-	b		
	Trichinosis	<i>Trichinella</i> spp.	21,418	19mill	0	-	0	-	0	-	0	a		
	Salmonellosis	<i>Salmonella</i> spp.	17,067	689,086	5.0	18,159	1.3	9,979	3.0	3,371	1.8	8,411	0.01	c
		<i>S. Enteritidis</i>	-	-	-	-	0	-	0	-	0	-	0	
<i>S. Typhimurium</i>		-	-	-	-	0.8	-	2.1	-	1.2	-	0		
	Other serotypes	-	-	-	-	0.5	-	0.9	-	0.6	-	0.01		
II	Campylobacteriosis	<i>Campylobacter</i> spp.	310	310	48.3	-	-	-	-	177	2	-	-	d
		<i>C. jejuni</i>	-	-	2	-	-	-	-	-	-	-	-	
		<i>C. coli</i>	-	-	46	-	-	-	-	-	-	-	-	
		<i>C. lari</i>	-	-	0.3	-	-	-	-	-	-	-	-	
		Coli infections	<i>E. coli</i> O157 (VT+)	-	-	-	-	-	-	-	524	0.4	-	-

Data: Danish Veterinary Laboratory, Danish Veterinary Service, National Food Agency

- All slaughter pigs examined in connection with meat inspection.
- Boars examined on admission to AI stations and before leaving the station. No cases found in 1996.
- A detailed table of *Salmonella* serotype distribution is shown in Table 9. Herds are monitored by serological testing. In this table herds belonging to level 2 and 3 are defined as *Salmonella* positive herds.
- Herds investigated by caecal samples from one animal per herd collected at slaughter.
- Presence of *E. coli* O157 in minced pork probably originates from beef as bovine serumprotein was detected in the positive samples.

Clinical salmonellosis was recorded in 78 herds (Table 5). The figure was determined by the number of herds submitting material from clinically affected animals to the laboratory. As can be seen there has been an increase in cases of clinical salmonellosis in pigs from 1995 to 1996.

At the retail level, *Salmonella* was found in a total of 1.8% of the samples of fresh pork and 0.01% of the samples of heat treated pork (Table 4). The serotype distribution largely reflects the serotypes found in the herds and at slaughter.

Cattle and beef

Herds of cattle are only investigated for *Salmonella* infection on clinical indications (salmonellosis). Salmonellosis was diagnosed in 87 (0.3%) cattle herds in 1996. The predominant serotypes isolated from clinical cases in cattle in 1996 were *S. Dublin* (70%) and *S. Typhimurium* (24%) (Table 6).

At cattle slaughterhouses approximately 250 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 1.3% during 1996 with an average of 0.5%. This is a reduction compared to 1995 (0.6%). The predominant serotypes were *S. Typhimurium* (78.2%) and *S. Dublin* (21.8%) (Table 7 and 9).

Table 5. Pigs: Isolations of *Salmonella* in material from outbreaks of clinical disease

Serotype	No. 1996	No. 1995	No. 1994	No. 1993	No. 1992	No. 1991
Agona	-	-	-	1	1	-
Anatum	-	-	-	-	1	-
Berta	-	-	-	1	-	-
Derby	3	-	-	6	4	-
Dublin	-	1	-	-	-	1
Enteritidis	-	1	-	-	-	-
Falkensee	-	-	-	-	2	-
Hadar	1	-	1	-	-	1
Heidelberg	-	-	1	-	-	-
Infantis	2	-	2	10	4	1
Infantis/Derby	1	-	-	-	-	-
Livingstone	-	-	2	2	-	-
Mbandaka	1	-	1	2	2	-
Meleagridis	1	-	1	-	-	-
Ohio	-	-	-	1	-	-
Orion	-	-	-	-	1	-
Panama	-	-	2	-	2	-
Putten	1	-	-	-	-	-
Saint paul	-	-	-	1	-	-
Stanley	1	-	-	-	-	-
Typhimurium	61	60	83	91	112	42
Typhimurium/Infantis	-	-	-	1	-	-
Typhimurium/Ohio	-	-	-	-	1	-
Typhimurium/typable	2	-	-	-	-	-
Worthington	-	-	-	2	1	3
1.4.12:d-	1	-	-	-	-	-
4.12:b:-	3	-	3	7	14	4
16:d:-	-	-	-	1	1	-
Non typable	-	-	-	-	-	1
Total	78	62	96	126	146	53

Data: Danish Veterinary Service, Danish Veterinary Laboratory.

