

# Chapter 2.1

## REPORTS OF *SALMONELLA* IN CATTLE

Results are given for adult cattle (10 months of age and older), calves (less than 10 months of age) and cattle of all ages (adult cattle, calves and cattle of unknown age). All isolations are recorded by the age of the individual animal. If an incident involves both adult cattle and calves then the age of the index case is used to classify the incident. For example, an incident affecting calves and adults in which the first case was reported in a calf would be reported as a calf-associated incident, but all isolations would be recorded separately for calves and adult cattle. It is therefore possible that the number of incidents of a particular serovar in one age class may be zero, although several isolations are listed.

There were 8.76 million cattle in Great Britain in 2005, 1.6% less than in 2004 and 0.8% less than in 2003. Over half a million adult cattle were slaughtered during the FMD epidemic in 2001. 698,594 cattle were slaughtered in the Over Thirty Months Scheme (OTMS) of the Government's control programme for Bovine Spongiform Encephalopathy (BSE) during 2005 which ended in November 2005. There have been some changes in the cattle industry with fewer larger farms staying in business in recent years and in some areas more male calves are being kept alive and reared either on their farm of origin or other farms than in recent years. Larger farms with increased numbers of young calves could potentially increase the risk of *Salmonella* isolations. Additional changes post-FMD included increased requirements to clean and disinfect vehicles and livestock movement restrictions, both of which would have been expected to have reduced *Salmonella* transmissions between premises in recent years.

The number of diagnostic submissions from cattle reported to the VIDA database in 2005 decreased to 39,321, a 2% decrease compared to 2004, 14% decrease compared to 2003 and 10% less than in submissions recorded in 2002. In 2001 there were fewer diagnostic submissions (31,280) due to the FMD epidemic (see Introduction). Many farms that were de-populated during the FMD epidemic have been re-stocked and in some cases clinical disease including salmonellosis was reported subsequently. *Salmonella* data for 2001 are included in italics in the tables because it is not possible to evaluate temporal trends using the 2001 data because of the uncertain impact of FMD control measures.

There is no routine *Salmonella* monitoring of cattle in Great Britain, therefore the majority of isolates come from cattle with clinical disease.

The number of reports is dependent on the total cattle population and number of diagnostic submissions to government veterinary laboratories. As in previous years, the majority (93%) of *Salmonella* reports (n=831) in cattle were from samples taken from clinical diagnostic purposes (see Table 1, Chapter 1) and came from animals on farms.

There were 11% less *Salmonella* incidents in cattle reported in 2005 (831) as compared to 2004 (936) associated with a decrease in diagnostic submission numbers. New *Salmonella* serotypes reported in 2005, as compared with the last five years, were *S. Havana* (in adult dairy cattle, with reported clinical signs of diarrhoea), *S. Indiana* (in dairy cattle of mixed age), *S. Kentucky* (in calves in a suckler beef unit, with reported clinical signs of diarrhoea) and *S. enterica* subspecies *diarizonae* structure 61:k:1,5,7 (two reports in adult cattle, one of which was in a dairy herd and the other in a suckler beef herd, and two reports in calves in suckler beef units, all of which had diarrhoea). *Salmonella* serotypes that have not been reported since 2000 include *S. Livingstone*, *S. Orion*, *S. Rubislaw* and *S. Ruiru*. Of the 831 incidents in cattle, 53% were in adult cattle, 38% in calves and 10% in cattle of unknown age. For the seventh year, in 2005 *S. Dublin* was the most common (66% of incidents) serovar reported in cattle, but its relative proportion has decreased compared to 2004 (71% of the *Salmonella* incidents in cattle).

### ***Salmonella* Dublin**

For the seventh consecutive year, *S. Dublin* was the most common serotype in adult cattle (63% of incidents; Table 12) and calves (78% of incidents; Table 14). The relative proportion of *S. Dublin* in adult cattle remained the same, while the relative proportion of *S. Typhimurium* decreased (from 17 to 10%) in 2005 compared to 2004 (Table 12). However, the relative proportion of *S. Dublin* in calves decreased (from 84% to 78%), while the relative proportion of *S. Typhimurium* increased (from 8% to 13%) in 2005 compared to 2004 (Table 14). There continues to be a seasonal increase in the number of incidents in the autumn months (Figure 6). This is likely to be associated with housing stress as well as stress associated with an increased number of calving and abortions seen at that time. *S. Dublin* was the 3rd most common infectious cause of bovine fetopathy in GB (11.4% of diagnosed submissions; VIDA 2005). There was no regionality seen in the number of reports of *S. Dublin* in 2005. *Salmonella* Dublin infection is associated with sporadic cases as well as outbreaks of disease, including enteric or reproductive disease in adult cattle and enteric disease, pneumonia or septicaemia in calves. Nervous signs have been

recorded in calves. An outbreak of *S. Dublin* enteritis in calves was investigated. Movement restrictions following a herd breakdown with TB, which led to increased stocking rates and calf numbers on a dairy unit, was thought to have been one of the predisposing factors to the outbreak. *Salmonella* Dublin was confirmed in septicaemic distribution in a 2-month-old Limousin-cross calf with a clinical history of stiff gait and some increased respiratory effort. *S. Dublin* was also isolated from lung samples and intestinal contents in an outbreak in 8-week-old calves in a rearing unit where there was widespread coughing and haemorrhagic enteritis reported from a dead animal.

### ***Salmonella* Typhimurium**

*Salmonella* Typhimurium continues to be the second most common *Salmonella* serotype reported from cattle in 2005 with 144 incidents reported (Table 10). The proportion of *Salmonella* incidents in adult cattle due to this serovar, decreased in 2005 (16.4%) compared to 2004 (17.2%) (Table 12) but has increased in calves to 12.8% compared to 2004 (8.2%) (Table 14). *Salmonella* Typhimurium definitive types DT2a and DT170b were reported from cattle in 2005 for the first time. Definitive type DT135, which was also reported in 2005, was last reported from cattle in 1999. Another new definitive type for 2005 was DT8, which was last reported in 2003. Definitive types DT67, DT104c and DT108 have not been reported since 2000. Cases due to *S. Typhimurium* U310, previously linked predominantly with pigs, decreased (four incidents reported in 2005, while eight incidents were reported in 2004). Reports of *Salmonella* Typhimurium DT104 appear to fluctuate during the year with a first peak noted in May and a second, lower peak in October and November (Figure 13). DT104 remains the most common definitive type (60% of incidents) and is usually found in dairy cattle. Incidents reported due to *S. Typhimurium* DT104 increased by 28% in 2005 compared to 2004. Forty per cent of incidents were due to non-DT104 phage types, although 13% were strains related to DT104 (DT104b, DT12, U302). A farm visit was undertaken following an outbreak of multi resistant *Salmonella* Typhimurium DT104 on a beef suckler and sheep unit in which 5 of 6 family members had developed severe gastroenteritis. The organism was initially isolated from a lamb carcass and subsequently from a young suckler calf with severe necrotising and fibrinous enteritis, submitted for post mortem examination. Away wintered sheep were thought to have introduced the infection back to the farm. The housing of lambing ewes and retention of some ewes and lambs in a shed for bottle-feeding may have exacerbated the outbreak leading to spill over into the beef calves. At the time of the visit approximately 40-50/450 lambs and 7/110 beef suckler calves had died. Environmental sampling of the farm revealed

widespread contamination of buildings as is common with DT104. Appropriate advice on control was given. The HPA were informed and involved from an early stage. On another occasion a multidrug resistant *S. Typhimurium* definitive type DT12 (a phage type related to DT104) was isolated from two cows with post-calving diarrhoea. Further sampling was carried out and, of 197 samples collected, 101 were positive for *Salmonella* species. Subsequent to this, *Salmonella Typhimurium* DT104 was isolated from a recently aborted cow. The dairyman was also ill (although not confirmed with salmonellosis) and a *Salmonella* investigation visit was carried out on the premises. Further samples were collected and the DT104 organism was isolated from water troughs and other environmental samples, including the cubicle shed and horse faeces. Advice was given on the control of salmonellosis, including emphasis on zoonotic aspects.

### **Other serovars**

*Salmonella* Enteritidis, *S. Hadar*, *S. Thompson* and *S. Virchow* are all routinely phage typed. There were six reported incidents of *S. Enteritidis* (Table 18). These comprised two incidents of PT6a and one report of NOPT in adult cattle, one incident of PT4 in a calf and single incidents of phage types PT1 and PT4 in cattle of unknown age (Tables 18, 19 and 20). *Salmonella* Enteritidis PT6a was last reported in cattle in 2003. There were no incidents of *S. Hadar*, *S. Thompson* or *S. Virchow* reported from cattle in 2005 (Tables 21, 22 and 23). There were two reports of *S. Infantis* in cattle in 2005. Both were from the same dairy herd in the north of England. A few adult cows, aged five years, in a herd of approximately 150 animals were affected with diarrhoea. A *Salmonella* investigation visit was done to the premises and environmental sampling confirmed the presence of infection at the dairy unit, but the source of infection could not be established.

The increase in the number of incidents of *S. Anatum* in 2004 was sustained, particularly in adult cattle (5.7% of incidents; Table 12).

*Salmonella* Jangwani and *Salmonella* Kokomlemle had never been previously isolated from cattle during routine surveillance in Great Britain but were reported for the first time in cattle in 2005. There were four *S. Jangwani* reports involving two premises in Scotland. The reported clinical sign in all cases was diarrhoea, and there was also human illness reported. There was a *Salmonella* investigation visit done to both premises. Sewage effluent was considered to be the most likely vehicle of infection. *Salmonella* Kokomlemle was reported from an adult bovine animal from a zoo. Other new serovars reported from cattle in 2005 included: *S. Carno* (from adult dairy cattle with diarrhoea), which

was last reported in 1994, *S. Coeln* (from pre-weaned animals with diarrhoea in a calf-rearing unit), which was last reported from cattle of unknown age in 1996, *S. Saint Paul* (from adult cattle with diarrhoea in a suckler beef unit), which was last reported from cattle of unknown age in 1999, *S. Senftenberg* (in adult cattle), which was last reported in 2000, and *S. Uganda* (in adult cattle in poor condition in a suckler beef unit), which was last reported from cattle of unknown age in 1997.

