A Report on the Japanese Veterinary Antimicrobial Resistance Monitoring System

-2008 to 2011-

National Veterinary Assay Laboratory

Ministry of Agriculture, Forestry and Fisheries

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Contents

Introduction

Antimicrobial agents are essential for the maintenance of health and welfare in animals as well as humans. However, the use of antimicrobials can be linked to the emergence and increasing prevalence of antimicrobial-resistant bacteria. The impact on human health has been a concern since Swann *et al.* reported that antimicrobial-resistant bacteria arising from the use of veterinary antimicrobial agents were transmitted to humans through livestock products and consequently reduced the efficacy of antimicrobial drugs in humans. In addition, the development of antimicrobial resistance in bacteria of animal origin reduces the efficacy of veterinary antimicrobial drugs.

Antimicrobial agents have been used for prevention, control and treatment of infectious diseases of animals worldwide and for non-therapeutic purposes, such as growth promotion in food-producing animals in some countries, including Japan. In Japan, the Japanese Veterinary Antimicrobial Resistance Monitoring System (JVARM) was established in 1999 in response to an international concern about the impact of antimicrobial resistance on public and animal health. The JVARM program conducted preliminary monitoring for antimicrobial-resistant bacteria in 1999, and the program has operated continuously since this initial surveillance was conducted.

Veterinary antimicrobial use is a selective force for the appearance and prevalence of antimicrobial-resistant bacteria in food-producing animals. However, antimicrobial-resistant bacteria are also found in the absence of antimicrobial selective pressures. The trends in antimicrobial resistance in foodborne bacteria and in indicator bacteria from healthy food-producing animals and the relationship between antimicrobial usage and the prevalence of resistant bacteria under the JVARM program from 2008 to 2011 are outlined in this report.

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I. The Japanese Veterinary Antimicrobial Resistance Monitoring System

1. Objectives

The objectives of JVARM are to monitor both the occurrence of antimicrobial resistance in bacteria in food-producing animals and the consumption of antimicrobials for animal use. These objectives allow the efficacy of antimicrobials in food-producing animals to be determined, prudent use of such antimicrobials to be encouraged, and the effect on public health to be ascertained.

2. Outline of JVARM

JVARM comprises three components (summarized in Figure 1): monitoring the quantities of antimicrobials used in animals; monitoring resistance in zoonotic and indicator bacteria isolated from healthy animals; and monitoring resistance in animal pathogens isolated from diseased animals. In Japan, the Ministry of Agriculture, Forestry and Fisheries (MAFF) is responsible for animal husbandry but not food hygiene. Thus, all bacteria are isolated from food-producing animals on farms but not from food products.

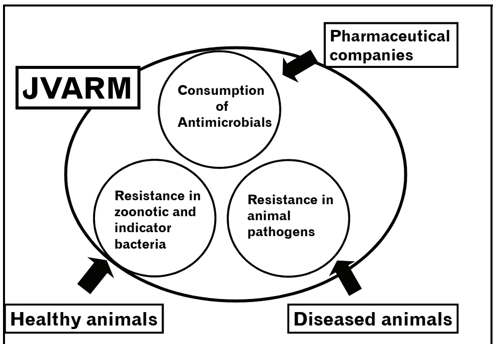

Fig.1. Outline of JVARM

(1) Monitoring of Antimicrobial Consumption

The monitoring implementation system of antimicrobial consumption is shown in Figure 2. Pharmaceutical companies that produce and import antimicrobials for animals are required to submit data to the National Veterinary Assay Laboratory (NVAL) annually in accordance with the Pharmaceutical Affairs Law. NVAL subsequently collates, analyses, and evaluates the data. MAFF headquarters then publishes this data in a yearly report entitled ‘Amount of medicines and quasi-drugs for animal use’.

The annual weight in kilograms of the active ingredients in approved antimicrobials used in animals is collected but includes antimicrobials for only therapeutic animal use. Data are then subdivided into animal species. This method of analysis provides only an estimate of the antimicrobial consumption for each target species, as one antimicrobial is frequently used for multiple animal species.

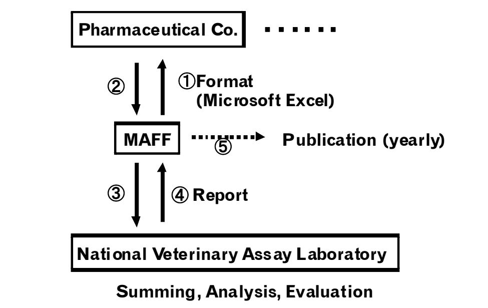

Fig.2. Monitoring of Antimicrobial Consumption

(2) Monitoring of Antimicrobial-resistant Bacteria

Bacteria used in antimicrobial susceptibility testing are continuously collected and include zoonotic and indicator bacteria isolated from healthy animals and pathogenic bacteria isolated from diseased animals. Zoonotic bacteria include *Salmonella* species and *Campylobacter jejuni* or *C. coli*; indicator bacteria include *Escherichia coli* and *Enterococcus faecium* or *E. faecalis*. Animal pathogens including certain species of *Staphylococcus*, *Pasteurella multocida*, and *Mannheimia haemolytica* were collected in the periods of this report. *Campylobacter* organisms and the indicator bacteria are isolated from faecal samples collected from cattle, pigs, and broiler and layer chickens. *Salmonella* organisms and animal pathogens are isolated from samples submitted for diagnosis. Minimum inhibitory concentrations (MICs) of antimicrobial agents for target bacteria are determined using the agar dilution method and broth microdilution method as described by the Clinical and Laboratory Standards Institute (CLSI; formerly, National Committee for Clinical Laboratory Standards [NCCLS]).

3. JVARM Implementation System

The JVARM implementation system is shown in Figure 3. Livestock Hygiene Service Centres (LHSCs), which belong to prefecture offices, participate in JVARM. The LHSCs function as participating laboratories of JVARM and are responsible for the isolation and identification of target bacteria, as well as for MIC measurement. They send results and tested bacteria to NVAL, which functions as the reference laboratory of JVARM and is responsible for preserving the bacteria, collating and analysing all data, and reporting to MAFF headquarters. MIC measurement, data collation, and preservation of *Enterococcus faecium* and *E. faecalis* are conducted at the Food and Agricultural Materials Inspection Center (FAMIC). Furthermore, NVAL conducts research into the molecular epidemiology and resistance mechanisms of the bacteria.