In samples collected from retail outlets the number of *Salmonella* positive samples of fresh beef has increased compared to the level in slaughterhouse (mean 0.9%), and the serotype distribution does not entirely reflect the distribution at slaughter. This indicates that cross contamination from other meat products takes place during cutting and processing of beef at retail outlets.

Salmonellosis in humans

The annual number of registered cases of human salmonellosis caused by zoonotic *Salmonella* serotypes increased from 1985 - 1994, where a maximum of 4,276 cases (82.3 cases per 100,000 inhabitants) was registered. In 1995 and 1996 the number of cases decreased. It is estimated that approx. 85% of the cases are domestically acquired, whereas the remaining 15% may have been contracted while travelling abroad. In 1996 the number of recorded cases decreased to a total of 3,259 (62.7 per 100,000 inhabitants). Predominant serotypes were *S. Enteritidis* (1771 cases) and *S. Typhimurium* (907 cases), whereas the remaining cases were distributed among approximately 90 different serotypes (Table 8). Among these *S. Virchow* (66 cases), *S. Hadar* (62 cases), *S. Berta* (33 cases) and *S. Infantis* (30 cases) predominated (Table 9). The phage type

Table 6. Cattle: Isolations of *Salmonella* in material from outbreaks of clinical disease

Serotype	No. 1996	No. 1995	No. 1994	No. 1993	No. 1992	No. 1991
Agona	-	-	-	-	-	1
Agona/Typhimurium	-	-	-	-	-	1
Berta	-	-	-	-	-	-
Brandenbrug	1	-	-	-	-	-
Dublin	60	105	92	71	143	167
Enteritidis	2	3	2	5	2	8
Enteritidis/4.12:b:-	-	-	-	-	1	-
Farmsen	-	-	-	-	1	1
Give	-	-	-	-	-	1
Hadar	-	-	-	-	1	1
Havana	-	-	-	1	-	-
Infantis	-	-	-	3	-	3
London	-	-	-	-	-	2
Mbandaka	-	-	-	-	1	1
Montevideo	-	-	-	-	1	2
Ohio	-	-	-	-	1	-
Ruiru	-	-	-	-	-	1
Senftenberg	-	-	-	-	-	1
Tennessee	-	-	-	-	1	1
Typhimurium	20	54	52	46	64	46
Typhimurium/Tennessee	-	-	-	1	-	-
Vejle	-	-	1	-	-	-
Y:1,5	-	-	-	-	-	1
1.4.12:-:-	1	-	-	-	-	-
1.9.12:-:-	3	-	-	-	-	-
4.12:b:-	-	-	-	-	-	3
Total	87	162	147	127	216	241

Data: Danish Veterinary Service, Danish Veterinary Laboratory.

distribution of *S. Typhimurium* and *S. Enteritidis* is shown in table 10 and 11.

The number of infections caused by *S. Enteritidis* has decreased in 1996 compared to 1995 (Figure 3). Investigations primarily based on epidemiological typing of bacterial isolates and investigations of outbreaks have pointed to the consumption of contaminated table eggs as the major source of infection. Eggs are still estimated to account for approximately half of all human *Salmonella* infections in Denmark (Figure 4).

Infections caused by *S. Typhimurium* have increased from 1995 to 1996. An outbreak in Funen in the fall comprising about 170 registered cases is responsible for this increase. Epidemiological investigations based on typing of bacterial isolates combined with the result of a case control investigation, traced the source to pork produced at a local slaughterhouse. Another outbreak at a hospital in Jutland was caused by the same *S. Typhimurium* strain. The hospital had received meat from the slaughterhouse in question and the two outbreaks were assumed to be connected.

The number of sporadic cases due to *S. Typhimurium* has decreased during 1996. This is primarily attributed to the decrease of *S. Typhimurium* in broilers observed through 1996 (Figure 1).

