Ministry of Food, Agriculture and Fisheries
Danish Veterinary and Food Administration

12 July 2010

FACT SHEETS

On the Danish restrictions of non-therapeutical use of antibiotics for growth promotion and its consequences

Denmark is a major livestock producer in Europe, and the worlds' largest exporter of pork. The Danish livestock production is highly industrialised, intensive and applies modern management principles. Due to the significance for the Danish economy the National Government takes the competitiveness of the Danish farmers seriously.

The Danish initiatives in the area of non-therapeutic use of antibiotics for growth promotion and control of the use of therapeutic antibiotics were – and still are - all taken to reduce the risk for occurrence of resistant bacteria in the food chain.

To provide facts on the background for the initiatives taken, the initiatives themselves, and our results The Danish Veterinary and Food Administration has developed five FACT SHEETS:

I. General data on the Danish agricultural sector
II. The Danish initiatives taken to mitigate the risk of resistant bacteria in the food chain
III. The occurrence of resistant bacteria in herds, in food of animal origin, and in humans
IV. Effects of the initiatives to reduce the use of antibiotics
V. Concurrent development with regard to food borne pathogens in food of animal origin

FACT SHEET I

General data on Danish agriculture

Denmark

Denmark lies between 54° and 58° of latitude north and 8° and 15° of longitude east. It is neighbouring Germany to the South, the North Sea to the West, Sweden to the East and Norway to the North. In addition to Denmark itself, the Kingdom also includes the Faroe Islands and Greenland.

- Population: 5.511.451 (2010)
- Area: 43.098 square kilometres
- Population density: 126,4 pr. square kilometre
- Geographic region: Scandinavia
- Gross domestic product: Approximately 280 billion USD (2009)

(The Ministry of Foreign Affairs in Denmark)

Agriculture

- The Danish agricultural sector in combination with the food industry employs some 150.000 persons and represents an export value of approximately 17 billion USD
- In 2008 approximately 5.800 pig farms, 5.200 dairy farms and 300 with specialised poultry production
- Census data 2008: 558.000 dairy cows (1.6 million cattle in total), 12.7 million pigs and 3.5 million hens
- Highly specialised – only 3% has more than one animal species
- Highly co-operatively organized sector where farmers own their slaughtering and processing companies
- Large co-operative companies including *Danish Crown*, the world's largest exporter of pork, with a group turnover at approximately 7.5 billion USD, and the dairy food company *Arla Foods* with a group turnover at approximately 7.8 billion USD
- Farmers, co-operatives and most private companies in the Danish agricultural sector are part of the same joint organisation: Danish Agricultural and Food Council

(Danish Agricultural and Food Council)

FACT SHEET II
The Danish initiatives to mitigate the risk of

resistant bacteria in the food chain

EU and Danish government interventions

- Since before the 1970s all veterinary medical products have been prescription only
- In 1994 the Central Husbandry Register (National Animal Identification System) was established, with national registration and identification of every herd in Denmark
- In 1994/95 any prophylactic use of antimicrobials was prohibited and the veterinarians' profits from direct sales of medicine were fixated at a very low level with a maximum of 10%
- In 1995 preventive veterinary strategies were implemented with herd health contracts on a voluntary basis and regular monthly visit from the veterinarian, irrespective of the actual herd health situation, in order to promote preventive veterinary strategies, optimizing antimicrobial use
- In 1995 the DANMAP programme (Danish Antimicrobial Resistance Monitoring and Research Programme, www.DANMAP.org) was established. The programme monitors and does research on antimicrobial usage and resistance in humans, animals and food and involves scientists, risk analysists and risk managers within both human and animal health
- In 1995, the Danish government banned the non-therapeutic use of avoparcin for growth promotion in Denmark; a ban that was extended to all EU countries in 1997.
- In January 1998, the Danish government banned the non-therapeutic use of virginiamycin for growth promotion.
- In December 1998 the EU implemented an overall ban of virginiamycin, bacitracin, tylosin and spiramycin for growth promotion.
- In 2000 the medicine database VetStat was established, recording every antibiotic prescribed to production animals on the age-group and herd and veterinarian level
- In 2002 fluoroquinolones were restricted to only be used if a current laboratory test shows that no other antibiotics can be used for that disease in that herd of production animals

- In 2002, EU voted to phase out all non-therapeutic use of antibiotics for growth promotion (i.e. all non-prescription use) as of the beginning of 2006.

- From 2003 the Medicine Control Task Force, a special unit under the Danish Veterinary and Food Administration, was established. The special unit plans the risk-based control and assists the regional veterinary officers in difficult cases; the unit assists the police and the Prosecution.

- Action plan 2005 for reduction and prudent use of antimicrobials in swine, including

    - treatment guidelines for swine veterinary practitioners
    - direct risk communication with the individual swine veterinary practitioners with a high prescription rate.

- Action plan 2007 for reduction and prudent use of antimicrobials in cattle, swine and poultry, including
    - direct risk communication including audit and supervision of prudent use of antimicrobials, every second year, of **all veterinarians working with food-producing animals**
    - a task force was established between the Danish Medicines Agency, the Danish Veterinary and Food Administration and taxation authorities in order to secure that there are no economical relationships between veterinary practitioners and the pharmaceutical industry
    - treatment guidelines for cattle veterinary practitioners.

- From 2009 an Early Notification Board on antibiotic usage in swine and cattle in cooperation with the industry, the Danish Veterinary Association and the Danish Veterinary and food Administration.

- From 2010 evidence based – including pharmacokinetics and –dynamics - novel treatment guidelines for swine veterinary practitioners

- From 2010 a joint Antimicrobial and Resistance action plan between the Ministry of Health and the Ministry of Food, Agriculture and Fisheries.

- From 2010 a National Antimicrobial Board for reduction of antimicrobial use and resistance with representatives from the Danish Veterinary and Food Administration, The Danish National Board of Health and scientists from both veterinarian and human health.

- From 2010 non-voluntary herd health agreements for swine and cattle with emphasis on health prevention strategies and animal welfare reducing antibiotic usage and resistance

- From 2010 establishment of threshold values for acceptable herd levels on mortality, antibiotic usage and certain welfare parameters in swine and cattle and enforced control in herds with levels above the threshold values

- From 2010 mandatory action plans for reduction of antibiotic usage in swine herds above the threshold value for antibiotics usage – the so-called ‘yellow card’ initiative

Voluntary actions taken by the Danish agricultural industry

- The Danish cattle and broiler industries voluntarily stopped the non-therapeutic use of all antibiotics for growth promotion in February 1998.