Reports of *Salmonella* Montevideo in cattle increased in 2005 (fourteen incidents and 1.7% of all incident reports) compared to 2004 (four incidents and 0.43% of all incident reports). The majority of the 2005 reports were from adult cattle from dairy herds in the South of England, while nearly half of them were from a single farm. The most common presenting sign of the affected animals was diarrhoea, while reproduction problems were also reported. A *S. Montevideo* outbreak in a dairy herd was investigated, when it transpired that a 5-year-old boy and a 55-year-old woman, both related to the manager, and the dairyman all had had transient sickness and diarrhoea. Salmonellosis was not diagnosed though, as none of them had contacted their General Practitioner. Sampling during the advisory visit indicated that *Salmonella* Montevideo was widespread on the farm, despite the lack of significant clinical disease. Advice was given to prevent further zoonotic infection and to protect the food chain.

There were no reports of *S. Vejle* in cattle in 2005, while there were eight reports in 2004 and four reports in 2003. This serovar was first reported in cattle in 2002, while it was last reported in 1990 from chickens and has been seen infrequently in a variety of livestock species and humans in different countries including Germany, Senegal and Israel.

There were eleven incidents of *Salmonella* Newport reported in cattle in 2005 (seven in adult cattle and two in calves), representing 1.6% of incidents in adult cattle and 0.64% of incidents in calves; All were fully susceptible to all antimicrobials tested. In 2004 there were six incidents of *S. Newport* reported, representing 1% of incidents in adult cattle and 0.24% of incidents in calves. An outbreak of enteritis caused by *Salmonella* Newport was investigated in a dairy herd. The organism was isolated from three aborted foetuses and from faecal samples from cows with dysentery. No deaths were reported at the time of the investigation. A group of six recently purchased calved heifers were suspected as the likely source of the infection. The multiple drug resistant *Salmonella* Newport (MDRSN) has not yet been reported in Great Britain, but is causing concern in the USA because of its effect in livestock, particularly cattle and its public health importance (Rankin and others, 2002). MDRSN has reduced sensitivity to ceftriaxone, in

addition to resistance to at least eight antimicrobials. In affected dairy herds in the USA, adult cows are reported to have a watery diarrhoea and rapid drop in milk production and clinical signs are often present around calving time. Morbidity and mortality has also been seen in calves on some farms. Like other *Salmonellae*, asymptomatic carriage of the organism occurs

([http://www.aphis.usda.gov/vs/ceah/cahm/Food\\_Safety/foodsfs.htm](http://www.aphis.usda.gov/vs/ceah/cahm/Food_Safety/foodsfs.htm)).

The VLA, in collaboration with other organisations, has established case definitions and protocols for fast-tracking the identification and reporting of the organism. In addition, new sampling protocols and epidemiological questionnaires have been developed to be used by Nominated Officers in England and Wales to investigate incidents associated with MDRSN should they occur.

In 2005 the following *Salmonella* serovars were reported for reasons other than routine surveillance, for example through research projects, but were not reported through routine surveillance: *S. Cubana* (1 report) (last reported from cattle in 1991), *S. Durham* (1 report) and *S. Kimuenza* (1 report). These reports have not been included in the tabulations or figures of this publication.

**Table 10: *Salmonella* in cattle on all premises (adults, calves & age unknown)**

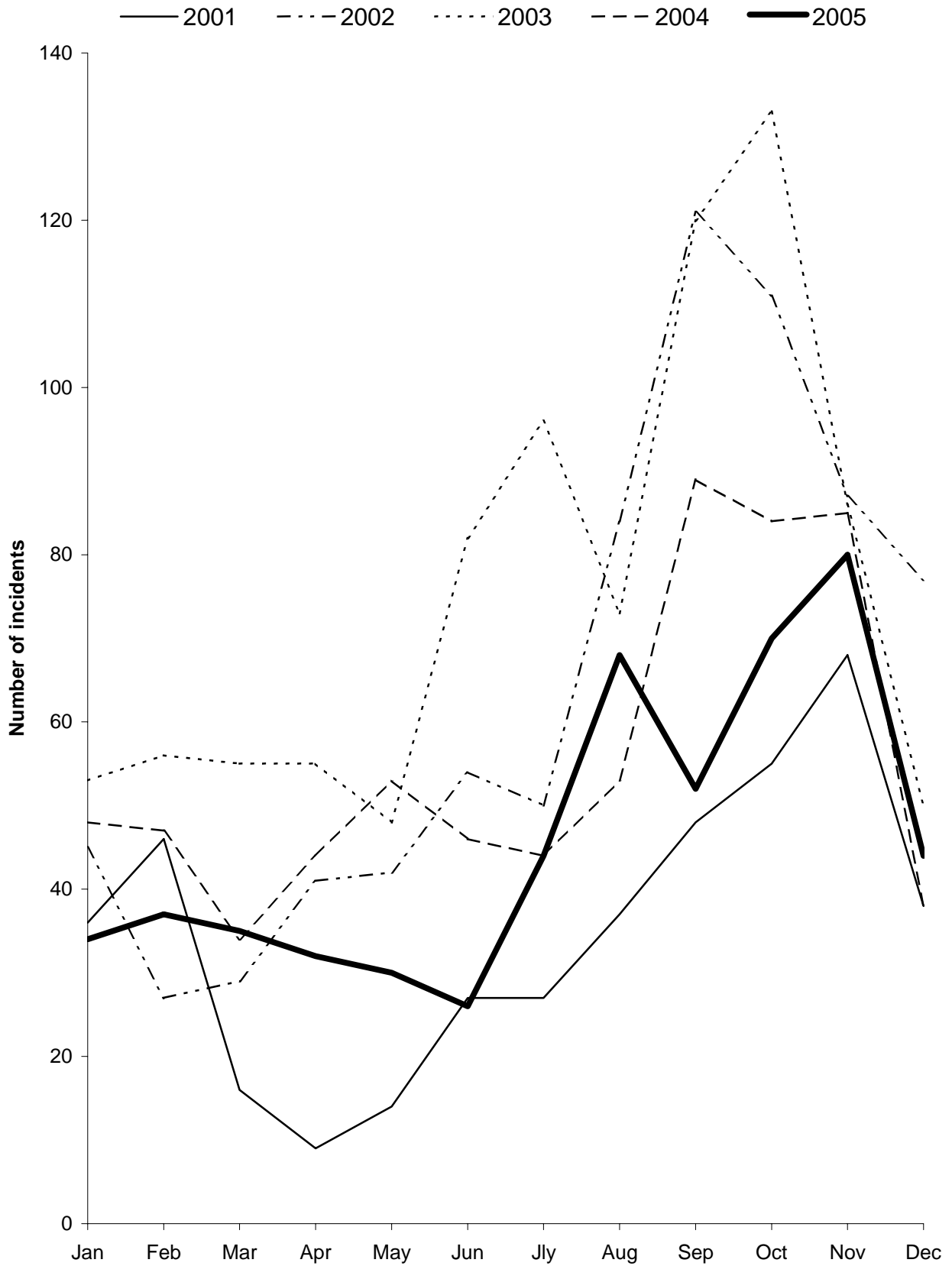
<i>Salmonella</i> Incidents (Isolations)	2001*	2002	2003	2004	2005
<b>ENTERICA ENTERICA</b>					
Agama	13 ( 17)	13 ( 19)	15 ( 16)	16 ( 16)	16 ( 17)
Agona	4 ( 7)	4 ( 4)	4 ( 4)	6 ( 6)	1 ( 1)
Ajiobo	- ( -)	2 ( 2)	1 ( 1)	2 ( 2)	1 ( 1)
Anatum	3 ( 4)	15 ( 26)	37 ( 40)	32 ( 34)	30 ( 30)
Ank	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
Binza	- ( -)	- ( -)	- ( -)	3 ( 3)	- ( -)
Bovis morbificans	1 ( 1)	- ( -)	- ( -)	1 ( 1)	3 ( 4)
Bradford	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Braenderup	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Brandenburg	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Bredeney	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
Carno	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Coeln	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Derby	2 ( 3)	- ( -)	2 ( 2)	2 ( 2)	1 ( 1)
Dublin	421 ( 539)	768 ( 985)	907 ( 1166)	665 ( 796)	552 ( 667)
Durham	1 ( 1)	- ( -)	1 ( 1)	- ( -)	- ( -)
Enteritidis	1 ( 1)	6 ( 6)	10 ( 14)	7 ( 7)	6 ( 7)
Give	1 ( 1)	1 ( 1)	- ( -)	2 ( 2)	4 ( 4)
Goldcoast	4 ( 4)	3 ( 5)	7 ( 8)	4 ( 4)	3 ( 3)
Hadar	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
Havana	1 ( 1)	- ( -)	1 ( 1)	- ( -)	2 ( 2)
Heidelberg	1 ( 2)	1 ( 1)	- ( -)	- ( -)	- ( -)
Indiana	2 ( 2)	1 ( 1)	- ( -)	- ( -)	1 ( 1)
Infantis	- ( 2)	2 ( 2)	1 ( 1)	- ( 1)	2 ( 2)
Jangwani	- ( -)	- ( -)	- ( -)	- ( -)	- ( 4)
Kedougou	- ( -)	- ( -)	12 ( 12)	5 ( 5)	2 ( 2)
Kentucky	- ( -)	1 ( 1)	- ( -)	- ( -)	1 ( 1)
Kiambu	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Kimuenza	- ( -)	- ( -)	3 ( 4)	1 ( 1)	- ( -)
Kokomlemlle	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Kottbus	- ( -)	1 ( 1)	1 ( 1)	1 ( 1)	- ( -)
Larochelle	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Liverpool	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
London	- ( -)	- ( -)	- ( -)	5 ( 6)	3 ( 3)
Mbandaka	- ( -)	2 ( 2)	( -) ( -)	2 ( 2)	3 ( 3)
Montevideo	3 ( 4)	3 ( 3)	7 ( 7)	4 ( 17)	14 ( 16)