In the Copenhagen area, a hospital-outbreak caused by the multi resistant *S. Typhimurium* DT104 occurred in October 1996. The source of the outbreak, which included 6 patients was never detected. However, the outbreak did initiate a thorough investigation of *S. Typhimurium* isolates gathered from Danish livestock and food stuffs through 1996. By this it was discovered that isolates formerly characterized as phage type RDNC (12+18) were actually DT104. A total

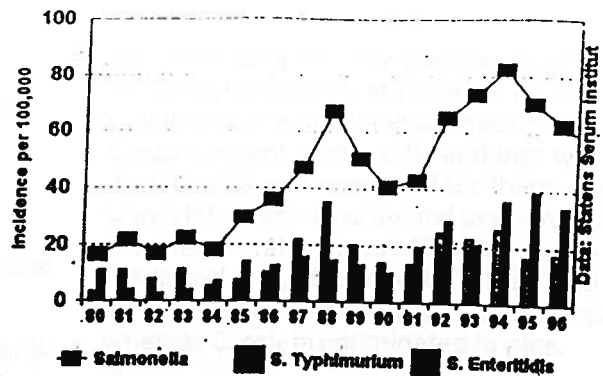


Figure 3. Registered cases of human salmonellosis in Denmark 1980-96

of 4 pigherds were retrospectively found infected with *S. Typhimurium* DT104. Of these herds, 2 also kept cattle on the farm. So far the distribution of *S. Typhimurium* DT104 in Danish livestock seems very limited. Precautions have been taken to prevent this particular type from becoming established in the primary production, as well as from spreading to the consumers.

During 1996, human and animal isolates of *Salmonella* were continuously compared by different epidemiological typing methods such as phage typing and DNA fingerprinting. Because most of the meat consumed in Denmark is domestically produced, it was possible to estimate the significance of different animal products as sources of human salmonellosis in Denmark in 1996 (Figure 4). Compared to 1995 pork has increased, whereas poultry has decreased, as source of human salmonellosis in 1996.

Only in the case of outbreaks of probable food-borne intestinal disease (defined as two or more cases associated with the same potential source of infection), the Municipal Food and Environ-

Table 7. Occurrence of zoonotic pathogens in cattle and beef in Denmark 1996

Category	Zoonosis	Zoonotic pathogen	Herd level		Slaughterhouse				Retail				Note:	
			Herds	Animals	Cuts of beef		Offal		Not heat treated		Heat treated			
					% positive samples	N	% positive samples	N	% positive samples	N	% positive samples	N		
I	Tuberculosis	<i>M. bovis</i>	-	-	0	All	0	All	0	-	0	-	0	a
	Brucellosis	<i>B. abortus</i>	-	-	0	-	-	-	-	-	-	-	-	b
	Salmonellosis	<i>Salmonella</i> spp.	-	-	-	1,927	0.5	1,166	1.4	3,306	0.9	3,342	0.03	c
		<i>S. Enteritidis</i>	-	-	-	-	0	-	0	-	0	-	0	
		<i>S. Typhimurium</i>	-	-	-	-	0.2	-	0.1	-	0.5	-	0	
	<i>S. Dublin</i>	-	-	-	-	0.3	-	1	-	0.2	-	0		
	Other serotypes	-	-	-	-	0	-	0.3	-	0.2	-	0.03		
II	Campylobacteriosis	<i>Campylobacter</i> spp.	-	93	43	-	-	-	-	198	2	-	-	d
		<i>C. jejuni</i>	-	-	40	-	-	-	-	-	-	-	-	
		<i>C. coli</i>	-	-	3	-	-	-	-	-	-	-	-	
		<i>C. lari</i>	-	-	0	-	-	-	-	-	-	-	-	
	Coli infections	<i>E. coli</i> O157 (VT+)	-	-	-	-	-	-	1,584	0.1	-	-	e	

Data: Danish Veterinary Laboratory, Danish Veterinary Service, National Food Agency

- a) Bulls at AI stations are examined by TB test. Notifiable disease. No cases diagnosed in 1996.
- b) Bulls examined on admission to AI stations and annually after entry. Clusters of abortion notifiable. Notifiable disease in cattle.
- c) Herds only diagnosed on clinical indication, see also table 7.
- d) Herds were investigated by caecal samples from one animal per herd were collected at slaughter.
- e) Samples of minced beef collected at retail outlets during 1996.