- The Danish swine industry voluntarily stopped all non-therapeutic use of antibiotics in swine above 35 kg by April 1998, and for all age groups by January 2000.

- The Danish swine industry enforced a voluntary ban on all usage of the high-risk antibiotics Cephalosporins from 1. July 2010.

All the Danish agricultural industries initiatives were taken voluntarily and upon their own initiative and had nothing to do with any orders or fines from the authorities. Presumably, the industry found it worthwhile to have a production free from antimicrobial growth promoters, very low antimicrobial residues and a high standard on food safety.

FACT SHEET III

The occurrence of resistant bacteria in herds, food of animal origin and in humans

Risk of transmitting antimicrobial resistance from animals/food to humans

- Cephalosporin usage is for instance causing resistance in Escherichia coli (E. coli). This is shown, as prevalence of ESC positive E. coli from Danish farms with and without Cephalosporin consumption <6 month prior to sampling, shows that farms without Cephalosporin usage has only 8% ESC positive E.coli compared to 18% in herd using Cephalosporins.. ESC is a group of genes coding for resistance against 3. and 4. generation Cephalosporins. (Y. Agersø, DTU, 2010)
- Studies from 2009 detected ESC positive E. coli in 35 % of the samples from imported broiler meat (3.4% Danish broiler meat) (Figure 1) (Y. Agersø, DTU, 2010)

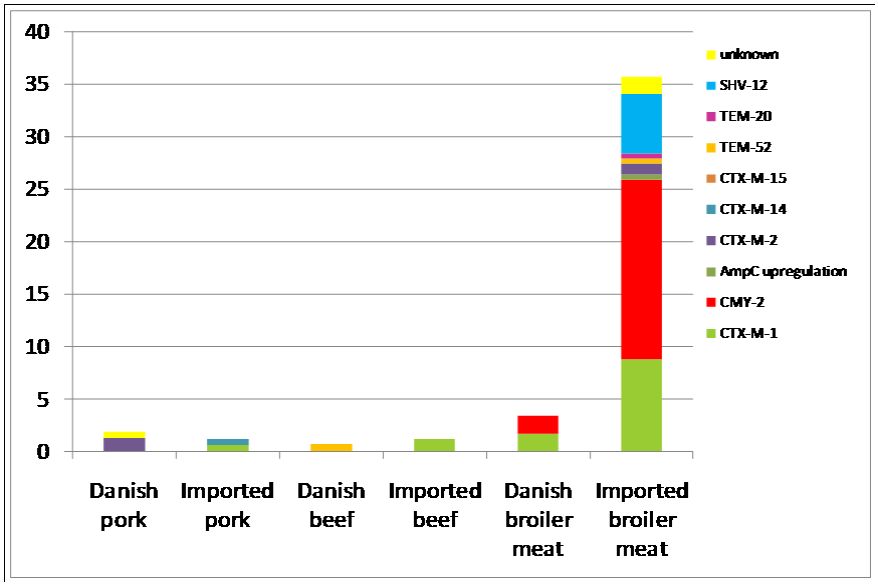
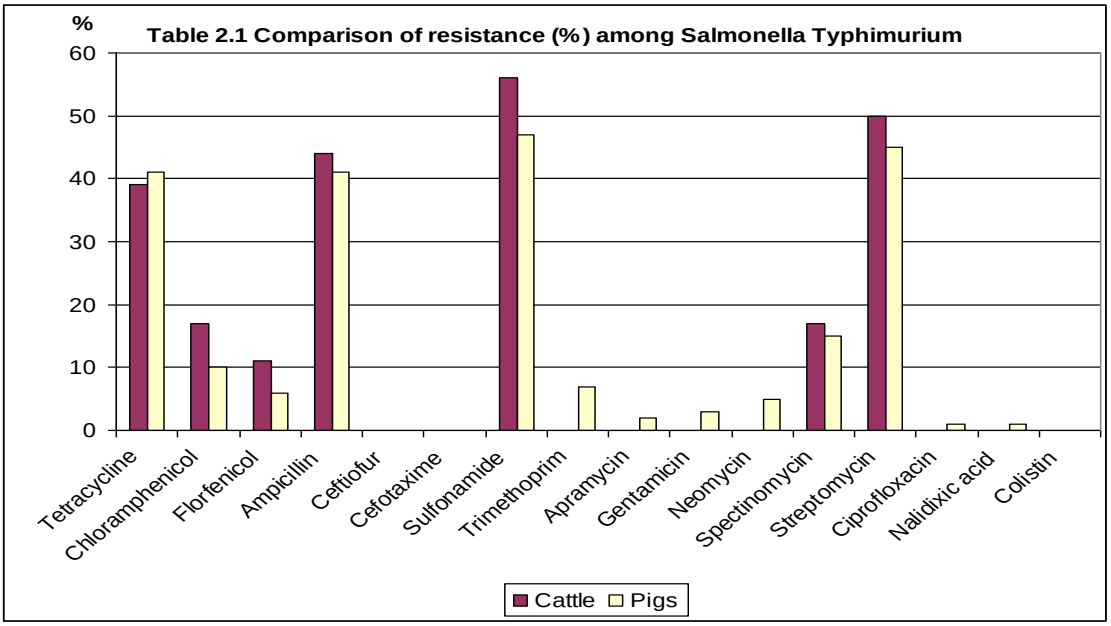