**Table 10: *Salmonella* in cattle on all premises (adults, calves & age unknown)**

<i>Salmonella</i> Incidents (Isolations)	2001*	2002	2003	2004	2005
<b>ENTERICA ENTERICA</b>					
Nagoya	1 ( 1)	2 ( 2)	1 ( 1)	- ( -)	- ( -)
Newington	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Newport	7 ( 9)	11 ( 15)	7 ( 7)	6 ( 7)	11 ( 11)
Oslo	- ( -)	- ( -)	5 ( 5)	- ( -)	- ( -)
Paratyphi B var java	- ( -)	- ( -)	3 ( 3)	- ( -)	- ( -)
Poona	- ( -)	- ( -)	1 ( 1)	1 ( 1)	- ( -)
Reading	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Saint Paul	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Schwarzengrund	- ( -)	1 ( 2)	- ( -)	6 ( 6)	- ( -)
Senftenberg	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Stanley	- ( -)	- ( -)	1 ( 1)	2 ( 2)	- ( -)
Stourbridge	- ( -)	- ( -)	2 ( 2)	1 ( 1)	2 ( 2)
Tees	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Thompson	3 ( 3)	4 ( 5)	1 ( 1)	4 ( 4)	- ( -)
Typhimurium	148 (205)	140 (188)	148 (182)	132 (160)	144 (171)
Uganda	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Vejle	- ( -)	4 ( 8)	4 ( 4)	8 ( 8)	- ( -)
Virchow	1 ( 1)	1 ( 1)	- ( -)	- ( -)	- ( -)
<b>ENTERICA DIARIZONAE</b>					
61:k:1,5,7	- ( -)	1 ( 1)	2 ( 2)	- ( -)	4 ( 4)
61:-:1,5	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
61:-:1,5,7	1 ( 1)	1 ( 1)	1 ( 1)	1 ( 1)	1 ( 1)
structure only	3 ( 3)	8 ( 11)	7 ( 7)	10 ( 10)	8 ( 9)
rough strain	3 ( 3)	2 ( 2)	4 ( 5)	3 ( 7)	8 ( 8)
untyped	- ( -)	3 ( 4)	- ( -)	- ( -)	- ( -)
untypable	- ( -)	- ( -)	- ( 1)	- ( -)	- ( -)
<b>TOTAL</b>	<b>629 (819)</b>	<b>1004 (1302)</b>	<b>1196 (1504)</b>	<b>936 (1116)</b>	<b>830 (982)</b>

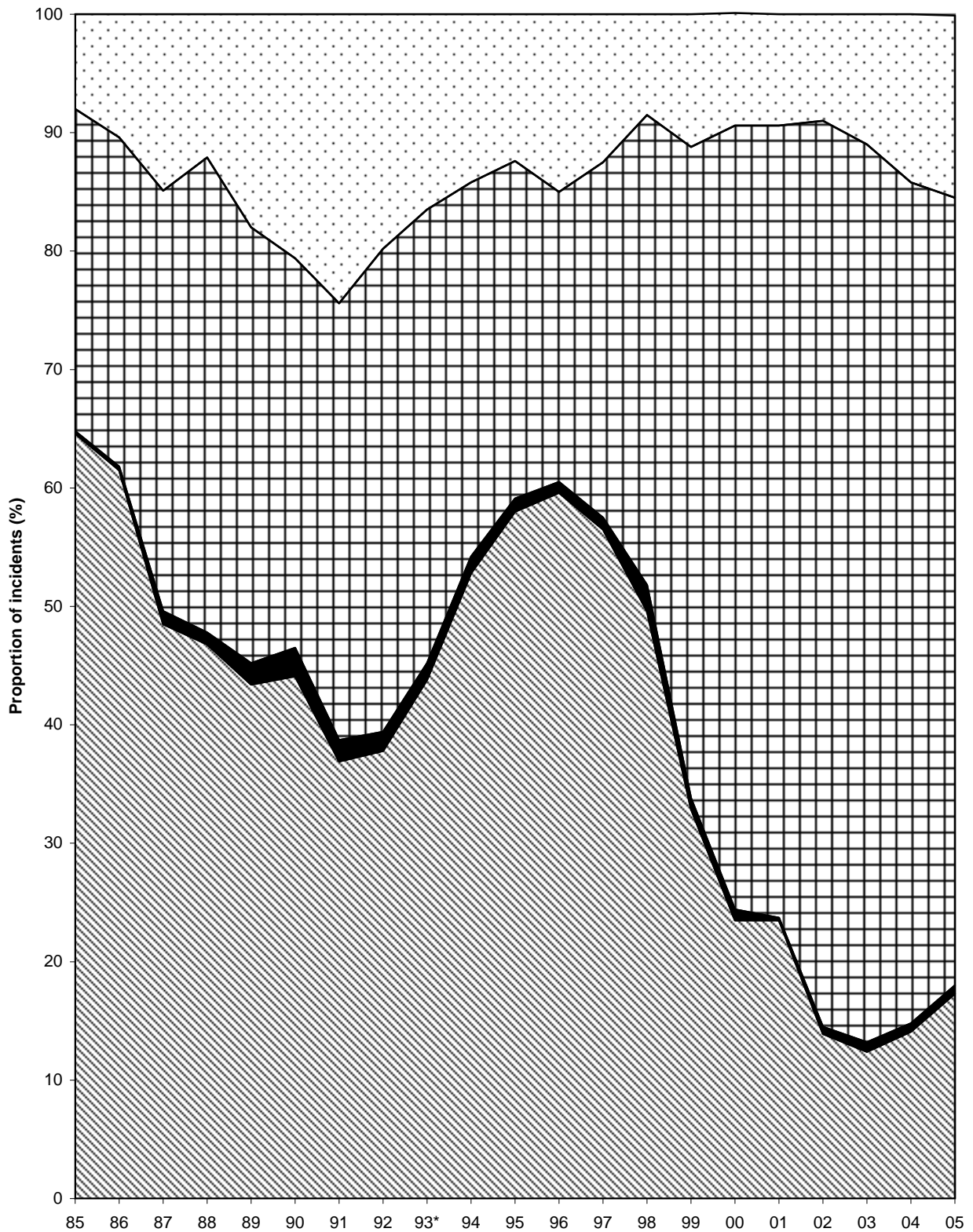
\* 2001 data may not be comparable due to impact of FMD epidemic

**Fig 6: Seasonality of S. Dublin in cattle  
(2001 - 2005)**



**Fig 7: S. Enteritidis, S. Typhimurium and S. Dublin as a proportion of all incident reports in cattle (1985 - 2005)**

▣ S. Typhimurium   ■ S. Enteritidis   □ S. Dublin   □ All other Salmonella serotypes



**Table 11: *Salmonella* in adult cattle on all premises**

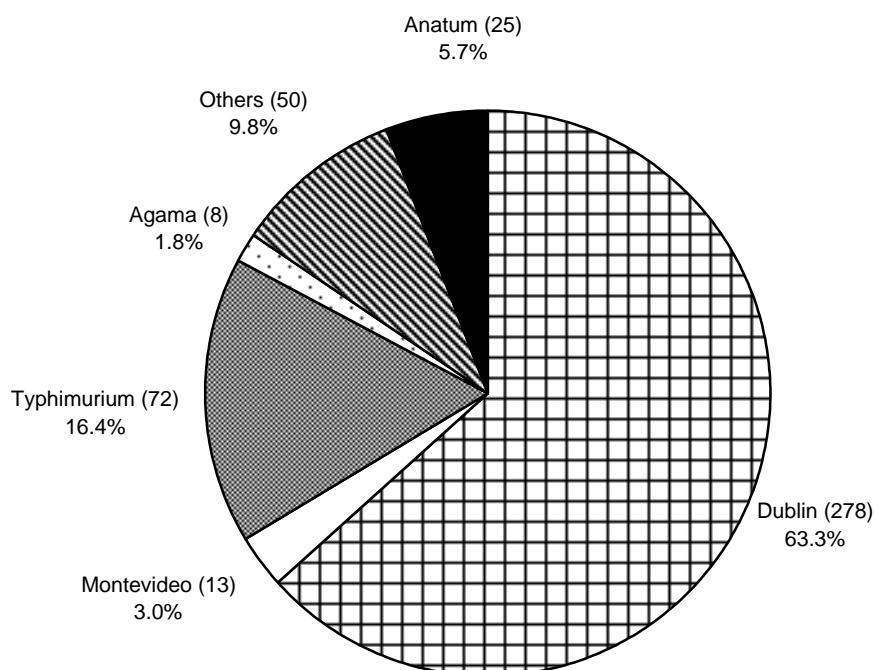
<i>Salmonella</i> Incidents (Isolations)	2001*	2002	2003	2004	2005
<b>ENTERICA ENTERICA</b>					
Agama	7 ( 9)	10 ( 12)	8 ( 8)	10 ( 10)	8 ( 9)
Agona	3 ( 5)	1 ( 1)	1 ( 1)	3 ( 3)	1 ( 1)
Ajiobo	- ( -)	1 ( 1)	1 ( 1)	- ( -)	- ( -)
Anatum	2 ( 2)	11 ( 20)	26 ( 29)	22 ( 23)	25 ( 25)
Ank	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
Bovismorbificans	- ( -)	- ( -)	- ( -)	- ( -)	3 ( 4)
Bradford	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Bredeney	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
Carno	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Derby	1 ( 1)	- ( -)	1 ( 1)	2 ( 2)	1 ( 1)
Dublin	219 (279)	388 (509)	412 (455)	292 (292)	278 (285)
Enteritidis	1 ( 1)	1 ( 1)	5 ( 6)	6 ( 6)	3 ( 3)
Give	- ( -)	1 ( 1)	- ( -)	2 ( 2)	3 ( 3)
Goldcoast	- ( -)	1 ( 1)	5 ( 6)	3 ( 3)	3 ( 3)
Havana	- ( -)	- ( -)	1 ( 1)	- ( -)	1 ( 1)
Heidelberg	1 ( 2)	- ( -)	- ( -)	- ( -)	- ( -)
Infantis	- ( 2)	- ( -)	1 ( 1)	- ( -)	2 ( 2)
Kedougou	- ( -)	- ( -)	7 ( 7)	4 ( 4)	1 ( 1)
Kentucky	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
Kimuenza	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Kokomlemle	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Kottbus	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Larochelle	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Liverpool	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
London	- ( -)	- ( -)	- ( -)	2 ( 3)	- ( -)
Mbandaka	- ( -)	1 ( 1)	- ( -)	1 ( 1)	3 ( 3)
Montevideo	3 ( 3)	1 ( 1)	2 ( 2)	4 ( 4)	13 ( 13)
Nagoya	- ( -)	1 ( 1)	1 ( 1)	- ( -)	- ( -)
Newington	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Newport	4 ( 4)	7 ( 8)	5 ( 5)	5 ( 6)	7 ( 7)
Ohio	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Oslo	- ( -)	- ( -)	3 ( 3)	- ( -)	- ( -)
Poona	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
Saint Paul	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Schwarzengrund	- ( -)	1 ( 1)	- ( -)	5 ( 5)	- ( -)