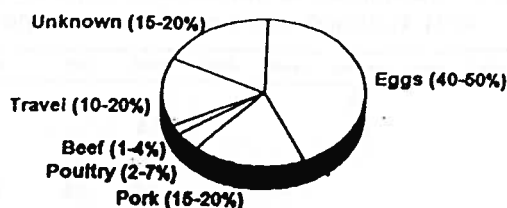


Figure 4. Estimated sources for human salmonellosis in Denmark 1996

mental Laboratories will be requested to identify a potential common source of infection. In 1996, 11 outbreaks comprising a total of 203 patients were investigated. The results of these investigations indicated that eggs were the most common source of zoonotic foodborne outbreaks in 1996 (Table 12).

A total of 1,014 persons reported to the local medical practitioner to have contracted putative food borne infection in 1996, 99 of these assumed they had contracted their infection abroad. Laboratory diagnosed general and family outbreaks registered at Statens Serum Institut in 1996 is shown in table 13.

2. *Campylobacter jejuni/coli*

Poultry, pigs and cattle

A continuous programme for monitoring thermophilic campylobacters (*C. jejuni*, *C. coli* and *C. lari*) in broilers, pigs and cattle was initiated by The Danish Veterinary Laboratory at the end of 1995. Faecal samples were obtained every month from all major slaughterhouses.

Cloacal swabs from individual broiler chickens at slaughter were examined. Only one animal per

flock was sampled. The prevalence of thermophilic campylobacters was found to be 35.3% with *C. jejuni* as the predominant species (Table 2). Caecal content from cattle and pigs was sampled at slaughter and examined for thermophilic campylobacters. One animal per herd was sampled. The prevalence was 43% and 48.3% for cattle and pigs, respectively (Table 7 and 4). In cattle, *C. jejuni* was the most common species, whereas *C. coli* predominated in pigs.

Products from retail outlets

The prevalence of thermophilic *Campylobacter* species (*C. jejuni*, *C. coli* and *C. lari*) in samples of raw meat from Danish retail outlets was determined in a nationwide survey performed by the National Food Agency and the Municipal Food and Environmental Laboratories.

Poultry products were examined in the spring (April/May) and in the autumn (September/October) of 1996. In Danish produced raw chicken products, the prevalence of campylobacters showed an increase from 29% in spring to 48% in autumn. This seasonal variation was also seen in a similar survey in 1995. Raw turkey and imported chicken had contamination levels of 24-43% without any clear seasonal variation. Less than 1% of heat treated poultry products were contaminated with campylobacters. Raw beef and pork was examined for *Campylobacter* spp. in the autumn (November/December) and the prevalence was found to be 2% for both products (Table 7 and 4). This is in agreement with the prevalences found in 1995. Also game birds were examined in the autumn, and the prevalence of campylobacters was 19% (144 samples).

Table 8. Zoonoses in humans 1996 - incidence and trends of 5 and 10 years

Category	Zoonosis	Agent	1996		Five years trend					10 years	Note:
			Cases per 100,000 inh.	Registered cases	1995	1994	1993	1992	1991		
I	Tuberculosis	<i>M. bovis</i>	0.2	11	9	5	7	9	3	8	a
	Brucellosis	<i>B. abortus/melitensis</i>	0	0	0	0	0	0	0	0	a
	Trichinosis	<i>T. spiralis/nativa</i>	0	0	0	0	0	0	0	0	a
	Salmonellosis	<i>Salmonella</i> spp.	62.7	3,259	3,654	4,276	3,802	3,379	2,238	1,858	b
		<i>S. Enteritidis</i>	34.1	1,771	2,070	1,876	1,093	1,511	1,013	654	
		<i>S. Typhimurium</i>	17.4	907	848	1,363	1,193	1,289	705	540	
	Other serotypes	11.2	581	736	1,037	1,516	579	520	664		
II	Campylobacteriosis	<i>C. coli/jejuni</i>	57.2	2,973	2,601	2,196	1,776	1,129	1,261	1,101	
	Echinococcosis	<i>E. multilocularis/granulosus</i>	0	0	0	0	0	0	0	0	c
	Listeriosis	<i>L. monocytogenes</i>	0.8	39	29	23	27	24	32	43	d
	Rabies		0	0	0	0	0	0	0	0	e
	Toxoplasmosis	<i>T. gondii</i>	-	-	-	-	-	-	-	-	f
	Yersiniosis	<i>Y. enterocolitica</i>	10.2	532	779	643	710	901	929	1,359	
	Coll infections	<i>E. coli</i>	0.8	40	28	35	28	33	49	43	
		O157	0.1	7	2	2	1	3	6	0	

Notes:

- Notification not mandatory. Cases of tuberculosis due to reactivation of latent infection in elderly.
- Only first isolations registered.
- Notification not mandatory. A few imported cases occur.
- Notification mandatory from 1986.
- Notification mandatory. No domestical or imported cases.
- Notification not mandatory. Approx. 1% of the population seroconvert annually.