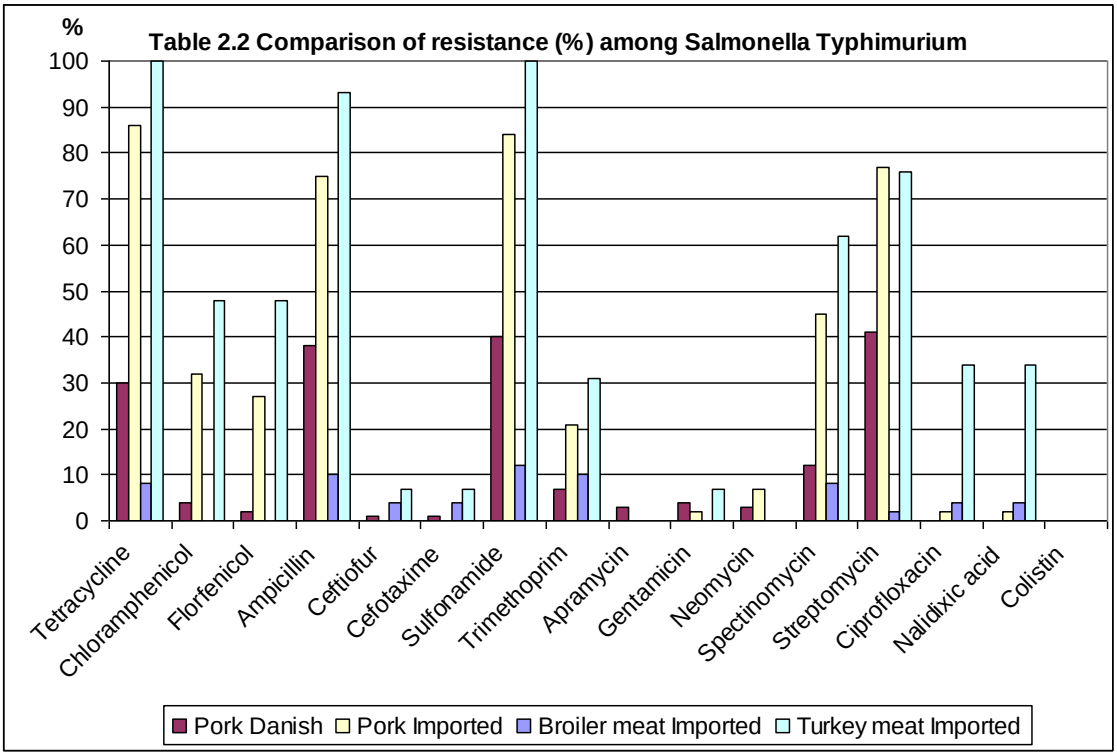
Figure 1: % Ceftriaxone resistant *E. coli* in each of six meat categories and distribution of ESC genes.

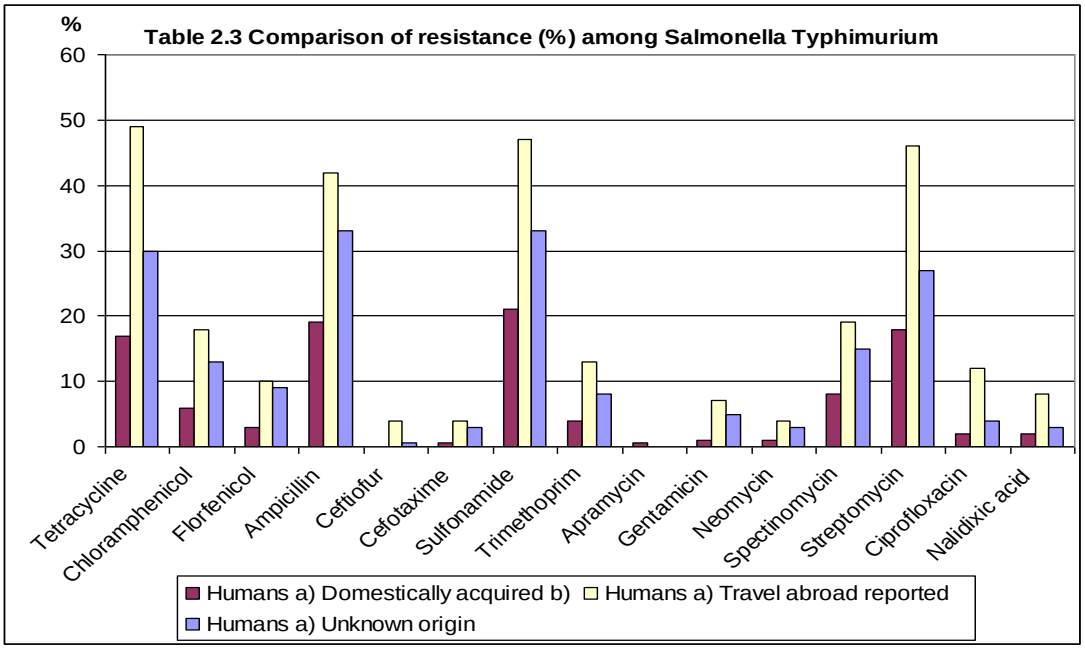
Antibiotic resistance in zoonotic and other bacteria

- Resistance in Salmonella Typhimurium in Danish animals and products, in imported products and in humans. For humans, the principal source is indicated. (Table 2) (DANMAP 2008). Shows the amount of resistance in imported meat is much higher and resistance in humans are often acquired abroad.

Table 2.1 – 2.3. Comparison of resistance (%) among Salmonella Typhimurium from food animals, pork of Danish and imported origin and human cases acquired domestically a), reported as associated with travel abroad or with an unknown origin, 2008







- Resistance in Campylobacter jejuni from food animals, food of Danish or imported origin and human cases categorized as acquired domestically or reported as associated with travel abroad 2008 (Table 3) (DANMAP 2008). Shows that resistance in broiler meat is mainly imported and for a large proportion acquired abroad for humans. Pork and swine not in the table, as Campylobacter in swine in Denmark most often are C. coli.

Table 3. Comparison of resistance (%) among Campylobacter jejuni from food animals, food of Danish or imported origin and human cases categorized as acquired domestically or reported as associated with travel abroad 2008

Compound	Cattle	Broilers	Broiler meat		Humans	
	Danish	Danish	Danish	Imported	Domestically acquired	Travel abroad reported
	%	%	%	%	%	%
Tetracycline	3	10	12	49	17	51
Chloramphenicol	0	0	0	0	0	0
Erythromycin	0	0	0	7	2	7
Gentamicin	0	0	0	0	2	2
Streptomycin	1	5	4	3	2	15
Ciprofloxacin	20	12	19	53	28	73
Nalidixic acid	20	12	19	53	29	73
Number of isolates	90	82	26	152	185	41

Resistance in Escherichia coli from food animals, food of Danish and imported origin and army recruits, 2008 (Table 4) (DANMAP 2008)

Table 4. Occurrence of resistance (%) among Escherichia coli from food animals, food of Danish and imported origin and army recruits, 2008