**Table 11: *Salmonella* in adult cattle on all premises**

<i>Salmonella</i> Incidents (Isolations)	2001*	2002	2003	2004	2005
<b>ENTERICA ENTERICA</b>					
Senftenberg	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Stanley	- ( -)	- ( -)	- ( -)	2 ( 2)	- ( -)
Stourbridge	- ( -)	- ( -)	2 ( 2)	1 ( 1)	1 ( 1)
Tees	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Thompson	3 ( 3)	3 ( 4)	- ( -)	1 ( 1)	- ( -)
Typhimurium	65 ( 85)	74 ( 89)	74 ( 83)	80 ( 86)	72 ( 73)
Uganda	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Vejle	- ( -)	2 ( 4)	3 ( 3)	6 ( 6)	- ( -)
Virchow	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
<b>ENTERICA DIARIZONAE</b>					
61:-:1,5,7	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
61:-:1,5	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
61:k:1,5,7	1 ( 1)	1 ( 1)	2 ( 2)	- ( -)	2 ( 2)
structure only	- ( -)	2 ( 3)	2 ( 2)	6 ( 6)	3 ( 3)
rough strain	2 ( 2)	1 ( 1)	2 ( 2)	1 ( 1)	3 ( 3)
untyped	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
<b>TOTAL</b>	<b>315 ( 402)</b>	<b>513 ( 655)</b>	<b>565 ( 624)</b>	<b>464 ( 473)</b>	<b>439 ( 449)</b>

\* 2001 data may not be comparable due to impact of FMD epidemic

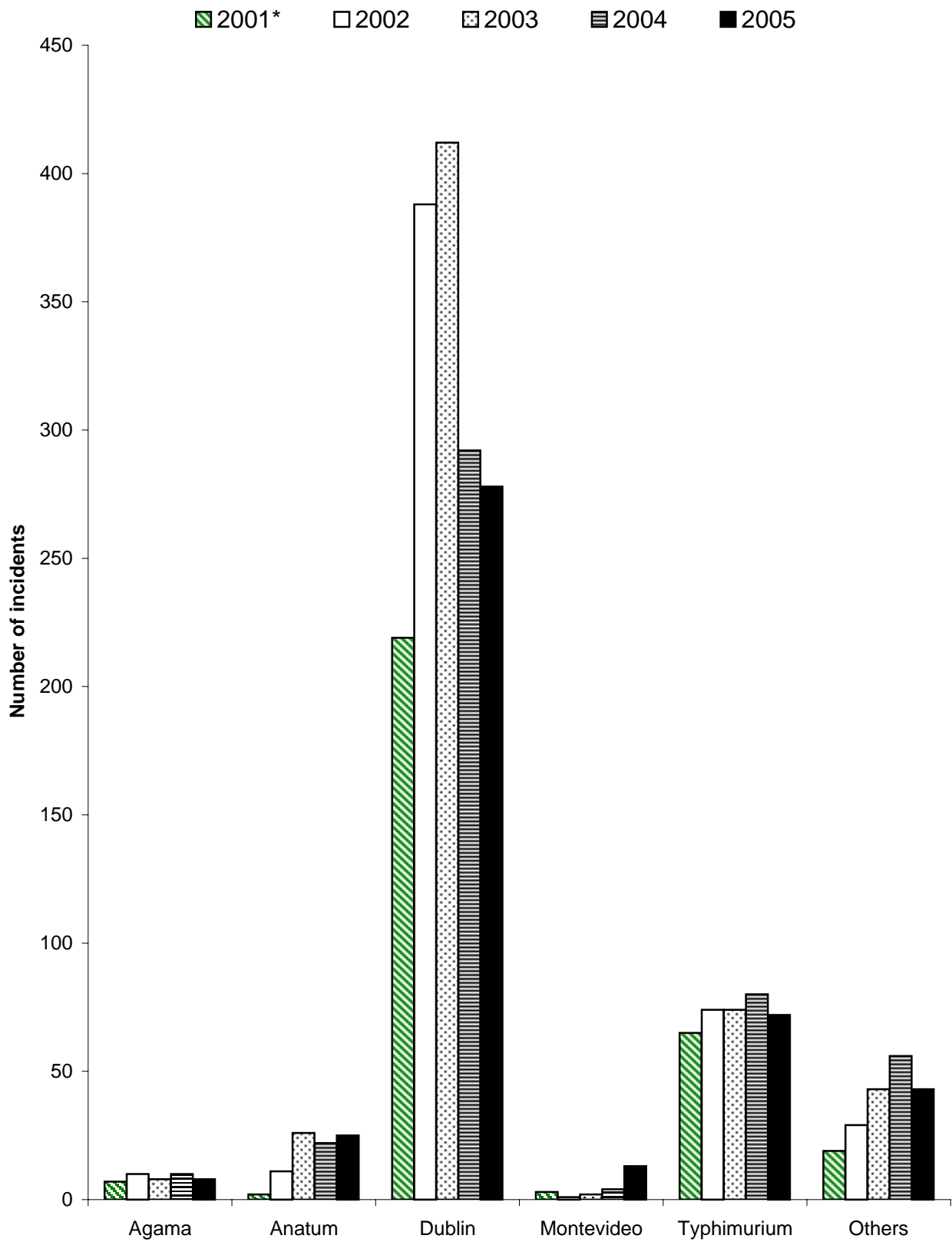
**Fig 8: Incidents of *Salmonella* serotypes in adult cattle in 2005**



**Table 12: Incidents of the top 5 *Salmonella* serotypes in adult cattle in 2005 as a % of all incidents compared to previous years**

Serotype	2001	2002	2003	2004	2005
S. Dublin %	69.5	75.6	72.9	62.9	63.3
S. Typhimurium %	20.6	14.4	13.1	17.2	16.4
S. Anatum %	0.6	2.1	4.6	4.7	5.7
S. Montevideo %	1.0	0.2	0.4	0.9	3.0
S. Agama %	2.2	1.9	1.4	2.2	1.8
Total no. incidents	315	513	565	464	439