Table 9. Serotype distribution of *Salmonella* from animals, meat at slaughterhouses and humans in Denmark 1996

Serotype	Pigs	Pork	Cattle	Beef	Broilers	Layers	Ducks	Turkeys	Pigeons	Human
<i>S. Agona</i>	-	-	-	-	2.3	-	-	9.5	-	0.7
<i>S. Anatum</i>	-	0.2	-	-	1.0	-	-	1.0	-	0.3
<i>S. Berta</i>	-	-	-	-	-	-	-	-	-	1.0
<i>S. Bredeney</i>	0.1	0.8	-	-	-	-	-	-	-	-
<i>S. Derby</i>	4	4.2	-	-	-	-	-	-	-	0.2
<i>S. Dublin</i>	0.1	0.4	70	78.2	-	-	-	-	-	0.4
<i>S. Enteritidis</i>	0.2	-	2	-	1.8	76.9	60.0	1.5	-	54.3
<i>S. Hadar</i>	-	-	-	-	2.3	-	-	0.3	-	1.9
<i>S. Havana</i>	0.2	2	-	-	-	-	-	-	-	<0.1
<i>S. Heidelberg</i>	0.1	0.6	-	-	5.2	-	-	47.5	-	0.5
<i>S. Indiana</i>	-	-	-	-	6.5	-	-	-	-	0.2
<i>S. Infantis</i>	4.2	6.5	-	-	16.2	7.7	-	-	-	0.9
<i>S. Lexington</i>	-	-	-	-	-	-	-	6.0	-	-
<i>S. Livingstone</i>	2.2	1.3	-	-	0.3	-	-	-	-	<0.1
<i>S. Manhattan</i>	-	1.1	-	-	-	-	-	-	-	-
<i>S. Mbandaka</i>	0.5	-	-	-	0.3	-	-	-	-	0.4
<i>S. Meleagridis</i>	1.6	3.4	-	-	-	-	-	-	-	-
<i>S. Muenster</i>	-	-	-	-	3.9	-	-	21.4	-	<0.1
<i>S. Newport</i>	-	-	-	-	0.5	-	-	-	-	0.8
<i>S. Saintpaul</i>	-	-	-	-	0.5	-	-	0.8	-	0.4
<i>S. Senftenberg</i>	-	-	-	-	1.3	-	-	1.0	-	0.2
<i>S. Tennessee</i>	0.2	-	-	-	0.8	-	-	0.8	-	-
<i>S. Typhimurium</i>	78.2	74.1	24	21.8	26.6	15.4	20.0	0.1	91.2	27.8
<i>S. Virchow</i>	-	-	-	-	0.3	-	-	-	-	2.0
<i>S. 4:12:b:-</i>	1.2	1.7	-	-	25.1	-	-	5.5	-	<0.1
<i>S. 6:7:-:-</i>	0.2	-	-	-	0.3	-	-	-	-	-
<i>S.1.9.12:-:-</i>	-	-	2	-	-	-	-	-	-	-
<i>S.1.9.12:LV:-</i>	0.5	2.7	-	-	-	-	-	-	-	-
Others	6.5	1	2	-	4.8	-	20.0	4.6	8.8	7.9
Total	100	100	100	100	100	100	100	100	100	100
Number typed	827	476	100	23	383	13	10	398	34	3259

Data: Danish Veterinary Laboratory, Danish Veterinary Service, Statens Serum Institut

Table 11. Phage type distribution (%) of *S. Typhimurium* from animals and humans in Denmark 1996