Compound	Broilers	Cattle	Pigs	Broiler meat		Beef		Pork meat		Army recruits
	Danish	Danish	Danish	Danish	Imported	Danish	Imported	Danish	Imported	
	%	%	%	%	%	%	%	%	%	%
Tetracycline	11	4	30	4	42	6	12	33	44	29
Chloramphenicol	0	1	1	0	14	0	2	6	7	5
Florfenicol	0	1	0	0	1	0	2	0	1	0
Ampicillin	12	1	19	11	48	6	10	29	30	28
Cephalothin	-	-	-	-	-	-	-	-	-	3
Ceftiofur	0	0	0	1	8	0	0	0	1	1
Cefpodoxime	-	-	-	-	-	-	-	-	-	3
Cefotaxime	0	0	0	1	8	0	0	0	1	-
Sulfonamide	11	5	25	12	45	6	15	30	28	35
Trimethoprim	4	2	18	3	32	2	5	24	25	-
Apramycin	0	0	0	0	0	0	0	0	0	0
Gentamicin	1	0	1	0	3	0	0	0	2	7
Neomycin	1	0	3	0	10	0	2	2	6	9
Spectinomycin	3	1	14	6	23	0	5	20	15	11
Streptomycin	8	4	26	8	33	8	15	32	40	28
Ciprofloxacin	12	0	1	4	33	0	5	2	6	13
Nalidixic acid	12	0	1	3	32	0	5	2	4	13
Colistin	0	0	0	0	4	0	0	0	1	-
Number of isolates	114	97	151	113	304	63	40	66	96	75

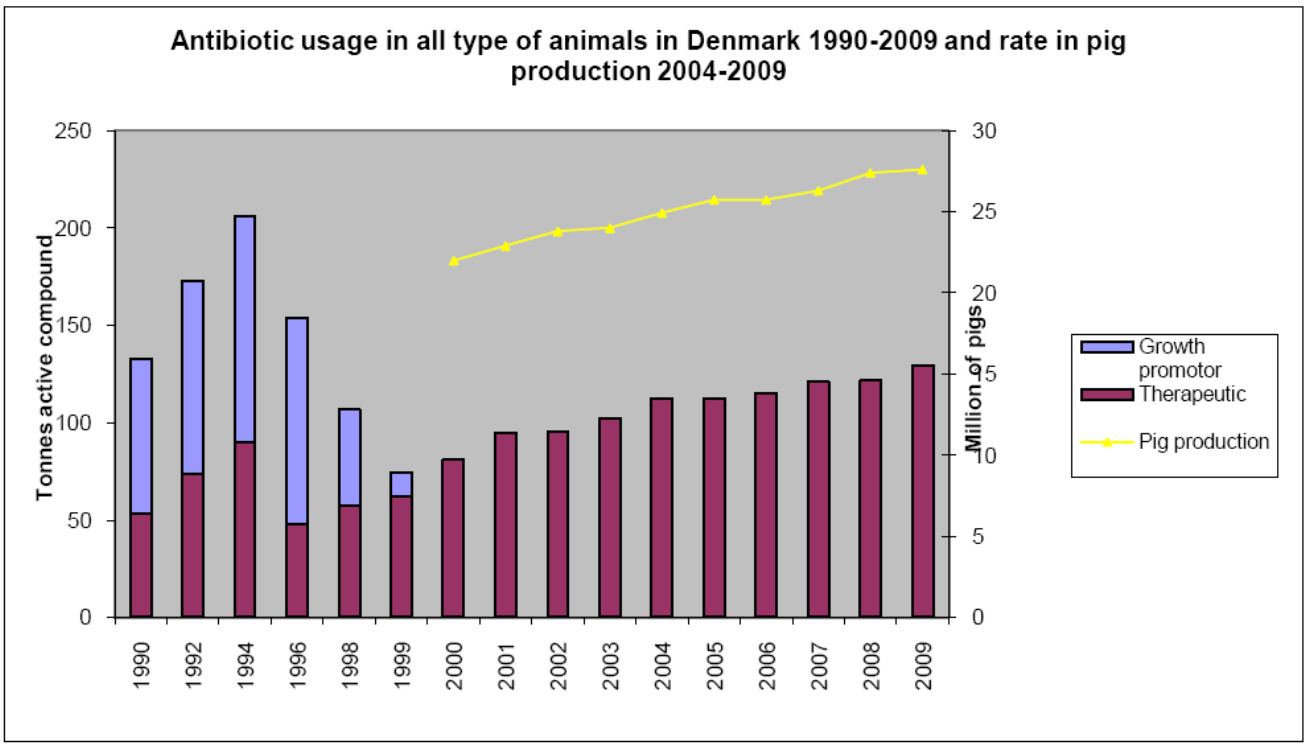
FACT SHEET IV

Effects of the initiatives to reduce the use of antibiotics

Changes in antimicrobial usage in Danish agriculture from 1992 to 2009

- Total antimicrobial consumption in Denmark for all animals (Figure 1) has fluctuated over time; highest in 1994 and lowest in 1999. And the consumption is still 37% less in 2009 than in 1994. The production of pigs has increased continuously over time (The Danish Veterinary and Food Administration, 2010).

Figure 1. Consumption of antibiotics (therapeutic and non-therapeutic (AGP)) in all type of animals in Denmark. Usage in tonnes and pig production in million heads. Swine comprises >80% of all usage in animals.



Changes in antimicrobial resistance

- The stop for use of different non-therapeutic antibiotic growth promoters (avilamycin, avoparcin, spiramycin, tylosin, virginiamycin) has resulted in a reduction in antimicrobial resistance, for instance vancomycin resistance (figure 2) (www.DANMAP.org)