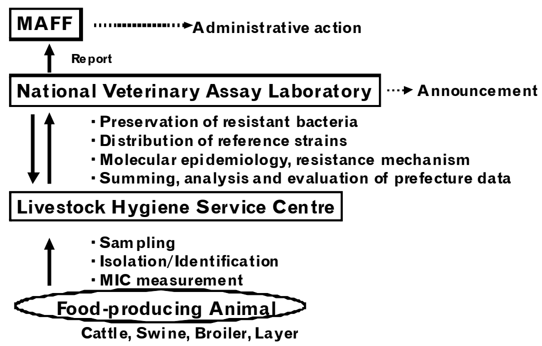

Fig.3. Monitoring of Resistant bacteria

4. Quality Assurance/Quality Control Systems

Quality control procedures are implemented in participating laboratories that perform antimicrobial susceptibility testing to help monitor the precision and accuracy of the test procedure, the performance of the appropriate reagents, and the training of the personnel involved. Strict adherence to standardized techniques is necessary for the collection of reliable and reproducible data from participating laboratories. Quality control reference bacteria are also tested in each participating laboratory to ensure standardization. Moreover, NVAL holds a national training course on antimicrobial resistance every year to provide training in standardized laboratory methods for the isolation, identification, and antimicrobial susceptibility testing of target bacteria.

5. Publication of Data

Because the issue of antimicrobial resistance directly influences animal and human health, it is of paramount importance to distribute information on antimicrobial resistance as soon as possible. We have officially taken three steps to publicise such information: initially, through the MAFF weekly newspaper called 'Animal Hygiene News', followed by publication in scientific journals, and, finally, via the NVAL website (http://www.maff.go.jp/nval/tyosa_kenkyu/taiseiki/index.html).

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II. An Overview on the Availability of Veterinary Antimicrobial Products in Japan used for Therapy or Growth Promotion

The numbers of animals slaughtered for meat in slaughterhouses and poultry slaughtering plants between 2007 and 2010 are shown in Table 1. In the last decade, there has been no remarkable change in the number of meat animals produced, except in cattle. Although the number of slaughtered beef cattle decreased from 1.5 million in 1995 to 1.2 million in 2003, it has recovered for the last three years. The scale of pig and poultry farms has increased each year. However, the number of farmers in Japan has decreased because of the absence of successors.

Table 1. Number of animals slaughtered in slaughterhouses and poultry slaughtering plants (1,000 heads/birds).

	Cattle	Calf	Horse	Pig	Broiler	Fowl*
2007	1198.9	8.2	15.5	16267.6	622834	93928
2008	1226.6	11	15.0	16192.1	629766	93090
2009	1216.8	10.9	14.6	16965.7	634692	94224
2010	1209.0	9.7	14.2	16807.1	633799	91081

*Most of these fowls are old layer chickens.

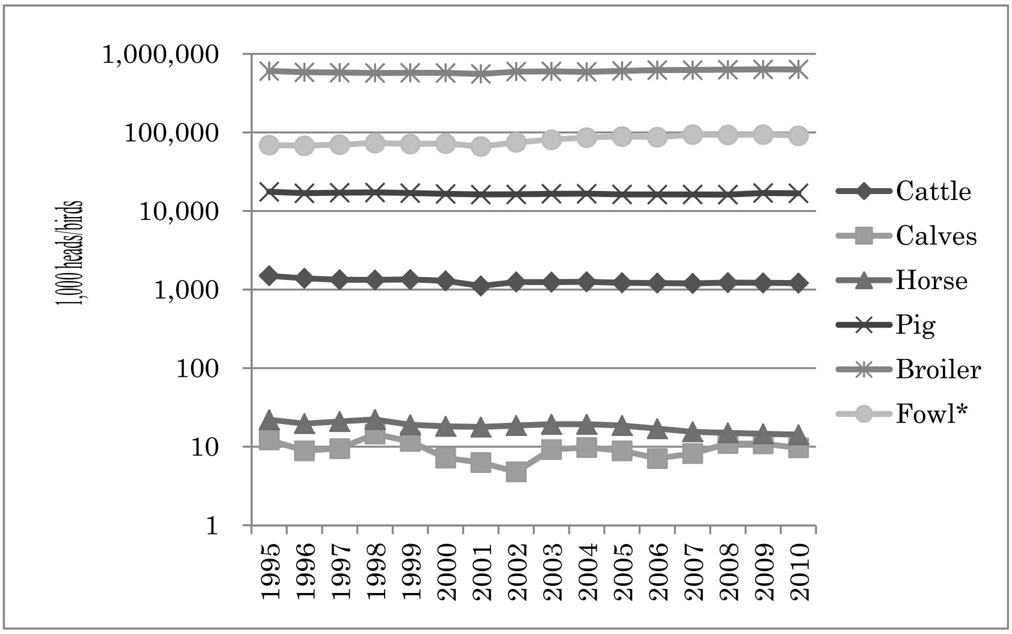

Figure 4. Trends in Number of animals slaughtered in slaughterhouses and poultry slaughtering plants (1,000 heads/birds).

The sales volume of veterinary medical products was about 870 tonnes on the average between 2004 and 2010 (Figure 5). The total antimicrobial consumption for animals decreased gradually during the periods of interest. Antimicrobials were used most frequently in pigs, compared with cattle and poultry. Tetracycline antimicrobials accounted for 40% of total sales volume of veterinary antimicrobials, whereas fluoroquinolones and cephalosporins were used restrictively (less than 1% of total sales volume of veterinary antimicrobials).

The use of antimicrobial feed additives commenced in the 1950s. In Japan, all antimicrobial feed additives must be subjected to a national assay before distribution. The current trends in assay-acceptable amounts of feed additives (converted to bulk products) are shown in Figure 6. From 2007 to 2009, the total volume was fairly constant, averaging 171 tonnes. After 2009, the total volume increased, which was associated with an increase of ionophores. Ionophores and polypeptides composed a large percentage of feed additives (average of 113 [64.3%] and 35 [20.2%] tonnes, respectively), whereas other compounds, including tetracyclines and macrolides, each composed less than 4% of the total volume (average of 2.5 [1.4%] and 5.7 [3.3%] tonnes, respectively).

Presently, the total usage volume of antimicrobial drugs is much greater than that of antimicrobial feed additives in Japan. Thus, veterinary antimicrobial drugs are given priority as risk factors associated with bacterial antimicrobial resistance.