Phage type	Pigs	Pork	Cattle	Beef	Broilers	Humans
3	-	-	-	-	2.1	0.3
8	-	-	-	-	2.1	0.3
10	4.7	3.3	4.0	8.3	-	1.0
12	56.6	59.6	40.0	41.7	6.2	68.7
15a	3.1	6.8	4.0	-	-	6.7
17	4.1	1.8	4.0	-	-	0.5
41	0.6	0.1	4.0	-	28.9	0.5
66	6.2	7.3	12.0	16.7	4.1	4.4
104	0.4	-	4.0	-	-	2.4
110	2.6	0.7	12.0	-	13.4	3.4
120	-	-	-	-	3.1	2.4
125	-	-	-	-	1.0	-
135	1.3	1.2	8.0	-	32.0	1.0
177	-	-	-	-	-	0.2
193	5.3	5.5	4.0	8.3	2.1	1.0
195	-	-	-	-	1.0	-
U288	-	-	-	-	-	2.1
RDNC	-	-	-	-	-	4.7
NT	-	-	-	-	1.0	2.9
f1/r1	-	-	-	-	3.1	1.5
Others	15.0	13.7	4.0	25.0	0.9	2.0
Total	100	100	100	100	100	100
No. typed	680	1688	25	12	97	613

Data: Danish Veterinary Laboratory

Table 10. Phage types of human *S. Enteritidis* (%) in Denmark 1996

Phage type	Total %
1	3.2
4	23.0
6	49.2
6a	1.9
8	15.1
21	1.3
25	2.4
34	-
RDNC	0.9
NT	0.9
Others	2.1
Total	100
Number typed	531

Data: Danish Veterinary Laboratory

Table 12. Outbreaks of food borne zoonotic diseases registered by the Municipal Food and Environmental Laboratories in 1996

Zoonotic agent	No. patients involved	Suspected source	Confirmed by culture
<i>S. Enteritidis</i>	9	Egg	Yes
do.	15	Egg	No
do.	9	Egg	Yes
do.	6	Egg	Yes
do.	5	Egg	No
do.	45	Egg	No
do.	15	Egg	Yes
do.	5	Egg	Yes
do.	65	Egg	No
<i>S. Hadar</i>	19	Turkey/ Cordon Bleu	Yes
<i>S. Typhimurium</i> DT104	5	Poultry	No
Total:	198 Persons involved in 11 outbreaks		

Data: National Food Agency

Table 13. Registered outbreaks of food borne zoonotic diseases diagnosed at Statens Serum Institut 1996

Zoonotic pathogen	General outbreaks			Family outbreaks		
	No. of outbreaks	No. patients involved	Suspected source	No. of outbreaks	No. patients involved	Suspected source
Campylobacter	14	2-app. 2,800c)	Contaminated water(1), unpast.milk (1), poultry (2), unknown (10)	8	3-14	Poultry (5), unknown (3)
S. Enteritidis	15	3-60	Mousse (2), buttermilk dish (1), sausages (2), minced beef (1), unknown (5)	28	3-20	Buttermilk dish (6), layer cake (6), ice cream (3), eggs (2), others (3) unknown (4)
S. Typhimurium	7	2-app. 10,000c)	Pork (1), cold buffet (1), meat (2), unknown (3)	3	5-10	Barbecued pork, turkey, unknown
Others	9 a)	2-35	Meat (1), unknown (8)	9 b)	2-12	Poultry (2), ice cream/meat balls (1), unknown (6)
Unknown	39	3-80	Minced meat (2), poultry (2), unknown (35)	17	5-25	Poultry (2), barbecued pork (1), minced meat (1), oysters (1), ice cream (1), mousse (1), unknown (10)

a) S. Berta (3), S. Hadar (1), Yersinia (3), Sh. sonnei (2)

b) Sh. sonnei (3), S. Paratyphi B (2), S. Virchow (2), S. Saintpaul (1), S. O:4,5,12 (1)

c) Estimated no. of cases based on telephone interviews

Wild mammals and birds

During the period from November 1992 until December 1996 a total of 529 carcasses of wild mammals and birds found dead have been examined for infection with *Campylobacter* spp. Of these 280 were from 1992-95 and 249 from 1996. The results are shown in table 14. Of the 97 positive isolates 45% were found to be *C. jejuni*, the rest belonged to other strains, some of which were atypical.

Pet animals: Dogs and cats

Occurrence of thermophilic *Campylobacter* in healthy dogs and cats (age 11-17 weeks) was also examined in 1996. Twenty-nine percent of 72 faecal samples from dogs and 5% of 42 faecal samples from cats were positive for campylobacter. In dogs, *C. jejuni* was the predominant speci-

Table 14. Occurrence of thermophilic *Campylobacter* spp. in wild mammals and birds.