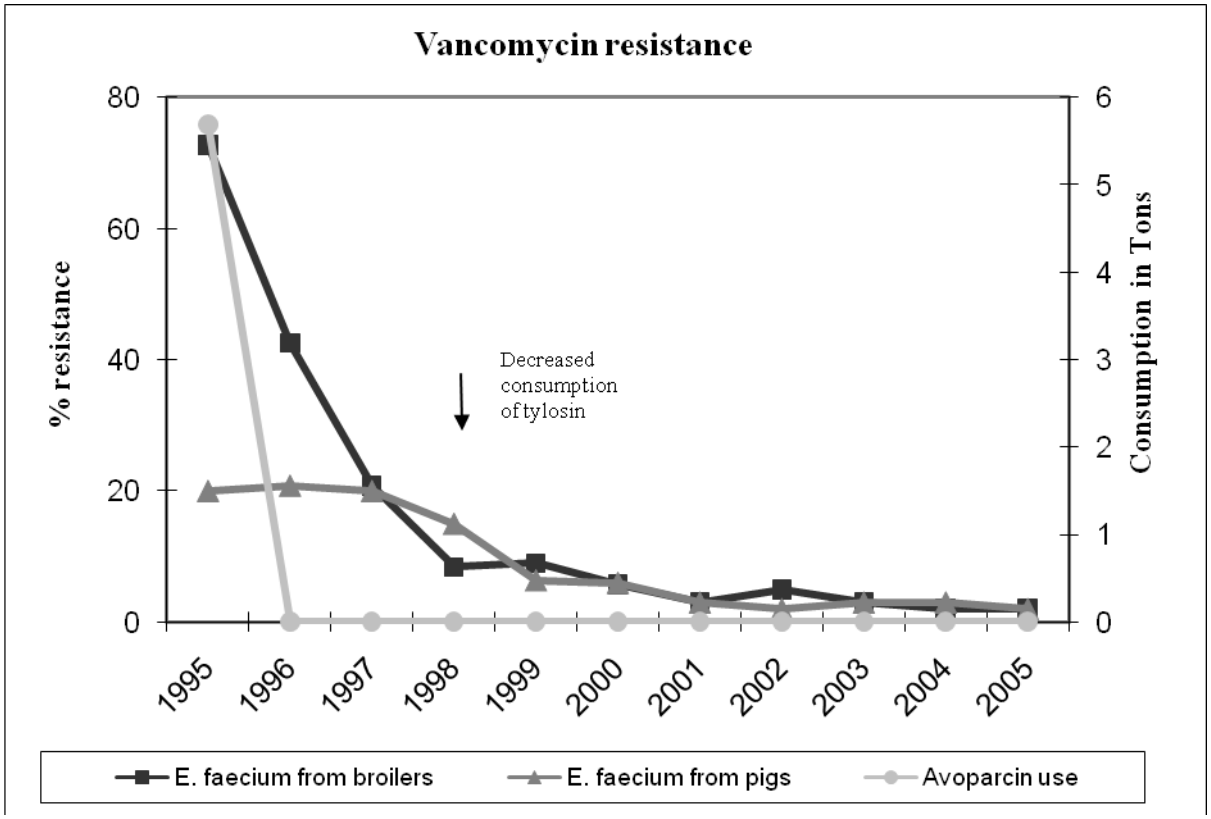


Figure 2. Occurrence of vancomycin resistance and consumption of avoparcin from 1995-2005 - Denmark

- Tylosine is used for both growth promotion and therapy. This usage will also select for (lead to development of) resistance in Campylobacter. As shown in figure 3, the occurrence of macrolide resistance in *Campylobacter coli* from pigs has closely followed the consumption of tylosine in the food animal production (www.DANMAP.org)
- **Campylobacter coli are the absolutely most common Campylobacter in Danish swine. C. jejuni is very rare in swine in Denmark.**

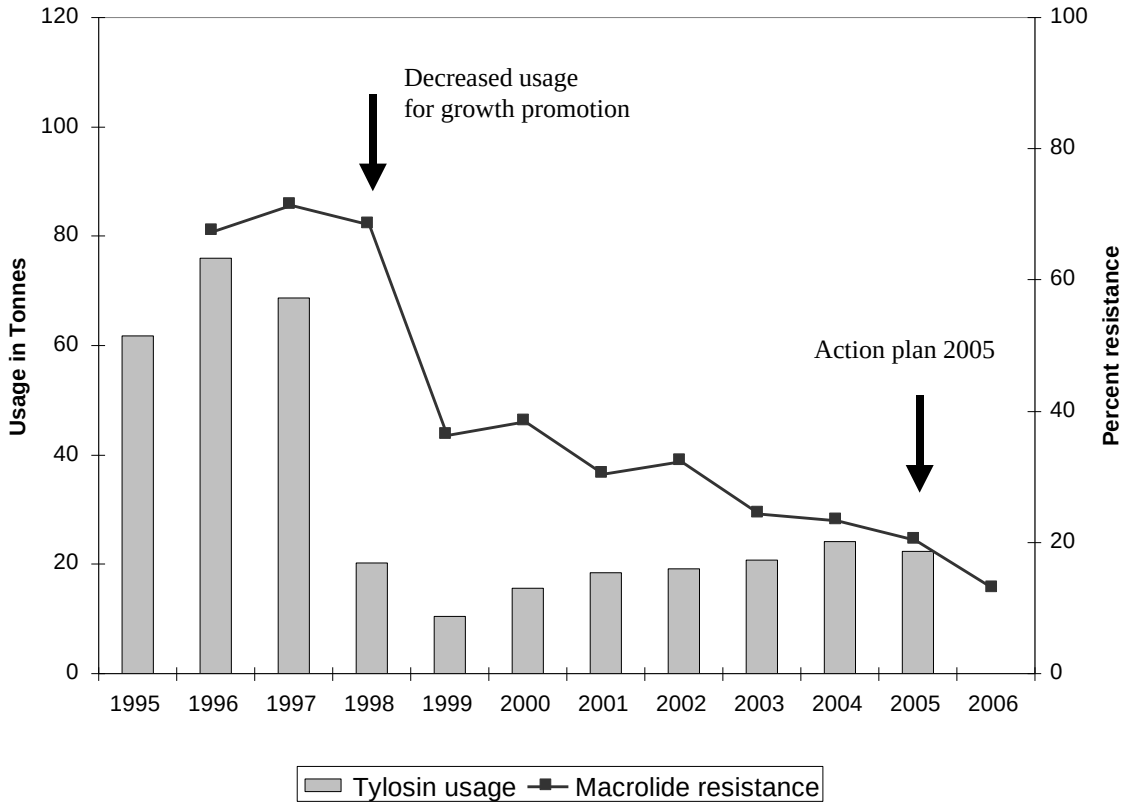


Figure 3. Macrolide resistance among Campylobacter coli from pigs and consumption of tylosine for growth promotion and therapy, 1995-2006, Denmark.

Effects on productivity and animal health - Denmark

Cattle

- No evidence, not even anecdotal, suggests any negative health effects of the growth promoters stop, as there were no increases in treatment of neither sick animals nor mortality.