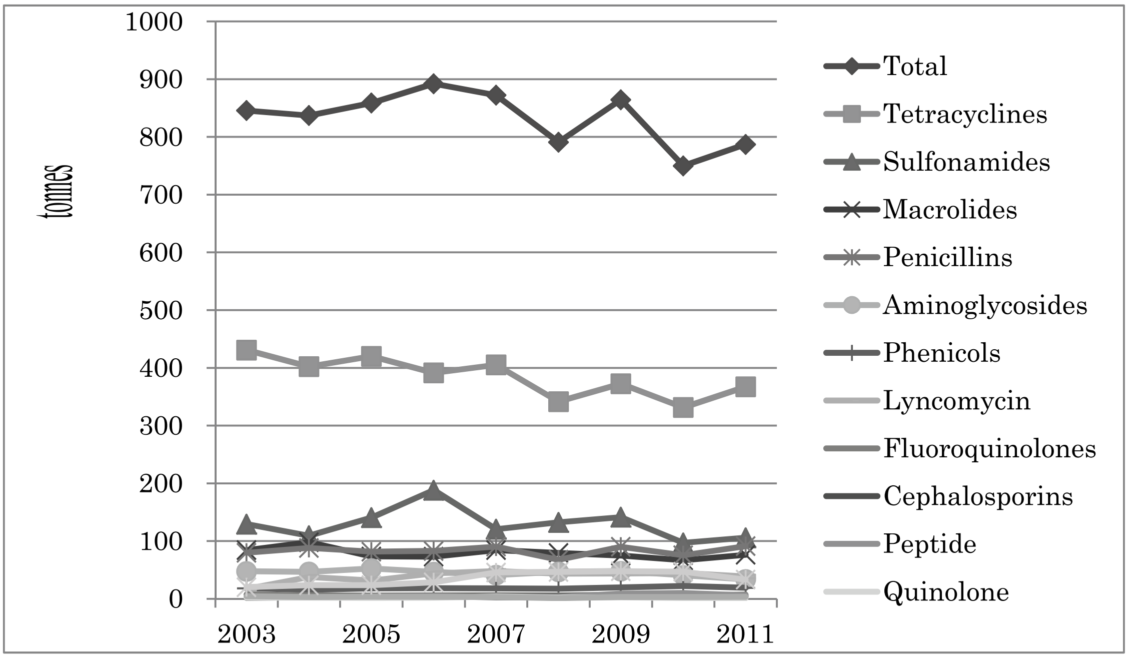

Figure 5. Trends in veterinary antimicrobials sold from pharmacies in Japan (in tonnes of active compound).

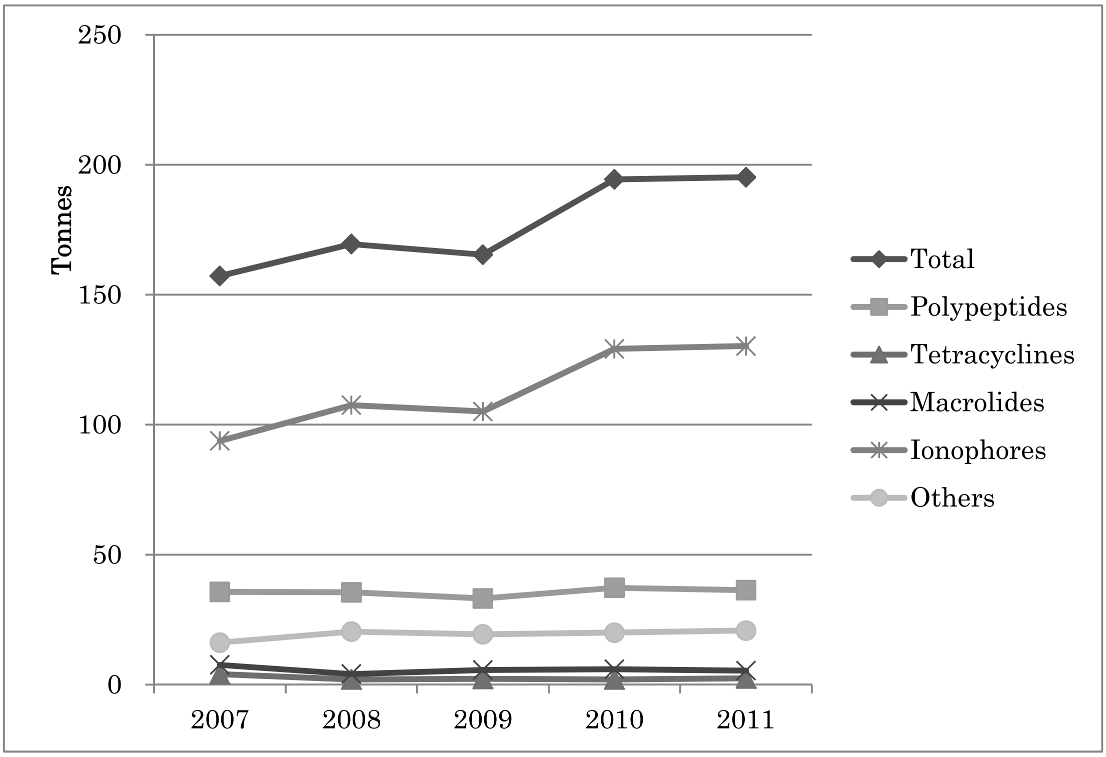

Figure 6. Trends in assay-acceptable amounts of antimicrobial feed additives in Japan (in tonnes of active compound).

III. Monitoring of Antimicrobial Resistance

1. *Escherichia coli*

In total, 2,862 isolates of *E. coli* (1120 from cattle, 567 from pigs, 582 from broiler chickens, and 593 from layer chickens) collected between 2008 and 2011 were available for antimicrobial susceptibility testing. The MIC distributions during the 2008–2011 period are shown in Tables 2.1–2.4. Trends in resistance to selected antimicrobial agents in isolates from food-producing animals during the 2008–2011 period are presented in Figure 7.

Antimicrobial resistance was found for all antimicrobials tested. Resistance rates against most antimicrobials studied were stable in *E. coli* isolates during the period from 2008 to 2011. Resistance was frequently found against tetracyclines (oxytetracycline, 2008–2009; tetracycline, 2010–2011), streptomycin antibiotics (dihydrostreptomycin, 2008–2009; streptomycin, 2011), and ampicillin in food-producing animals.

In general, the highest resistance rate was found in *E. coli* from pigs or broilers. Resistance in pig and broiler chicken isolates was most common against dihydrostreptomycin (resistance rate in pigs and broilers, 50.7% and 34.4-40.8%), streptomycin (43.4% and 28.6%), oxytetracycline (62.5-65.2% and 51.0-73.1%), tetracycline (58.6-60.0% and 47.2-56.4%), ampicillin (22.1-32.9% and 42.1-48.5%), kanamycin (6.9-15.9% and 12.3-24.6%), chloramphenicol (18.6-26.1% and 9.3-16.2%), trimethoprim (2008-2009, 23.9-32.6% and 30.2-32.3%) and trimethoprim-sulfamethoxazole (2010-2011, 26.2-27.1% and 23.6-25.6%).