Animal group	1996		1992 to 1995	
	N	% positive samples	N	% positive samples
Deer	10	10	15	13
European Hare	36	8	2	50
Red fox	14	21	120	17
Other mammals	102	14	51	14
Water birds	23	26	29	31
Other birds	64	28	63	21
Total	249	18	280	19

Data: Danish Veterinary Laboratory.

es, but a few *C. upsaliensis* and *C. coli* were also detected. In cats only *C. upsaliensis* was detected.

Campylobacteriosis in humans

The human incidence of campylobacteriosis increased from 2,601 cases in 1995 to 2,973 cases in 1996 (Table 8, Figure 5). Compared to 1992 (1,129 cases) the incidence has more than doubled over these 4 years, which is a major cause for concern. At the moment the reason for this increase is not entirely known, but several investigations have been initiated with the aim of tracing the sources of *Campylobacter* infections for humans and reducing the incidence of human campylobacteriosis in Denmark.

In January - February 1996 a small town in northern Jutland experienced an outbreak caused by corporation water contaminated through a leak in the sewerage system. 110 residents and visitors were culture positive for *C. jejuni*, whereas Enteraggregative *E. coli* (EAggEC) was demonstrated in 8 cases. Of these, 4 patients were infected with both agents. Based on telephone interviews it was estimated that approximately 2,800 people were affected by the outbreak. Genotypic examination of isolates from the contaminated water demonstrated the same strain of *C. jejuni* as the one encountered from the stored human isolates (n=29). In addition 2 serotypes of EAggEC was found in the water supply and in 6 of the 8 patients from which EAggEC was isolated. The significance of this finding is not clear.

The serotype distribution of *C. jejuni* and *C. coli* in livestock and humans is shown in table 15 and 16, respectively.

Table 15. Serotype distribution (%) of *Campylobacter jejuni* from animals and human patients (heat-stable antigens, "Penner" serotypes).

Serotype	Cattle	Broilers	Humans
1,44	5	21	18
2	31	22	26
3	-	3	4
4,13,16,43,50,64	12	15	18
5	2	1	4
6,7	7	5	1
11	7	1	2
12	-	1	2
19	7	4	2
21	7	1	1
23,36	7	5	1
37	-	1	3
53	-	-	3
55	-	-	3
Others	15	20	12
No. typed	42	78	136

Data: Danish Veterinary Laboratory

Table 16. Serotype distribution (%) of *Campylobacter coli* from animals and human patients (heat-stable antigens, "Penner" serotypes).

Serotype	Pigs	Broilers	Humans
5	13	20	-
24	16	13	11
30	16	20	33
46	19	7	11
54	11	13	11
56	8	-	11
Others	17	27	23
No. typed	113	13	9

Data: Danish Veterinary Laboratory

3. *Yersinia enterocolitica*

Yersiniosis in Denmark is almost exclusively caused by *Yersinia enterocolitica* serotype 0:3, biotype 4 identical to the *Yersinia* types isolated from Danish pigs and pork. More than 50% of human yersiniosis cases are seen in children below 5 years of age. The incidence of yersiniosis has decreased since 1985. In 1996, 529 cases of *Y. enterocolitica* serotype 0:3 were registered. The primary source of *Yersinia* in Denmark is believed to be pigs. Most Danish slaughter pigs are assumed to harbour *Yersinia enterocolitica* serotype 0:3 biotype 4.

4. *Listeria monocytogenes*

In 1996, 39 human cases of *Listeria monocytogenes* infections were registered. This is the highest incidence since 1986, where an epidemic caused by a particular strain was observed. However, in 1996 no single phage type was isolated from more than 4 patients. Consequently, there is no indication of a new epidemic. The reason for the increase in the incidence of human listeriosis in 1996 can for the time being not be explained.