Swine

- The Danish swine production has increased with similar rates before and after the non-therapeutic use of for growth promotion stopped (almost 50% from 1992 to 2008). Also the average annual number of pigs raised for slaughter per sow has continued to increase (figure 4) (DTU, Danish Technical University, 2009)

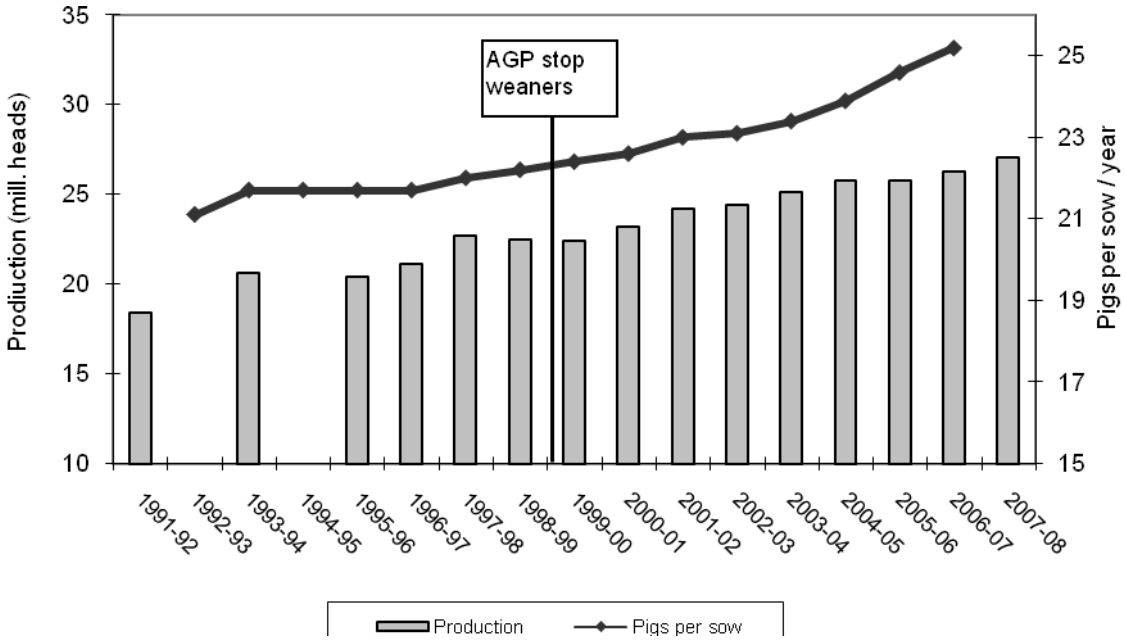


Figure 4. Production of swine and numbers of pigs produced per sow/year in Denmark

- Weaner mortality increased several years before as well as few years after non-therapeutic use stopped, but has drastically decreased in recent years, indicating little if any effect of the termination. Weaner average daily gain has increased after the termination. (Figure 5) (DTU, Danish Technical University, 2009).

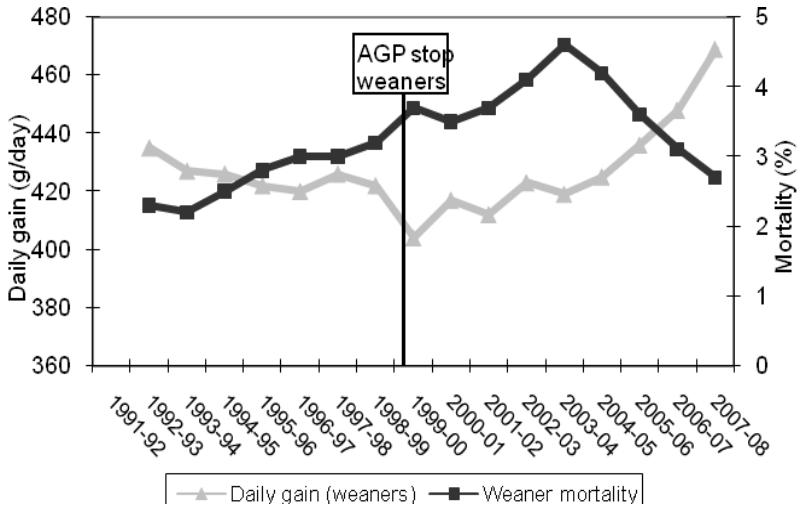


Figure 5. Daily weight gain of weaner pigs and mortality of weaner pigs in Denmark

- Finisher mortality has not been affected by the termination. Finisher average daily gain has continued to increase before and after the termination (Figure 7) (DTU, Danish Technical University, 2009).

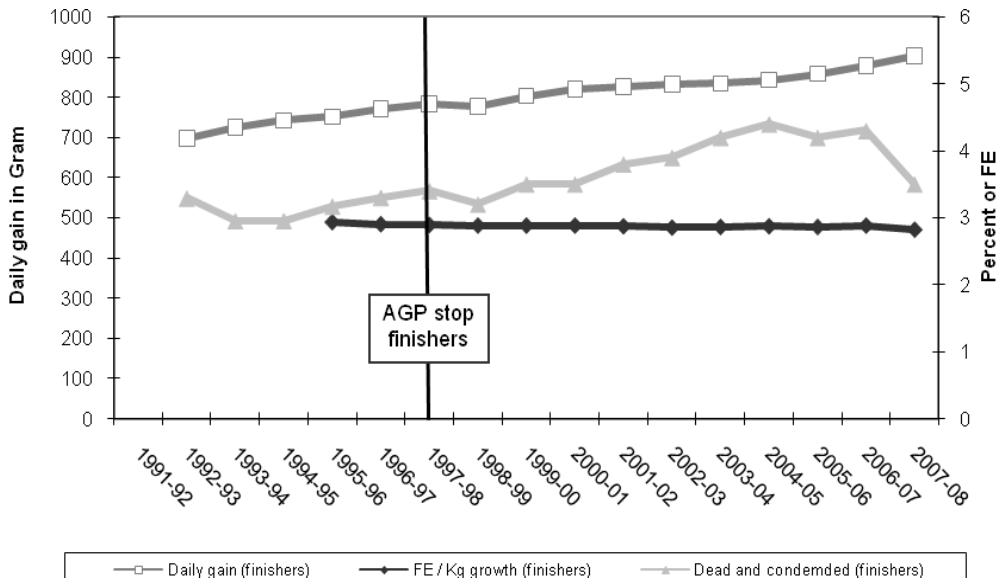


Figure 7. Daily weight gain, mortality and feed efficiency of finishing pigs in Denmark

Broilers

- Productivity and mortality was not affected by the termination, as shown in the figures beneath. Productivity varied both before and after the ban. The feed conversion ratio increased, but the amount spent on feed was gained again as there were no expenses on growth promoters. Productivity is measured not in number of broiler heads, but kg of broilers pr square meter in the stable (Figure 8, 9, 10) (DTU, Danish Technical University, 2009)