Incidence of nalidixic acid resistance was high in the *E. coli* isolates from broiler chickens (30.8–38.5%), intermediate in those isolates from pigs (6.9–10.1%) and layer chickens (4.4–12.8%), and low in those isolates from cattle (1.0–4.2%). Frequency of enrofloxacin (2008–2009) and ciprofloxacin (2010–2011) resistance remained low, except for isolates of *E. coli* from broilers (7.7–12.5 % and 5.0–5.1%, respectively).

Resistance to cefazolin was found in *E. coli* isolates of only broilers in 2008, but resistance was found in isolates from all animal species in 2011. In addition, resistance frequencies to cefazolin remained high in *E. coli* isolates of broiler origin between 2008 and 2011 (18.8–20.8%), and the resistance frequencies to third generation cephalosporins (ceftiofur [16.7–17.7%, 2008–2009] and cefotaxime [17.9–18.6%, 2010–2011]) were at a similar level.

2. *Enterococci*

A total of 701 *E. faecalis* and 561 *E. faecium* isolates collected between

2008 and 2011 were subjected to antimicrobial susceptibility testing. *Enterococcus faecium* was isolated from faeces of all four food-producing animal species, whereas *E. faecalis* was isolated mainly from faeces of pigs, layers, and broilers. The MIC distributions during the 2008–2011 period are shown in Tables 3.1–4.4. Trends in resistance to selected antimicrobial agents in isolates from food-producing animals during the years 2000–2011 are presented in Figures 8–9.

Antimicrobial resistance was found for 9 of the 14 tested antimicrobials in *E. faecalis* and *E. faecium* (Tables 3.1–4.4). Extent of resistance rates to each antimicrobial varied by bacterial species and animal species. Antimicrobial resistance was more frequently found in *E. faecalis* isolates than *E. faecium* isolates. Resistance rates of isolates originating from pigs and broiler chickens tended to be higher than those isolates originating from cattle and layer chickens. Resistance rates against the majority of antimicrobials studied were stable in *E. faecalis* and *E. faecium* isolates during the period from 2008 to 2011.

Resistance in pig and broiler chicken isolates was frequently found against oxytetracycline (resistance rates in *E. faecalis and E. faecium,* 64.8–100% and 42.9–76.2%), dihydrostreptomycin (57.3–95.2% and 18.4–48.6%), kanamycin (28.0–61.9% and 16.1–53.3%), erythromycin (44.0–76.9% and 19.0–36.4%), and lincomycin (46.0–88.9% and 18.4–45.7%). Dihydrostreptomycin resistance in *E. faecalis* increased in the third and fourth stages of JVARM compared with the second stage.

Enrofloxacin resistance rate in *E. faecium* isolates (18.2–65.3%) was higher than in *E. faecalis* (0–16.7%). Enrofloxacin resistance in *E. faecium* isolates increased in the third and fourth stages of JVARM compared with the second stage.

3. *Campylobacter*

A total of 617 *C. jejuni* and 313 *C. coli* isolates collected between 2008 and 2011 were subjected to antimicrobial susceptibility testing. *C. jejuni* was isolated mainly from faeces of cattle, layers, and broilers, whereas *C. coli* was isolated mainly from pig faeces. The MIC distributions from 2008 to 2011 are shown in Tables 5.1–6.4. Trends in resistance to selected antimicrobial agents in isolates from food-producing animals during the 2000–2011 period are presented in Figure 10.

Antimicrobial resistance was found for all antimicrobials tested, except for gentamicin. However, extent of resistance rates to each antimicrobial varied by bacterial species and animal species. *Campylobacter coli* isolates were more frequently resistant to almost all antimicrobials studied than *C. jejuni* isolates. In general, the highest resistance

rate was found in *C. coli* from pigs.

Compared to other antimicrobial study, resistance was more frequently found against tetracyclines (oxytetracycline, 2008–2009; tetracycline, 2010–2011) in *C. coli* (60.2–79.0%) and *C. jejuni* (29.0–46.7%). Resistance in *C. jejuni* and *C. coli* isolates was found against ampicillin (resistance rate in *C. jejuni* and *C. coli*, 13.8–17.4% and 0–17.3%), streptomycin antibiotics (0–2.6% and 31.8–50.6%; dihydrostreptomycin, 2008–2009; streptomycin, 2011), erythromycin (0% and 28.4–47.4%), chloramphenicol (0–1.0% and 11.4–24.6%), nalidixic acid (17.0–28.3% and 37.9–55.7%), fluoroquinolones (16.0–24.7% and 35.1–52.3%; enrofloxacin, 2008–2009; ciprofloxacin, 2008–2009).

Frequency of fluoroquinolone resistance gradually increased in *C. coli* from pigs and *C. jejuni* from cattle in the third and fourth stages of JVARM. Frequency of fluoroquinolone resistance was stable in *C. jejuni* from broilers in the third and fourth stages of JVARM, although it increased between 1999 and 2007.

Erythromycin resistance was found in a few *C. jejuni* isolates in 2011 and was frequently found in *C. coli* isolates but was stable (44.4–61.9%) in the third and fourth stages.

4. *Salmonella*

In total, 688 *Salmonella* isolates (301 from cattle, 236 from pigs, and 151 from chickens) collected between 2008 and 2011 were available for antimicrobial susceptibility testing. The MIC distributions during the years 2008–2011 are shown in Tables 8.1–8.3.

The predominant serovars were *S.* Typhimurium (244 isolates, 35.5%), *S.* Choleraesuis (85 isolates, 12.4%), and *S.* Infantis (48 isolates, 7%). *Salmonella* Typhimurium was the predominant serovar isolated from cattle and pigs (134/301, 44.5% and 108/236, 45.8%, respectively). *Salmonella* Infantis was the predominant serovar isolated from chickens (35/151, 23.2%).

Antimicrobial resistance was found for most antimicrobials tested, except for enrofloxacin and ciprofloxacin. Resistance rates against the majority of antimicrobials studied were stable in *Salmonella* isolates during the period from 2008 to 2011. Resistance was frequently found against tetracyclines (oxytetracycline, 2008–2009; tetracycline, 2010–2011), dihydrostreptomycin (2008–2009), and ampicillin in food-producing animals.