**Fig 9: Number of incidents of *Salmonella* serotypes in adult cattle (2001 - 2005)**



\* 2001 data may not be comparable due to uncertain impact of FMD epidemic

**Table 13: *Salmonella* in calves on all premises**

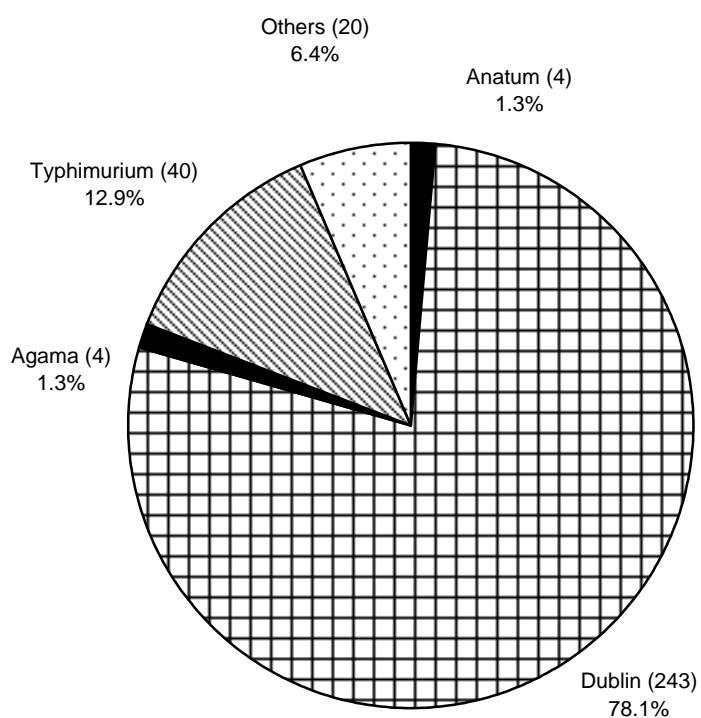
<i>Salmonella</i> Incidents (Isolations)	2001*	2002	2003	2004	2005
ENTERICA ENTERICA					
Agama	5 ( 6)	2 ( 5)	4 ( 4)	2 ( 2)	4 ( 4)
Agona	1 ( 1)	2 ( 2)	3 ( 3)	3 ( 3)	- ( -)
Ajiobo	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
Anatum	- ( 1)	4 ( 5)	7 ( 7)	6 ( 7)	4 ( 4)
Binza	- ( -)	- ( -)	- ( -)	2 ( 2)	- ( -)
Bovis morbificans	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Braenderup	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Coeln	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Derby	1 ( 2)	- ( -)	1 ( 1)	- ( -)	- ( -)
Dublin	150 ( 183)	300 ( 353)	399 ( 434)	338 ( 347)	243 ( 243)
Durham	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Enteritidis	- ( -)	4 ( 4)	4 ( 4)	1 ( 1)	1 ( 1)
Goldcoast	3 ( 3)	- ( -)	1 ( 1)	1 ( 1)	- ( -)
Havana	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Infantis	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
Kedougou	- ( -)	- ( -)	3 ( 3)	1 ( 1)	1 ( 1)
Kentucky	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Kimuenza	- ( -)	- ( -)	3 ( 4)	- ( -)	- ( -)
Kottbus	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
London	- ( -)	- ( -)	- ( -)	1 ( 1)	2 ( 2)
Mbandaka	- ( -)	1 ( 1)	- ( -)	1 ( 1)	- ( -)
Montevideo	- ( -)	- ( -)	2 ( 2)	- ( -)	- ( -)
Nagoya	1 ( 1)	1 ( 1)	- ( -)	- ( -)	- ( -)
Newport	2 ( 2)	2 ( 2)	- ( -)	1 ( 1)	2 ( 2)
Oslo	- ( -)	- ( -)	2 ( 2)	- ( -)	- ( -)
Paratyphi B var java	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
Poona	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Reading	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Thompson	- ( -)	1 ( 1)	- ( -)	2 ( 2)	- ( -)
Typhimurium	47 ( 60)	45 ( 56)	48 ( 50)	33 ( 33)	40 ( 40)
Vejle	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)

**Table 13: *Salmonella* in calves on all premises**

<i>Salmonella</i> Incidents (Isolations)	2001*	2002	2003	2004	2005
ENTERICA ENTERICA					
ENTERICA DIARIZONAE					
61:k:1,5,7	- ( -)	- ( -)	- ( -)	- ( -)	2 ( 2)
structure only	2 ( 2)	5 ( 7)	2 ( 2)	4 ( 4)	5 ( 6)
rough strain	1 ( 1)	1 ( 1)	1 ( 2)	2 ( 2)	5 ( 5)
untyped	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
TOTAL	216 ( 265)	372 ( 442)	479 ( 520)	402 ( 412)	311 ( 312)

\* 2001 data may not be comparable due to impact of FMD epidemic

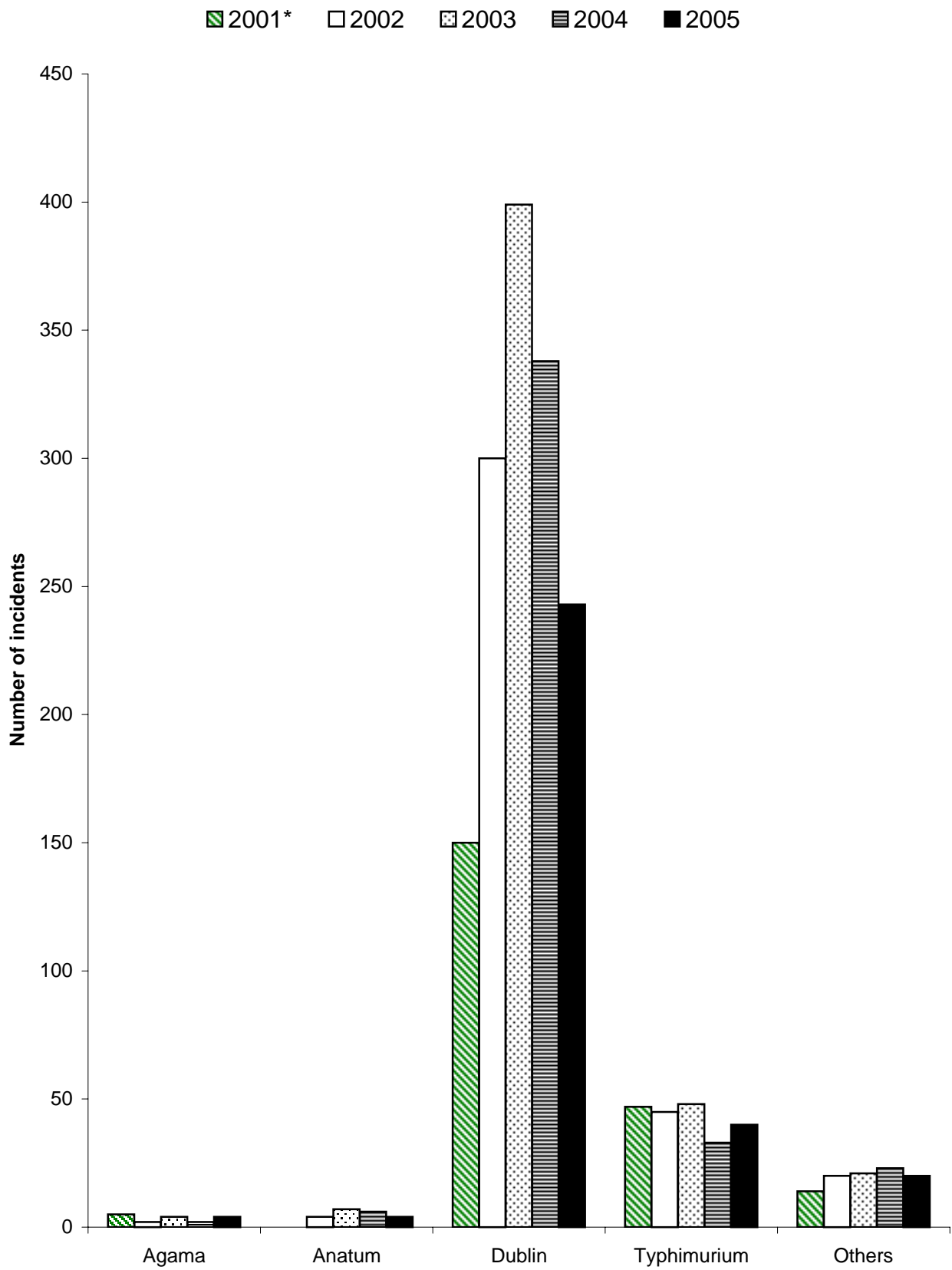
**Fig 10: Incidents of *Salmonella* serotypes in calves in 2005**



**Table 14: Incidents of the top 3 *Salmonella* serotypes in calves in 2005 as a % of all incidents compared to previous years**

Serotype	2001	2002	2003	2004	2005
S. Dublin %	69.4	80.6	83.3	84.1	78.1
S. Typhimurium %	21.8	12.1	10.0	8.2	12.9
S. Agama %	2.3	0.5	0.8	0.5	1.3
S. Anatum %	0	1.1	1.5	1.5	1.3
Total no. incidents	216	372	479	402	311

**Fig 11: Number of incidents of *Salmonella* serotypes in calves (2001 - 2005)**



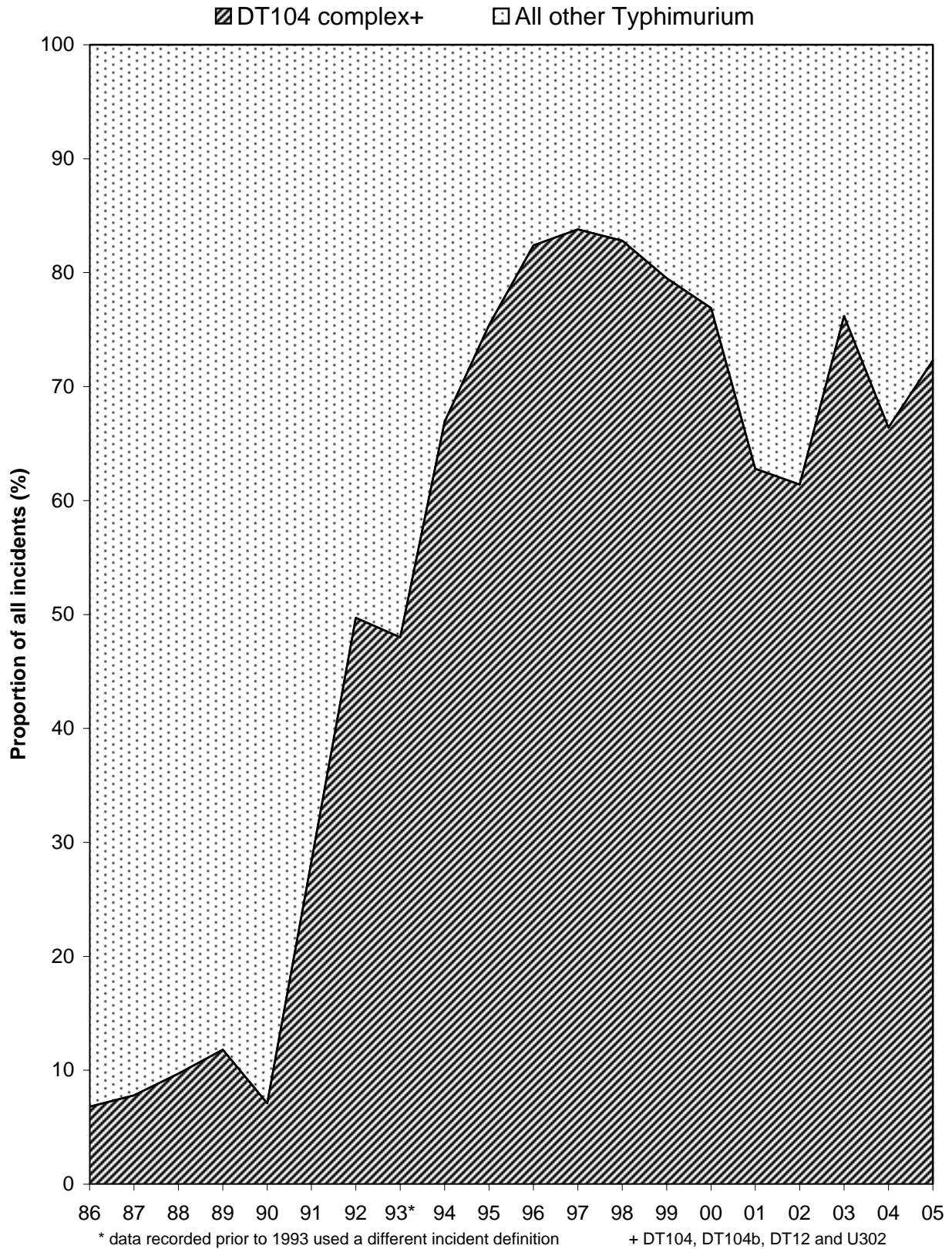
\* 2001 data may not be comparable due to uncertain impact of FMD epidemic