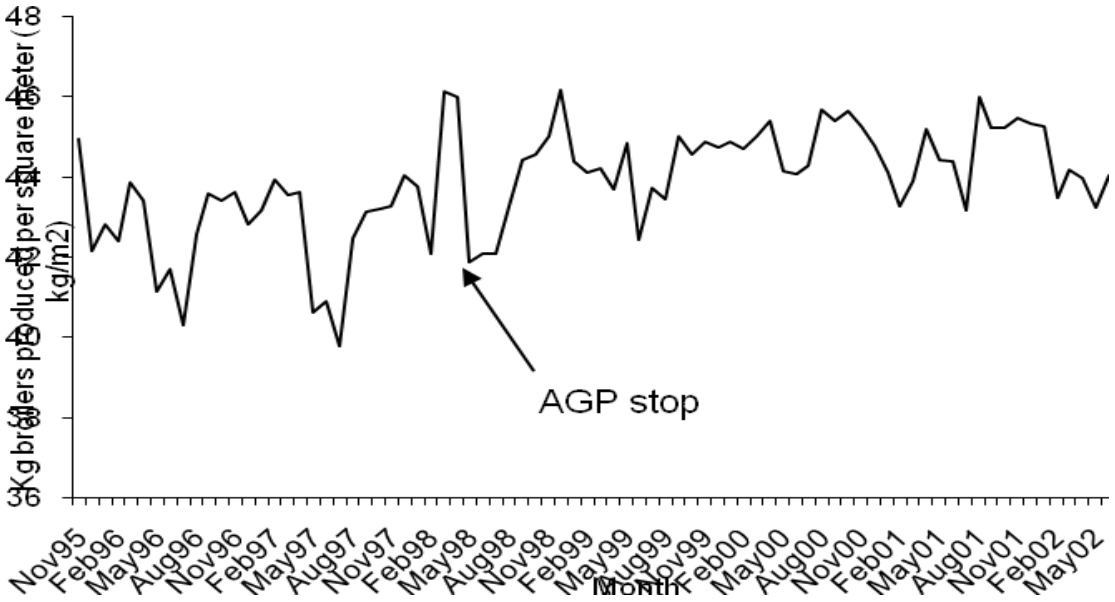


Figure 8. Productivity of broiler chicken in Denmark (kg produced per sqm)

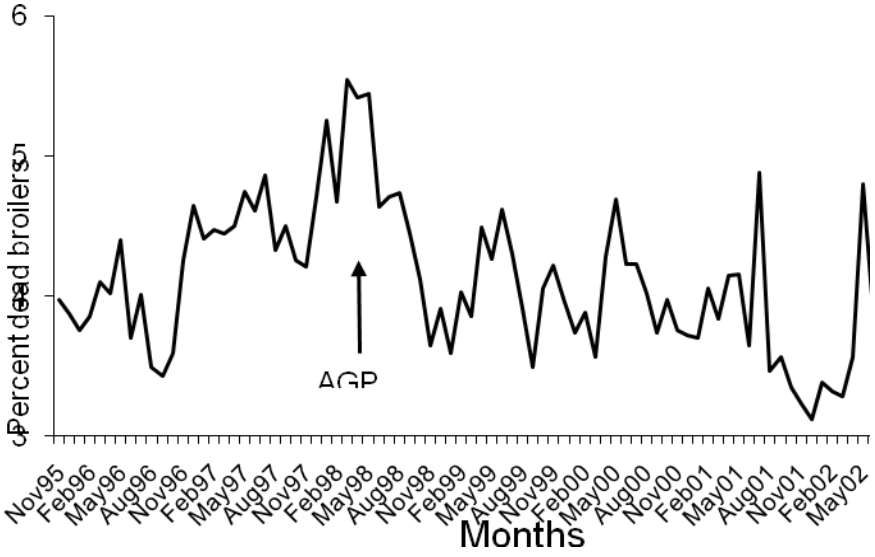


Figure 9. Mortality of broiler chicken in Denmark

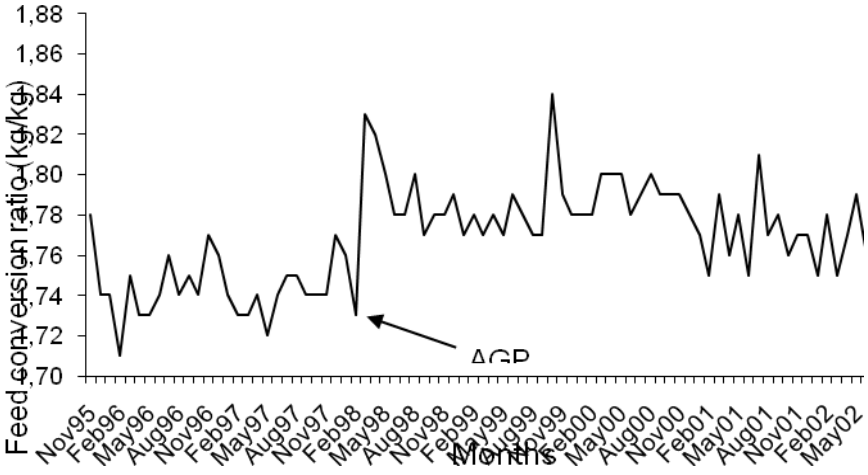


Figure 10. Feed conversion ratio in broilers in Denmark, change offset by reduced costs

FACT SHEET V

Concurrent development with regard to food borne pathogens in food of animal origin

Salmonella in pigs

- Action and control plans have been installed in Denmark since 1995. Prevalence of seropositive pigs in the breeding and multiplying herds is shown in Figure 1, prevalence of seropositive pigs for slaughter in Figure 2, and prevalence of bacteriologically positive carcasses in Figure 3. References for all Figures (Annual Report on Zoonoses in Denmark, DTU, 2009)

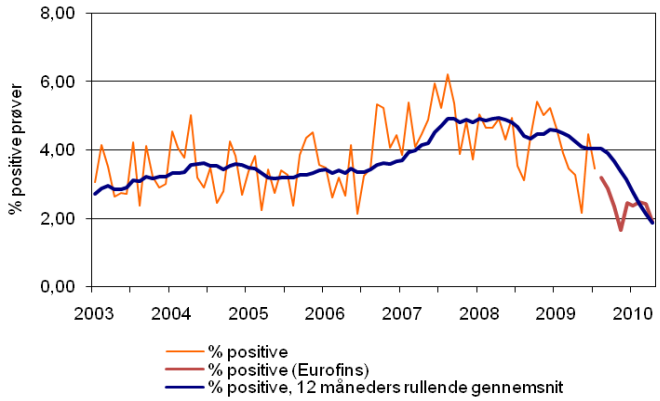


Figure 1. Percent positive samples, breeding and multiplier pigs.