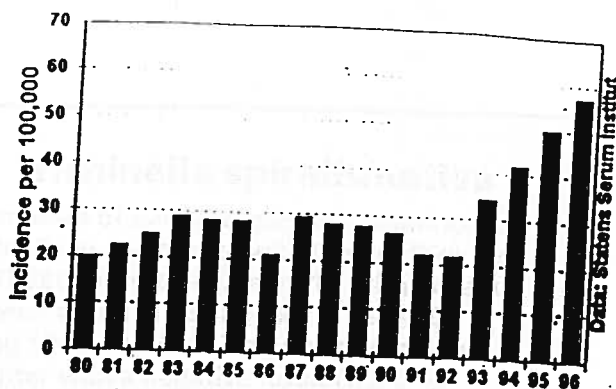


Figure 5. Incidence per 100,000 of human campylobacteriosis in Denmark 1980-96

5. *Escherichia coli* (EHEC)

The problem of zoonotic *E. coli* infections remains very low in Denmark and so far no outbreaks caused by EHEC have been recorded. The reason for this favourable situation is not entirely clear. Verotoxin producing *E. coli* (VTEC) 0157 have been found sporadically in Danish cattle herds and on carcasses of newly slaughtered cattle.

During 1996 a screening of fresh meat products from retail outlets was carried out by the National Food Agency and the Municipal Food and Environmental Laboratories. Of 1,584 samples of minced beef 2 samples were found positive for VT producing *E. coli* 0157. 524 samples of minced pork were examined. Of these, 2 were positive for VT producing *E. coli* 0157. The VT positive samples of minced pork were by an ELISA-method demonstrated to contain bovine serumprotein indicating that cross-contamination from beef to pork had occurred.

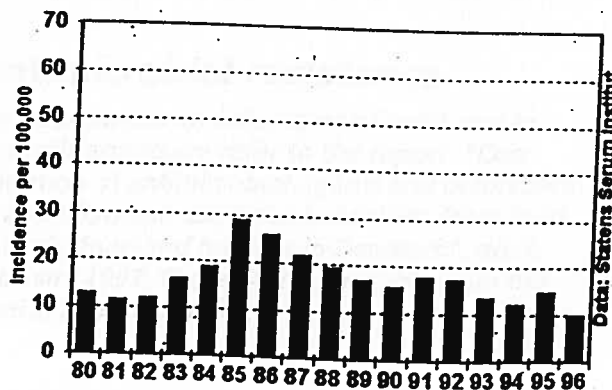


Figure 6. Incidence per 100,000 of human yersiniosis in Denmark 1980-96

6. *Mycobacterium bovis*

In accordance with Commission Decision 80/984/EEC, Danish cattle herds have been regarded officially free from bovine tuberculosis (TB) since 1980. TB 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 1988-89, 13 deer farms were found to be infected with bovine tuberculosis and until 1994 another 3 farms were found to be affected. Eradication measures were taken and restrictions have been lifted on all 16 farms. In 1995 and 1996, no deer farm was known to be infected with TB. All deer farms were surveyed through tuberculin testing of animals more than 1 year old or through meat inspection of slaughtered animals.

In 1996, 11 cases (0.21 cases per 100,000 inhabitants) of human tuberculosis caused by *M. bovis* were registered. No case of human tuberculosis caused by *Mycobacterium bovis* was associated with transmission from animals or food in Denmark. The few cases registered each year are predominantly seen in elderly persons and regarded as reactivation of a latent infection acquired years ago 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. Brucellosis in cattle has not been diagnosed since 1962. In 1994 one case of *B. suis* biotype 2 occurred in a herd of free range sows and boars; no cases occurred in pigs in 1996. Bulls and boars are subject to pre-entry serological examination before entering AI-stations. After entering, bulls are serologically examined annually and boars 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 I, chapter VIII. *Trichinella* has not been found in Danish pigs since 1930. During 1996, 19,474,622 pigs were examined at slaughter with a negative result (Table 4).

A national programme for screening of *Trichinella* infections in wild foxes was initiated in 1995. In 1996, 3,133 forelegs of foxes collected by hunters across the country were examined for *Trichinella*. Very low grade infestations were found in 3 foxes from the same geographical area. The 3 samples were sent to the reference laboratory in Rome. *Trichinella* was confirmed only in one sample, and there were too few organisms to make a final identification of the type.

No domestically acquired cases of human trichinosis were recorded in 1996. 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 1996, 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 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.

Antimicrobial resistance

For information on antimicrobial resistance in zoonotic agents we refer to the report: "Consumption of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from food animals, food and humans in Denmark", no. 1, February 1997. The report is available from the Danish Zoonosis Centre.