**Table 15: S. Typhimurium in cattle on all premises (all ages)**

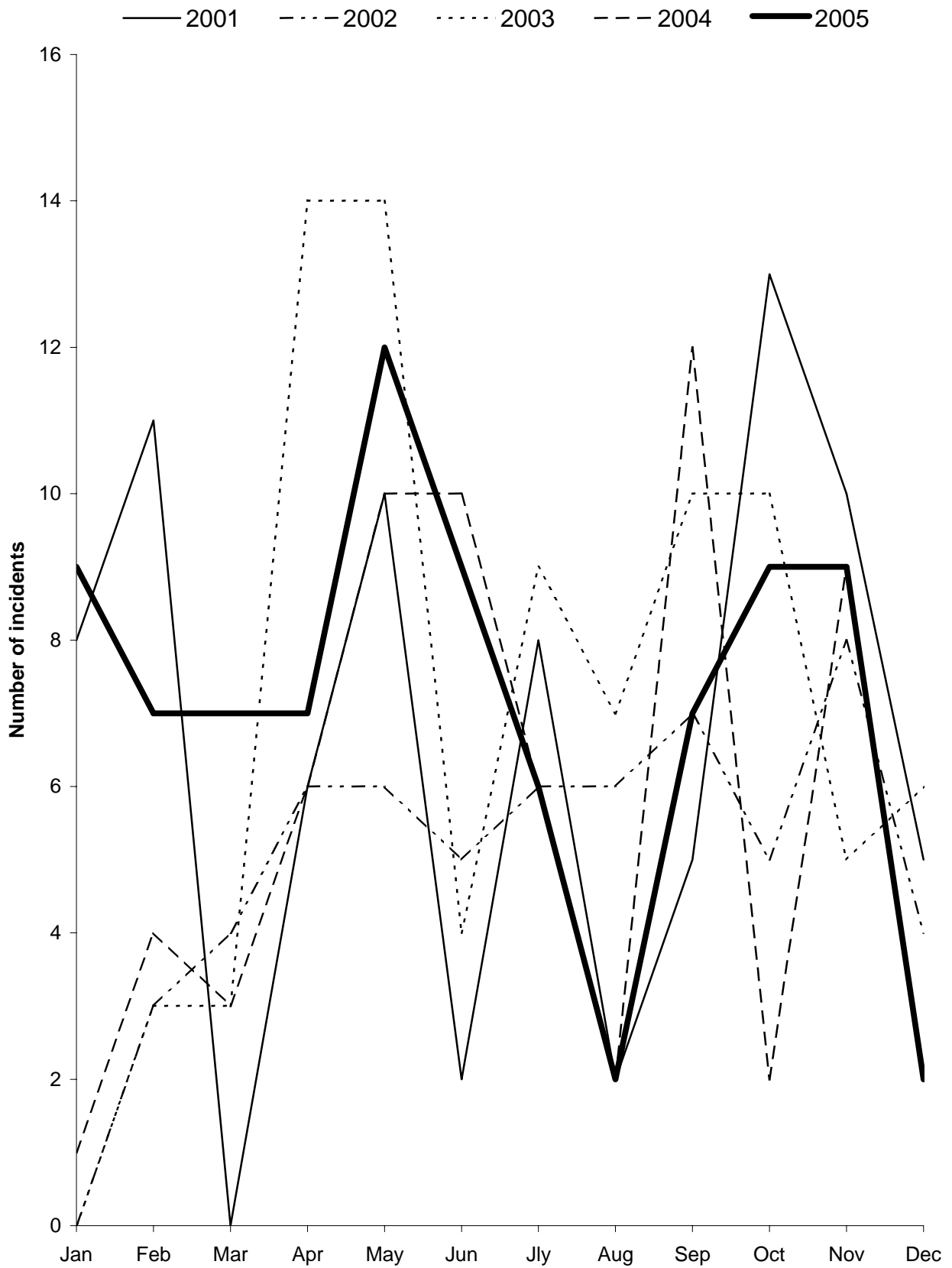
Definitive Types Incidents (Isolations)	2001*	2002	2003	2004	2005
2	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
2a	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
8	1 ( 1)	- ( -)	1 ( 1)	- ( -)	1 ( 1)
12	2 ( 2)	6 ( 8)	5 ( 6)	6 ( 6)	9 ( 9)
40	1 ( 1)	2 ( 2)	1 ( 2)	2 ( 3)	3 ( 3)
41	1 ( 1)	1 ( 1)	2 ( 2)	2 ( 3)	2 ( 2)
49	- ( -)	- ( -)	2 ( 2)	3 ( 3)	4 ( 5)
56	- ( -)	2 ( 2)	1 ( 1)	2 ( 3)	3 ( 3)
69	2 ( 3)	- ( -)	- ( -)	- ( -)	- ( -)
103	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
104	80 ( 118)	60 ( 89)	85 ( 106)	67 ( 81)	86 ( 109)
104b	5 ( 7)	5 ( 10)	8 ( 10)	6 ( 8)	9 ( 9)
120	6 ( 6)	4 ( 4)	1 ( 1)	6 ( 6)	2 ( 2)
135	- ( -)	- ( -)	- ( -)	- ( -)	5 ( 5)
166	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
169	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
170	3 ( 5)	6 ( 7)	- ( 2)	- ( 2)	- ( 1)
170b	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
193	6 ( 10)	3 ( 6)	3 ( 4)	7 ( 8)	6 ( 6)
193a	- ( -)	2 ( 3)	4 ( 6)	6 ( 6)	1 ( 1)
195	- ( -)	- ( -)	1 ( 1)	2 ( 2)	- ( -)
208	3 ( 6)	5 ( 6)	4 ( 4)	- ( -)	- ( -)
U288	- ( -)	- ( -)	2 ( 2)	- ( -)	- ( -)
U302	6 ( 9)	15 ( 19)	13 ( 16)	9 ( 10)	1 ( 1)
U308a	2 ( 2)	- ( -)	- ( -)	- ( -)	- ( -)
U310	1 ( 1)	- ( -)	6 ( 6)	8 ( 10)	4 ( 5)
U311	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
RDNC	3 ( 3)	10 ( 11)	- ( 1)	- ( 1)	- ( -)
NOPT	1 ( 1)	- ( -)	1 ( 1)	1 ( 1)	- ( -)
UNTY	20 ( 23)	9 ( 9)	5 ( 5)	5 ( 5)	6 ( 6)
Untyped	4 ( 5)	9 ( 10)	- ( -)	- ( 2)	- ( 1)
TOTAL	148 ( 205)	140 ( 188)	148 ( 182)	132 ( 160)	144 ( 171)

\* 2001 data may not be comparable due to impact of FMD epidemic

**Fig 12: *Salmonella* Typhimurium DT104 and related strains as a proportion of all reports of *Salmonella* Typhimurium in cattle 1986 - 2005**