In general, the highest resistance rate was found in *Salmonella* isolates from pigs. Resistance in pigs was most commonly against dihydrostreptomycin (93.5–100%, 2008–2009), oxytetracycline (72.7–81.5%, 2008–2009), tetracycline (61.9–71.2%, 2010–2011), ampicillin (25.4–47.8%), kanamycin (9.5–27.3%), chloramphenicol (6.8–27.3%), trimethoprim (27.3–32.6%, 2008–2009),

and trimethoprim-sulfamethoxazole (25.4–33.9%, 2010–2011).

Incidence of nalidixic acid resistance was intermediate in *Salmonella* isolates from pigs (3.4–20.7%) and low in those isolates from cattle (0–7.4%) and chickens (2.8–10.5%). Enrofloxacin (2008–2009) and ciprofloxacin (2010–2011) resistance was not observed.

Resistance to cefazolin was found in *Salmonella* isolates from all animal species; however, resistance frequencies were low (0–10%).

IV. JVARM Topics

In this section, we present the major study of JVARM published between 2008 and 2011.

1. Association between Antimicrobial Usage and Antimicrobial-resistant Bacteria in Food-producing Animals

(1) Prevalence of Antimicrobial-resistant Bacteria caused by Antimicrobial Usage

In Japan, enrofloxacin was first approved for treating avian colibacillosis in 1991, and three fluoroquinolone compounds have been approved for avian colibacillosis to date. Ozawa demonstrated that the resistance rate of avian pathogenic *Escherichia coli* (APEC) isolates to enrofloxacin was significantly higher in the APEC strains tested than in *E. coli* isolates from healthy chickens ($P < 0.05$). In APEC strains isolated in 1989 (before the approval of fluoroquinolones for treatment of avian colibacillosis), resistance to quinolones and fluoroquinolones was not observed. The results support the proposal that the emergence and increase of fluoroquinolone resistance in APEC strains may result from fluoroquinolone use in the treatment of avian colibacillosis. [Ozawa, M., *et al*. 2008. Avian Dis. 52: 392-397.]

(2) Contribution of Multiple Antimicrobial Resistance to Prevalence of Resistant Bacteria

The farm-level impact of the use of several different antimicrobial agents on the population of antimicrobial-resistant commensal bacteria of animal origin was investigated to appropriately assess the relative risk of resistance. This study was carried out based on the results of a survey on the history of antimicrobial drug use in 297 pig farms and antimicrobial susceptibility testing for the 545 *E.coli* isolates. A comparative analysis with the nonexposed herd revealed that ampicillin (ABPC) resistance in *E. coli* increased in the herds that were exposed to penicillin (relative risk [RR], 1.75) and penicillin-streptomycin (RR, 2.28); dihydrostreptomycin (DSM) resistance, in the penicillin-streptomycin-exposed herd (RR, 1.75); and trimethoprim (TMP) resistance in the trimethoprim-sulfonamide-exposed herd (RR, 2.10). On the other hand, ABPC and DSM resistances increased in the tetracycline-exposed herd (RR, 1.66 and 1.58, respectively); TMP resistance, in the penicillin-exposed herd (RR, 1.77); and oxytetracycline and kanamycin resistances, in the penicillin-streptomycin-exposed herd (RR, 1.28 and 2.22, respectively). These results demonstrated that the development of cross-resistance and coresistance, imposed by the therapeutic

use of the antimicrobials studied, contributed to the farm-level prevalence of antimicrobial-resistant *E. coli* and that the influence of coselection was characteristic to individual antimicrobial agents used. [Harada, K., *et al.* 2008. Microb. Drug Resist. 14:239-244.]

(3) Prevalence of Antimicrobial-resistant Bacteria in the Absence of Antimicrobial Selective Pressure

Salmonella enterica subspecies *enterica* serovar Schwarzengrund isolates from broiler chickens exhibited resistance to both bicozamycin and sulfadimethoxine. Bicozamycin resistance was rarely found in *S.* Infantis isolates from broiler chickens between 2000 and 2003. Bicozamycin has been approved as a veterinary medicine in cattle and pigs but not in poultry; between 1998 and 2007, it was not used to promote the growth of food animals. Thus, the prevalence of bicozamycin resistance in *S.* Schwarzengrund is not likely to the result of bicozamycin use on broiler chicken farms. [Asai, T., *et al.* 2009. Jpn. J. Infect. Dis. 62:198-200.]

2. Characteristics of Antimicrobial-resistant Bacteria

(1) *Escherichia coli*

a) Phylogenetic Groups and Cephalosporin Resistance Genes of *E. coli* from Diseased Food-producing Animals

A total of 318 *E. coli* isolates obtained from different food-producing animals affected with colibacillosis (72 bovine isolates, 89 poultry isolates and 157 porcine isolates) between 2001 and 2006 were subjected to phylogenetic analysis. Overall, the phylogenetic group A was predominant in isolates from cattle and pigs, whereas groups A and D were predominant in isolates from poultry. In addition, group B2 was not found among diseased food-producing animals, except for one poultry isolate. Thus, the phylogenetic group distribution of *E. coli* from diseased animals differed by animal species. Among the 318 isolates, cefazolin resistance (minimum inhibitory concentration: ≥ 32 μg/ml) was found in 6 bovine isolates, 29 poultry isolates, and 3 porcine isolates. Of these resistant isolates, 11 isolates (nine from poultry and two from cattle) produced extended spectrum b-lactamase (ESBL). The two bovine isolates produced $bla_{\text{CTX-M-2}}$, while the nine poultry isolates produced $bla_{\text{CTX-M-25}}$ (n = 4), $bla_{\text{SHV-2}}$ (n = 3), $bla_{\text{CTX-M-15}}$ (n = 1), and $bla_{\text{CTX-M-2}}$ (n = 1). Thus, these results showed that several types of ESBL were identified and three types of b-lactamase (SHV-2, CTX-M-25 and CTX-M-15) were observed for the first time in *E. coli* from diseased animals in Japan. [Asai, T., *et al.* 2011. Acta Vet. Scand. 53:52.]

b) Characterization of Avian Pathogenic *E. coli*

In total, 83 avian pathogenic *E. coli* (APEC) isolates from cases of avian colibacillosis during a period from 2001 to 2006 in Japan were investigated for serogroups, typical virulence factors, antimicrobial susceptibility, and genetic relatedness. The most common serogroup was O78 (30.1%); 80.7% of isolates harboured the *iss* gene, and 55.4% of isolates harbored the *tsh* gene. Antimicrobial resistance of the isolates was found for ampicillin (77.1%), oxytetracycline (75.9%), kanamycin (36.1%), fradiomycin (33.7%), trimethoprim (25.3%), enrofloxacin (21.7%), and florfenicol (6.0%). Although multiple antimicrobial resistance phenotypes (three or more antimicrobials) accounted for 54.2% of isolates, no isolate exhibited resistance to all agents tested. The fluoroquinolone-resistant isolates had point mutations in GyrA (Ser83RLeu, Asp87RAsn) and ParC (Ser80RIle, Glu84RGly). Of 18 enrofloxacin-resistant *E. coli* isolates, nine isolates belonged to serotype O78. In PFGE analysis, eight of the nine enrofloxacin-resistant O78 isolates were classified into a single cluster. This suggests that a specific genotype of fluoroquinolone-resistant O78 APEC may be widely distributed in Japan. [Ozawa, M., *et al.* 2008. Avian Dis. 52:392-397.]