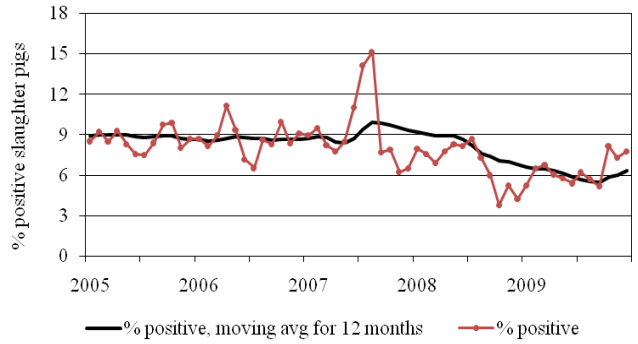


Figure 2. Percentage of positive meat juice samples – slaughter pigs.

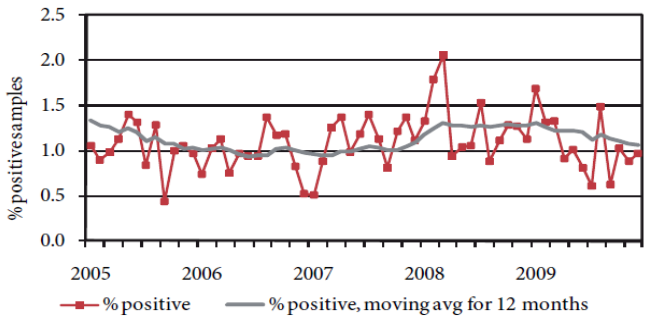


Figure 3 . Percentage of positive carcasses at the slaughterhouse.

Salmonella in layer flocks and in the broiler production

- Action and control plans have been installed in Denmark since the late 1980ies. The occurrence of salmonella in the layer sector (breeding flocks and layer flocks) is shown in Figure 4. Occurrence of salmonella in broilers is shown in Figure 5. Eggs and broilers from contaminated flocks are prevented from entering the market. References for Figures (Annual Report on Zoonoses in Denmark, DTU, 2009)

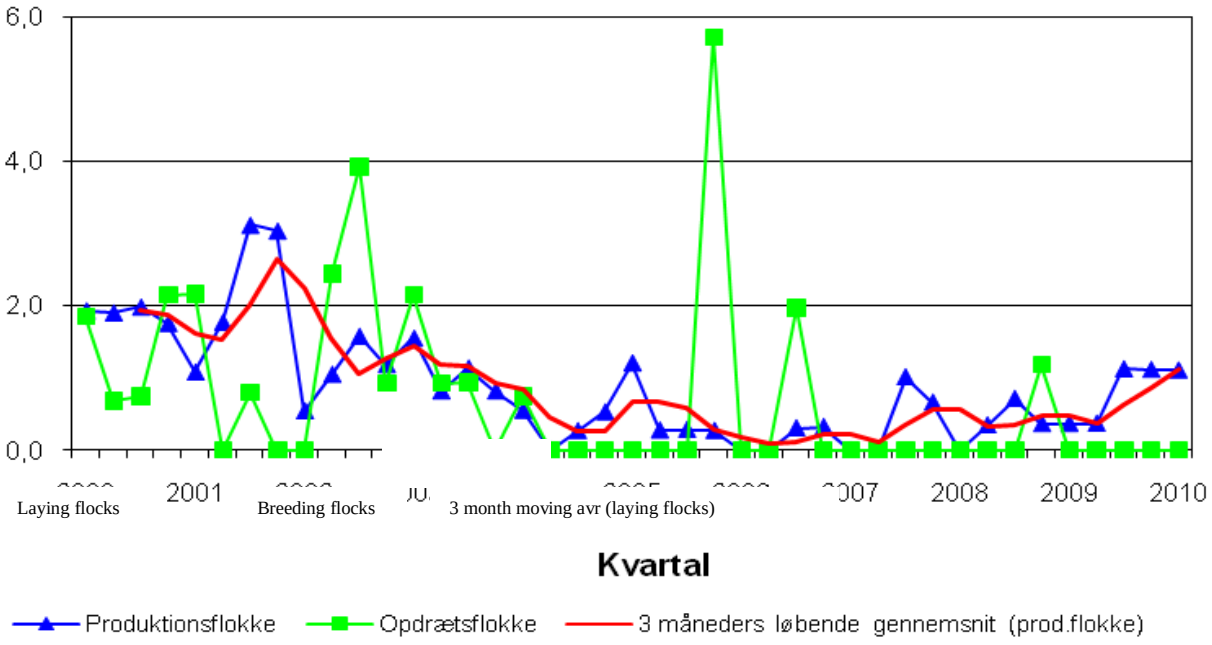


Figure 4. Prevalence (%) of salmonella in Danish table-layer flocks

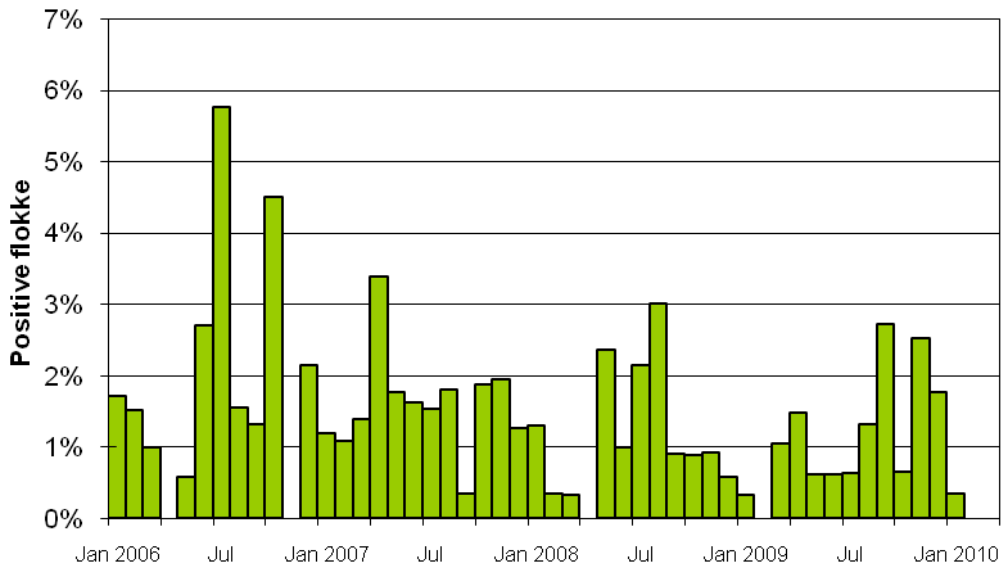


Figure 5. Prevalence of salmonella in Danish broiler flocks