**Fig 13: Seasonality of *S. Typhimurium* DT104 in cattle  
(2001 - 2005)**

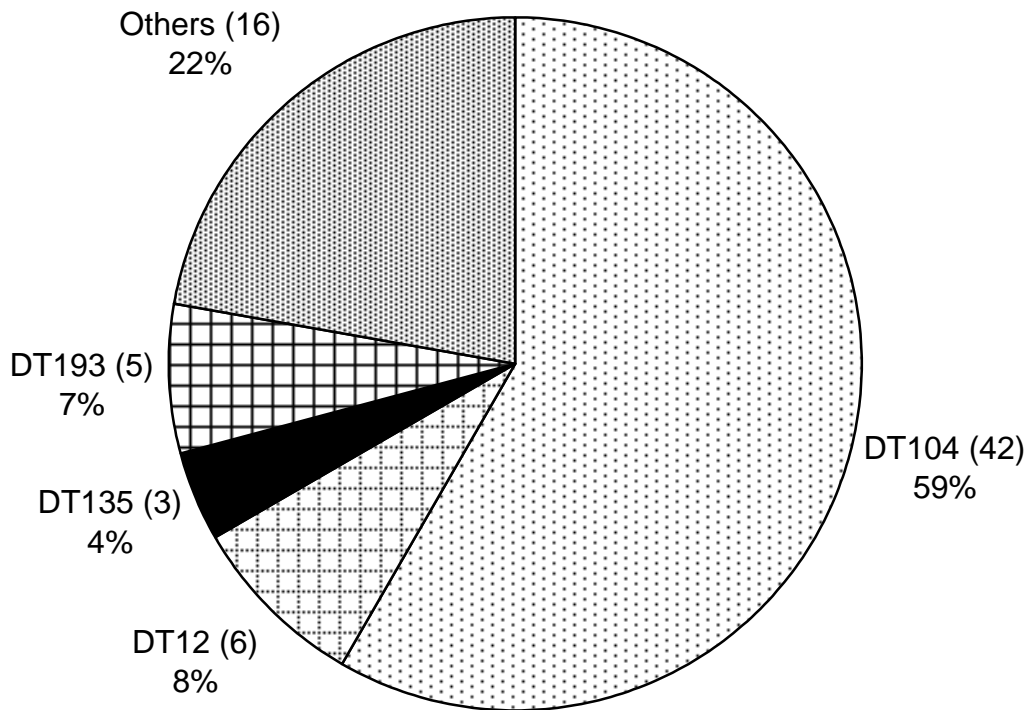


**Table 16: S.Typhimurium in adult cattle on all premises**

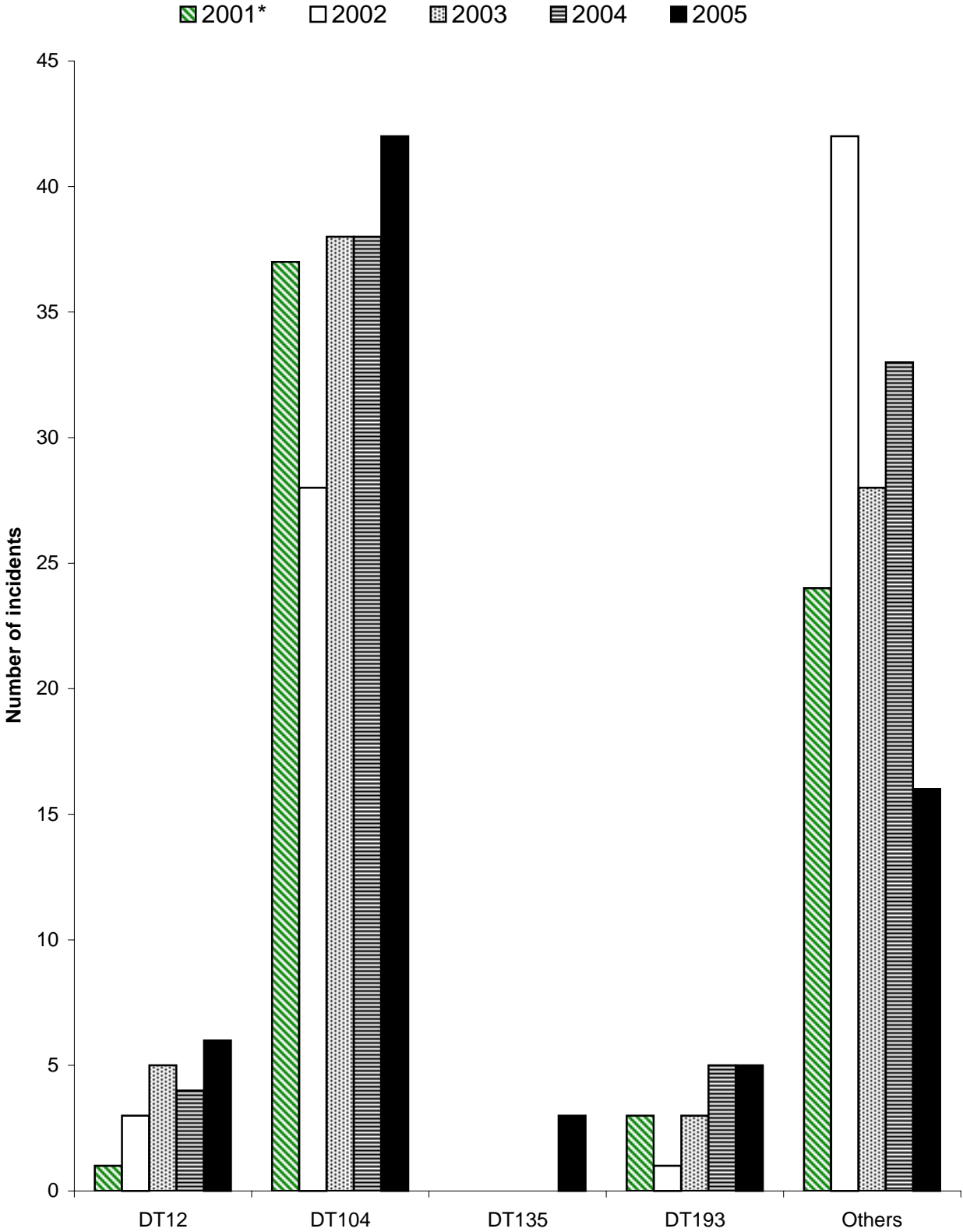
Definitive Types Incidents (Isolations)	2001*	2002	2003	2004	2005
2a	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
12	1 ( 1)	3 ( 4)	5 ( 6)	4 ( 4)	6 ( 6)
40	- ( -)	2 ( 2)	- ( -)	2 ( 2)	2 ( 2)
41	1 ( 1)	1 ( 1)	1 ( 1)	2 ( 2)	1 ( 1)
49	- ( -)	- ( -)	2 ( 2)	2 ( 2)	2 ( 3)
56	- ( -)	- ( -)	- ( -)	1 ( 1)	3 ( 3)
69	1 ( 2)	- ( -)	- ( -)	- ( -)	- ( -)
104	37 ( 48)	28 ( 38)	38 ( 41)	38 ( 43)	42 ( 42)
104b	2 ( 2)	2 ( 3)	3 ( 4)	4 ( 4)	- ( -)
135	- ( -)	- ( -)	- ( -)	- ( -)	3 ( 3)
120	1 ( 1)	2 ( 2)	- ( -)	4 ( 4)	1 ( 1)
166	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
169	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
170	2 ( 4)	5 ( 5)	- ( -)	- ( -)	- ( -)
170b	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
193	3 ( 4)	1 ( 1)	3 ( 4)	5 ( 4)	5 ( 5)
193a	- ( -)	1 ( 2)	3 ( 4)	3 ( 3)	1 ( 1)
195	- ( -)	- ( -)	1 ( 1)	1 ( 1)	- ( -)
208	3 ( 4)	3 ( 4)	3 ( 3)	- ( -)	- ( -)
U302	2 ( 3)	10 ( 11)	6 ( 8)	5 ( 5)	- ( -)
U308a	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
U310	- ( -)	- ( -)	4 ( 4)	5 ( 5)	2 ( 2)
U311	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
RDNC	1 ( 1)	7 ( 7)	- ( -)	- ( -)	- ( -)
NOPT	- ( -)	- ( -)	- ( -)	- ( 1)	- ( -)
UNTY	9 ( 11)	5 ( 5)	2 ( 2)	3 ( 3)	2 ( 2)
Untyped	1 ( 2)	4 ( 4)	- ( -)	- ( 1)	- ( -)
<b>TOTAL</b>	<b>65 ( 85)</b>	<b>74 ( 89)</b>	<b>74 ( 83)</b>	<b>80 ( 86)</b>	<b>72 ( 73)</b>

\* 2001 data may not be comparable due to impact of FMD epidemic

**Fig 14: Incidents of Salmonella Typhimurium definitive types in adult cattle in 2005**



**Fig 15: Incidents of *Salmonella* Typhimurium definitive types in adult cattle (2001 - 2005)**



\* 2001 data may not be comparable due to uncertain impact of FMD epidemic

**Table 17: S.Typhimurium in calves on all premises**

Definitive Types Incidents (Isolations)	2001*	2002	2003	2004	2005
8	1 ( 1)	- ( -)	1 ( 1)	- ( -)	1 ( 1)
12	- ( -)	1 ( 2)	- ( -)	- ( -)	1 ( 1)
40	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
41	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
49	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
56	- ( -)	2 ( 2)	1 ( 1)	1 ( 1)	- ( -)
69	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
103	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
104	29 ( 39)	25 ( 32)	31 ( 32)	20 ( 20)	26 ( 26)
104b	2 ( 3)	2 ( 4)	4 ( 4)	1 ( 1)	6 ( 6)
120	3 ( 3)	2 ( 2)	- ( -)	- ( -)	- ( -)
170	1 ( 1)	- ( 1)	- ( -)	- ( -)	- ( -)
193	1 ( 1)	1 ( 1)	- ( -)	2 ( 2)	1 ( 1)
193a	- ( -)	1 ( 1)	- ( 1)	2 ( 2)	- ( -)
208	- ( 1)	1 ( 1)	- ( -)	- ( -)	- ( -)
U288	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
U302	2 ( 3)	4 ( 4)	5 ( 6)	3 ( 3)	- ( -)
U308a	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
U310	1 ( 1)	- ( -)	1 ( 1)	1 ( 1)	1 ( 1)
RDNC	- ( -)	2 ( 2)	- ( -)	- ( -)	- ( -)
UNTY	2 ( 2)	3 ( 3)	2 ( 2)	2 ( 2)	3 ( 3)
Untyped	2 ( 2)	1 ( 1)	- ( -)	- ( -)	- ( -)
<b>TOTAL</b>	<b>47 ( 60)</b>	<b>45 ( 56)</b>	<b>48 ( 50)</b>	<b>33 ( 33)</b>	<b>40 ( 40)</b>