(2) *Salmonella*

a) *S.* Schwarzengrund

A total of 29 isolates of *S.* Schwarzengrund from broiler chickens (n = 19) and retail chicken meats (n = 10) in Japan were examined for antimicrobial susceptibility and pulsed-field gel electrophoresis (PFGE) profiling. All isolates exhibited resistance to both bicozamycin and sulfadimethoxine (minimum inhibitory concentration of both antimicrobial agents: > 512 μg/ml). Nalidixic acid resistance was found in only one broiler chicken isolate. PFGE analysis showed that there were two genotypes among *S.* Schwarzengrund isolates. Isolates from 11 of 19 broiler chickens and from 6 of 10 retail chicken meats exhibited resistance to dihydrostreptomycin, kanamycin, oxytetracycline, bicozamycin, trimethoprim, and sulfadimethoxine and had an identical PFGE pattern classified into a predominant genotype. Thus, these results indicate that genetically identical multidrug-resistant *S.* Schwarzengrund appeared to be disseminated among broiler chickens and retail chicken meats in Japan. [Asai, T., *et. al*. 2009. Jpn. J. Infect. Dis. 62:198-200.]

b) *S.* Choleraesuis

The emergence of fluoroquinolone-resistant strains of *S.* Choleraesuis is an important concern in several countries, including Japan. The intracellular concentration of enrofloxacin in *S.* Choleraesuis was examined to determine the existence of a

relationship with the emergence of quinolone resistance. The intracellular concentration of enrofloxacin was significantly lower in nalidixic acid-resistant isolates compared with nalidixic acid-susceptible isolates. In the presence of carbonyl cyanide m-chlorophenylhydrazone, the intracellular concentration of enrofloxacin increased in all isolates, with no significant difference in the intracellular concentration between nalidixic acid-susceptible and nalidixic acid-resistant isolates. The frequency of emergence of fluoroquinolone-resistant mutants was higher in susceptible isolates with a low intracellular concentration of enrofloxacin. The results presented suggest that a decrease in the intracellular concentration of enrofloxacin is related to active efflux pumps and contributes to the emergence of fluoroquinolone resistance. [Usui, M., *et al.* 2009. Int. J. Antimicrob. Agents.]

3) *Campylobacter*

Penner serotypes of *C. jejuni* in a total of 601 isolates from healthy cattle and layer and broiler chickens in Japan were examined between 2001 and 2006. Predominant serotypes were B (O:2, 19.1%), D (O:4, 13.5%), Y (O:37, 7.3%), and G (O:8, 5.8%), whereas the remaining serotypes made up less than 5% of the total isolates. The frequency of ampicillin resistance in serotype G (65.6%) was significantly higher than in serotypes D (12.5%), B (11.2%), and Y (0%). These results suggest that serotype is one factor contributing to the prevalence of ampicillin resistance in *C. jejuni* isolates. [Harada, K., *et al*. 2009. Microbial Immunol. 53:107-111.]

3. International Concern

JVARM investigated antimicrobial-resistant bacteria which attract international attention. Meticillin-resistant *Staphylococcus aureus* (MRSA) sequence type (ST) 398 is widely prevalent in swine in Europe and North America, and the plasmid-mediated quinolone resistance (PMQR) genes have been reported in bacteria isolated from humans and food-producing animals worldwide. Here, the studies of MRSA and the PMQR of *S.* Typhimurium are introduced.

(1) MRSA in Pigs

To determine the prevalence of MRSA, specifically ST398, in Japanese swine, a total of 115 nasal swabs and 115 faecal samples from swine reared at 23 farms located in eastern Japan were investigated. MRSA was isolated from one nasal sample (0.9%) but not from any faecal samples. The strain of MRSA was classified as ST221 by multilocus sequence typing and as t002 by spa typing. The MRSA isolate exhibited resistance to ampicillin, meticillin, and dihydrostreptomycin. Interestingly, it remained susceptible to cefazolin,

ceftiofur, imipenem, gentamicin, kanamycin, chloramphenicol, oxytetracycline, erythromycin, azithromycin, tylosin, vancomycin, enrofloxacin, and trimethoprim. The prevalence of MRSA amongst swine was low, and MRSA ST398 was not recovered in the present study. [Baba, K., *et al*. 2010. Int. J. Antimicrob. Agents. 36:352-354.]

(2) Plasmid-mediated Quinolone Resistance (PMQR)

A total of 225 isolates of *S.* Typhimurium collected from food-producing animals between 2003 and 2007 were examined for the prevalence of plasmid-mediated quinolone resistance (PMQR) determinants, namely *qnrA, qnrB, qnrC, qnrD, qnrS, qepA,* and *aac(6')Ib-cr*, in Japan. Two isolates (0.8%) of *S.* Typhimurium DT104 from different dairy cows on a single farm in 2006 and 2007 were found to have *qnrS1* on a plasmid of approximately 9.6 kbp. None of the *S.* Typhimurium isolates had *qnrA, qnrB, qnrC, qnrD, qepA,* or *aac(6')Ib-cr.* Currently in Japan, the prevalence of the PMQR genes among *S.* Typhimurium isolates from food animals may remain low or restricted. The PFGE profile of two *S.* Typhimurium DT104 isolates without *qnrS1* on the farm in 2005 had an identical PFGE profile to those of two *S.* Typhimurium DT104 isolates with *qnrS1*. The PFGE analysis suggested that the already existing *S.* Typhimurium DT104 on the farm fortuitously acquired the *qnrS1* plasmid. [Asai, T., *et al*. 2010. Gut Pathog. 2:17.]

V. Current Risk Management of Antimicrobial Resistance Linked to Antimicrobial Products

Veterinary medical products (VMPs) including antimicrobial products used for therapeutic purposes are regulated by the Pharmaceutical Affairs Law (Law No.145 of 1960). The purpose of the law is to regulate matters pertaining to drugs, quasi-drugs and medical devices so as to ensure their quality, efficacy and safety at each stage of development, manufacturing (importing), marketing, retailing, and usage. In addition to therapeutic use, growth promotion is another important use of antimicrobials and has significant economical consequences in the livestock industry. Feed additives (FAs), which include antimicrobial products used for growth promotion, are regulated by the Law Concerning Safety Assurance and Quality Improvement of Feed (Law No.35 of 1953). Compared with the antimicrobial VMPs, FAs are used at lower concentrations and for longer periods. Antimicrobial growth promoters in the animals cannot be used for 7 days preceding slaughter for human consumption.

There are specific requirements for marketing approval of antimicrobial VMPs in Japan. For the approval of antimicrobial VMPs, data concerning the antimicrobial spectrum; the antimicrobial susceptibility tests of recent field isolates of targeted bacteria, indicator bacteria, and foodborne bacteria; and the resistance acquisition test are attached to the application for consideration of public and animal health issues. For the approval of VMPs for food-producing animals, data concerning the stability of the antimicrobial substances under natural circumstances is also attached. The antimicrobial substance in the VMP is thoroughly described in the dossier, and the period of administration is limited to 1 week, where possible.

General and specific data are evaluated at an expert meeting conducted by MAFF. The data of VMPs used in food-producing animals are also evaluated by the Food Safety Commission. The Pharmaceutical Affairs and Food Sanitation Council, which is an advisory organization to the Minister, evaluates the quality, efficacy, and safety of the VMP. If the VMP satisfies all requirements, the Minister of MAFF approves the VMP. There are two stages at which post-marketing surveillance of VMPs occurs in Japan: during re-examination of new VMPs and during re-evaluation of all VMPs. After the re-examination period has ended for the new VMP, the field investigation data about efficacy, safety, and public and livestock health is attached to the application. For new VMPs, results of monitoring for antimicrobial resistance

should be submitted according to the requirements of the re-examination system. For all approved drugs, MAFF conducts literature reviews about efficacy, safety, residues and resistant bacteria as per the requirements of the re-evaluation system.

Because most of the antimicrobial VMPs have been approved as drugs requiring directions or prescriptions by a veterinarian, these VMPs cannot be used without diagnosis and instruction by a veterinarian. The distribution and use of VMPs, including veterinary antimicrobial products, is routinely inspected by the regulatory authority (MAFF).

For marketing and use of VMPs, veterinarians prescribe the drug and place restrictions on its use so that the drug does not remain beyond MRLs in livestock products. As for the label, there are restrictions relating to the description on the 'direct container' and on the 'package insert'. The description on the label must include all of the following: (1) the prescribed drug; (2) disease and bacterial species indicated; (3) the route, dose, and period of administration; (4) prohibition/withdrawal periods, (5) precautions for use, such as side effects and handling; and (6) in the case of specific antimicrobial drugs (fluoroquinolones and the third generation cephalosporins), the description includes an explanation that the drug is not considered as the first-choice drug. For the specific antimicrobial drugs fluoroquinolone and third generation cephalosporins, which are particularly important for public health, the application for approval of the drug for use in animals is not accepted until the end of the period of re-examination of the corresponding drug for use in humans. After marketing, monitoring data on the amount sold and the appearance of antimicrobial resistance in target pathogens and foodborne pathogens must be submitted to MAFF.
The risk assessment for antimicrobial resistance in bacteria arising from the use of antimicrobials in animals, especially in those bacteria that are common to human medicine, is provided to MAFF by the Food Safety Commission (FSC), which is established in 2003. FSC is an organization for risk assessment based on the Food Safety Basic Law (Law No. 48 of 2003) and is independent from risk management organizations such as MAFF and Ministry of Health, Labour and Welfare (MHLW). The risk assessment for antimicrobial resistance in bacteria from the use of antimicrobials in animals is undertaken on the basis of their new guidelines that are based on the OIE guidelines of antimicrobial resistance, Codex, and FDA guidelines (Food Safety Commission 2004).

To implement the risk management based on risk assessment by FSC, the management guidelines for

reducing the risk of antimicrobial resistance arising from antimicrobial use in food-producing animals and aquatic animals have been defined (http://www.maff.go.jp/nval/tyosa_kenkyu/taiseiki/pdf/240411.pdf). The purpose of the guidelines is to reduce the adverse effects for human health. However, the significance of antimicrobial VMPs in veterinary medicine should be considered in order to ensure food safety and stability. The guideline covers from development to implementation of risk management options in on-farm animal practices, referring to the standard guideline for risk management adopted by the JMAFF and JMHLW (http://www.maff.go.jp/j/syouan/seisaku/risk_analysis/sop/pdf/sop_241016.pdf).

Establishment of risk management strategy should be undertaken according to a stepwise approach. Firstly, available and possible risk management options are considered based on the results of risk assessment by FSCs ('high', 'medium', 'low', or 'negligible'), as shown in Table 9. Extended results of release assessment, especially, should be considered to determine the risk management options; high risk estimation of release assessment should be carefully estimated. Secondly, to decide risk management options, the factors in Table 10 are fully considered by each target animal and administration routes approved. As necessary, risk communication including public comment procedures should be implemented.

Antimicrobial VMPs are essential in animal husbandry in Japan. Growth promotion is another important use of antimicrobials in the livestock industry. In the present conditions, with the increased risk of outbreak due to emerging bacterial diseases as well as viral diseases such as foot-and-mouth disease and avian influenza, clinical veterinarians need various classes of antimicrobials to treat endemic and unexpected disease in domestic animals. The risk assessments of antimicrobial resistance in food-producing animals have been performed by FSC. Risk management strategies for Antimicrobial VMPs are established according to the guideline to perform appropriate risk-management on antimicrobial resistance considering the benefits/risks of antimicrobial use in animal husbandry.

The present situation on risk analysis of antimicrobial resistance in food-producing animals in Japan (as of 5 November, 2013)

	Japanese documents* of (URL)	
Antimicrobials	Risk assessment	Risk management
Fluoroquinolones used in cattle and swine	(http://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20071024051	http://www.maff.go.jp/nval/tyosa_kenkyu/taiseiki/pdf/240629.pdf
Tulathromycin used in swine	http://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20091124004	http://www.maff.go.jp/nval/tyosa_kenkyu/taiseiki/pdf/tulathromycin241225.pdf
Pirlimycin used in dairy cows	http://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20080212002	http://www.maff.go.jp/nval/risk/pdf/h250917risk.pdf

*English version is not available.