\* 2001 data may not be comparable due to impact of FMD epidemic

**Fig 16: Incidents of *Salmonella* Typhimurium definitive types in calves in 2005**

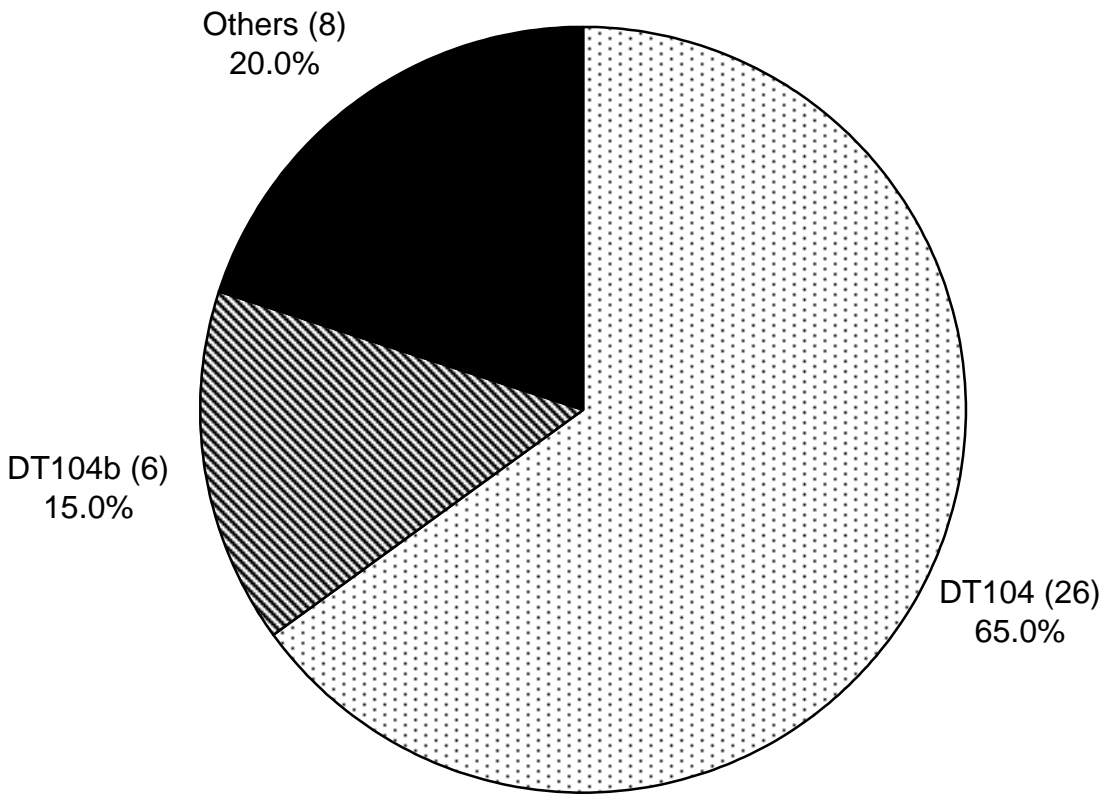
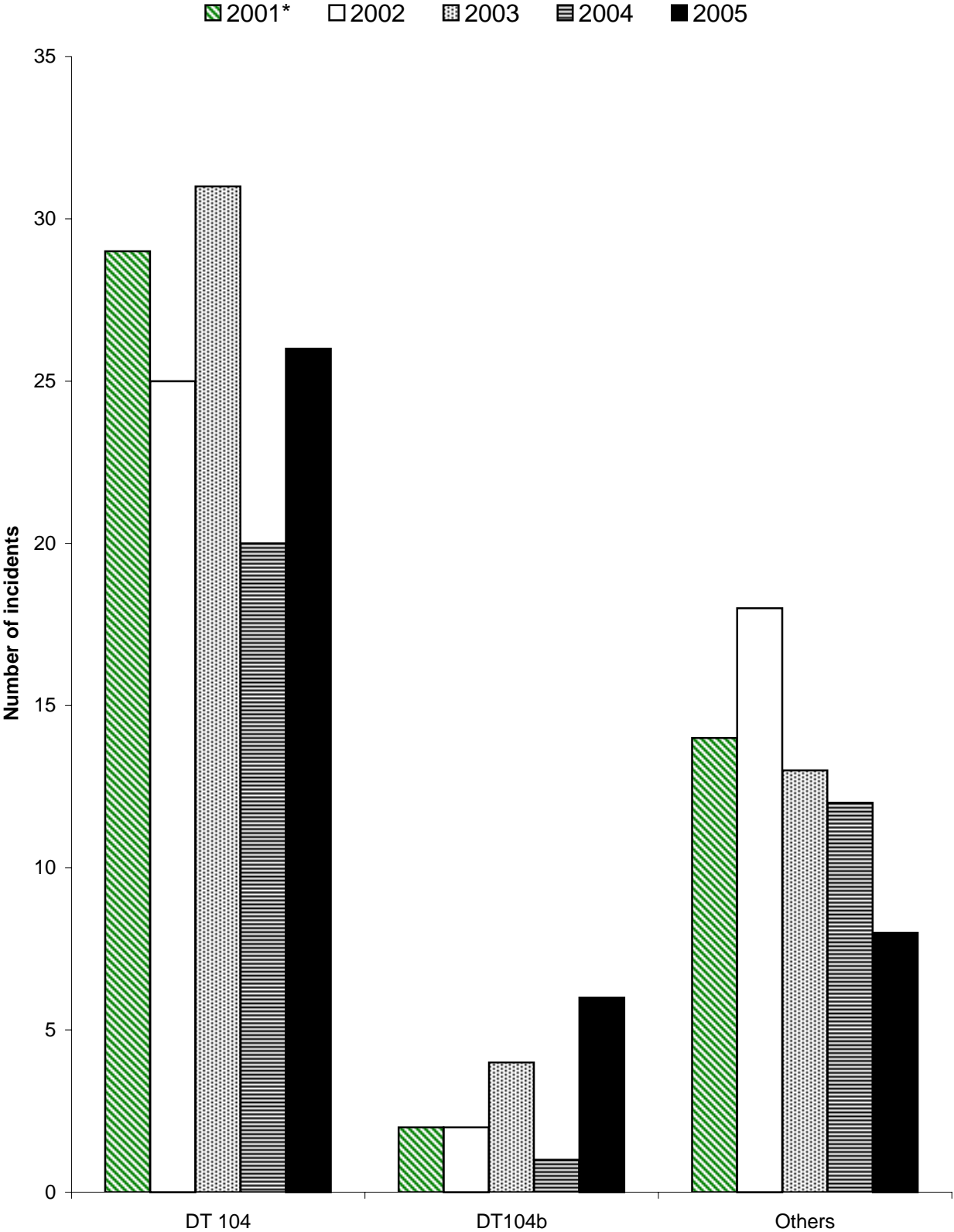


Fig 17: Incidents of *Salmonella* Typhimurium definitive types in calves (2001 - 2005)



\* 2001 data may not be comparable due to uncertain impact of FMD epidemic

**Table 18: S. Enteritidis in cattle on all premises (all ages)**

Phage Types Incidents (Isolations)	2001*	2002	2003	2004	2005
1	- ( -)	- ( -)	1 ( 3)	2 ( 2)	1 ( 1)
4	1 ( 1)	2 ( 2)	1 ( 1)	1 ( 1)	2 ( 3)
6	- ( -)	2 ( 2)	- ( -)	- ( -)	- ( -)
6a	- ( -)	1 ( 1)	1 ( 1)	- ( -)	2 ( 2)
7	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
8	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
11	- ( -)	- ( -)	- ( 1)	- ( -)	- ( -)
13a	- ( -)	1 ( 1)	5 ( 6)	1 ( 1)	- ( -)
14b	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
35	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
NOPT	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
UNTY	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
<b>TOTAL</b>	<b>1 ( 1)</b>	<b>6 ( 6)</b>	<b>10 ( 14)</b>	<b>7 ( 7)</b>	<b>6 ( 7)</b>

\* 2001 data may not be comparable due to impact of FMD epidemic

**Table 19: S. Enteritidis in adult cattle on all premises**

Phage Types Incidents (Isolations)	2001*	2002	2003	2004	2005
1	- ( -)	- ( -)	1 ( 2)	2 ( 2)	- ( -)
4	1 ( 1)	1 ( 1)	1 ( 1)	1 ( 1)	- ( -)
6a	- ( -)	- ( -)	- ( -)	- ( -)	2 ( 2)
7	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
8	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
13a	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
14b	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
NOPT	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
UNTY	- ( -)	- ( -)	- ( -)	- ( 1)	- ( -)
untyped	- ( -)	- ( -)	- ( -)	- ( 1)	- ( -)
<b>TOTAL</b>	<b>1 ( 1)</b>	<b>1 ( 1)</b>	<b>5 ( 6)</b>	<b>6 ( 6)</b>	<b>3 ( 3)</b>

**Table 20: S. Enteritidis in calves on all premises**

Phage Types Incidents (Isolations)	2001*	2002	2003	2004	2005
4	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
6	- ( -)	2 ( 2)	- ( -)	- ( -)	- ( -)
6a	- ( -)	1 ( 1)	1 ( 1)	- ( -)	- ( -)
13a	- ( -)	1 ( 1)	3 ( 3)	1 ( 1)	- ( -)
<b>TOTAL</b>	<b>- ( -)</b>	<b>4 ( 4)</b>	<b>3 ( 4)</b>	<b>1 ( 1)</b>	<b>1 ( 1)</b>

\* 2001 data may not be comparable due to impact of FMD epidemic

**Table 21: S. Hadar in cattle on all premises (all ages)**

Phage Types Incidents (Isolations)	2001*	2002	2003	2004	2005
9	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
TOTAL	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)

**Table 22: S. Thompson in cattle on all premises (all ages)**

Phage Types Incidents (Isolations)	2001*	2002	2003	2004	2005
1	- ( -)	- ( -)	- ( -)	4 ( 4)	- ( -)
3	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
23	2 ( 2)	- ( -)	- ( -)	- ( -)	- ( -)
NOPT	1 ( 1)	4 ( 5)	- ( -)	- ( 2)	- ( -)
TOTAL	3 ( 3)	4 ( 5)	1 ( 1)	4 ( 4)	- ( -)

**Table 23: S. Virchow in cattle on all premises (all ages)**

Phage Types Incidents (Isolations)	2001*	2002	2003	2004	2005
26	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
50	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
TOTAL	1 ( 1)	1 ( 1)	- ( -)	- ( -)	- ( -)

\* 2001 data may not be comparable due to impact of FMD epidemic