VI. JVARM Publications

2008

Asai, T., Harada, K., Kojima, A., Sameshima, T., Takahashi, T., Akiba, M., Nakazawa, M., Izumiya, H., Terajima, J., Watanbe, H. 2008. Phage type and antimicrobial susceptibility of *Salmonella enterica* serovar Enteritidis from food-producing animals between 1976 and 2004. New Microbiologica. 31:555-559.

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Morioka, A., Asai, T., Nitta, H., Yamamoto, K., Ogikubo, Y., Takahashi, T., Suzuki, S. 2008. Recent trends in antimicrobial susceptibility and the presence of the tetracycline resistance gene in *Actinobacillus pleuropneumoniae* isolates in Japan. J. Vet. Med. Sci. 70:1261-1264.

Ozawa, M., Harada, K., Kojima, A., Asai, T., Sameshima, T. Antimicrobial susceptibilities, serogroups and molecular characterization of avian pathogenic *Escherichia coli* isolates in Japan. Avian Dis. 52:392-396.

2009

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Harada, K., Ozawa, M., Ishihara, K., Asai, T., Koike, R., Ishikawa, H. 2009. Prevalence of antimicrobial resistance among serotypes of *Campylobacter jejuni* isolates from cattle and poultry in Japan. Microbiol. Immunol. 53(2):107-11.

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Kojima, A., Asai, T., Ishihara, K., Morioka, A., Akimoto, K., Sugimoto, Y., Sato, T., Tamura, Y., Takahashi, T. 2009. National monitoring for antimicrobial resistance among indicator bacteria isolated from food-producing animals in Japan. J. Vet. Med. Sci. 71:1301-1308.

Ozawa, M., Asai, T., Sameshima, T. 2009. Mutations in GyrA and ParC in fluoroquinolone-resistant *Mannheimia haemolytica* isolates from cattle in Japan. J. Vet. Med. Sci. 71:493-494.

Sugiura, K., Asai, T., Takagi, M., Onodera, T. 2009. Control and monitoring of antimicrobial resistance in bacteria in food-producing animals in Japan. Vet. Ital. 45:305-311.

Usui, M., Uchiyama, M., Iwanaka, M., Nagai, H., Yamamoto, Y., Asai, T. 2009. Intracellular concentration of enrofloxacin in quinolone-resistant *Salmonella enterica* subspecies *enterica* serovar Choleraesuis. Int. J. Antimicrob. Agents. 34:592-595.

2010

Asai, T., Namimatsu, T., Osumi, T., Kojima, A., Harada, K., Aoki, A., Sameshima, T., Takahashi, T. 2010. Molecular typing and antimicrobial resistance of *Salmonella enterica* subspecies *enterica* serovar Choleraesuis isolates from diseased pigs in Japan. Comp. Immunol. Microbiol. Infect. Dis. 33:109-119.

Asai, T., Sato, C., Masani, K., Masaru Usui, Ozawa, M., Ogino, T., Aoki, H., Sawada, T., Izumiya, H., Watanabe, H. 2010. Epidemiology of plasmid-mediated quinolone resistance in *Salmonella enterica* serovar Typhimurium isolates from food-producing animals in Japan. Gut Pathog. 2:17.

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2011

Asai, T., Masani, K., Sato, C., Hiki, M., Usui, M., Baba, K., Ozawa, M., Harada, K., Aoki, H., Sawada, T. 2011. Phylogenetic groups and cephalosporin resistance genes of *Escherichia coli* from diseased food-producing animals in Japan. Acta Vet. Scand. 53:52.

Ishihara, K., Kanamori, K., Asai, T., Kojima, A., Takahashi, T., Ueno, H., Muramatsu, Y., Tamura, Y. Antimicrobial Susceptibility of *Escherichia coli* isolates from wild mice in a Forest of Natural Park in Hokkaido, Japan. 2011. J. Vet. Med. Sci. 73:1191-1193.

Usui, M., Asai, T., Sato, S. 2011. Low expression of AcrB in the deoxycholate-sensitive strains of *Salmonella enterica* subspecies *enterica* serovar Pullorum. Microbiol. Immunol. 55:366-368.

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H., Yamamoto, Y., Asai, T. 2011. Contribution of enhanced efflux to reduced susceptibility of *Salmonella enterica* serovar Choleraesuis to fluoroquinolone and other antimicrobials. J. Vet. Med. Sci. 73:279-282.

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Masato Sakai (2010, 4-2013, 3)

IX. Appendix (Materials and Methods)

1. Sampling

Sampling was carried out by the Prefectural Livestock Hygiene Service Center across Japan. Fresh faecal samples were collected from healthy cattle, pigs, and layer and broiler chickens on each farm.

In brief, the 47 prefectures were divided into two groups (23 or 24 prefectures per year), selected evenly on the basis of the geographical differences from northern to southern areas. Freshly voided faecal samples from healthy cows, pigs, broiler chickens and layer chickens were collected from approximately six healthy cows, two pigs, two broiler chickens, and two layer chickens at the different farms in each prefecture.

2. Isolation and Identification

(1) *Escherichia coli*

E. coli isolates from each sample were kept using desoxycholate-hydrogen sulfate-lactose agar (DHL agar, Eiken, Japan). Candidate colonies were identified biochemically using a commercially available kit (API20E, bioMérieux, March l'Etoile, France). These isolates were then stored at -80°C until further use in tests.

(2) *Enterococcus*

Faecal samples were incubated in one of the following two ways: direct culturing using Bile Esculin Azide agar (BEA, Difco Laboratories, Detroit, MI, USA) or using the enrichment procedure with Buffered Peptone Water (Oxoid, Basingstoke, Hampshire, England). The former plates were incubated at 37°C for 48–72 h; the latter tubes were incubated at 37°C for 18–24 h and subsequently passaged onto plates used for the direct culturing method. Isolates were presumptively identified as enterococci by colony morphology. These isolates were subcultured onto heart infusion agar (Difco) supplemented with 5% (v/v) sheep blood, whereupon hemolysis was observed and Gram-staining was performed. Isolates were tested for catalase production, for growth in heart infusion broth supplemented with 6.5% NaCl, and for growth at 45°C. Hydrolysis of L-pyrolydonyl-β-naphtylamide, pigmentation, motility, and API 20 STREP (bioMérieux) were also evaluated. Further identification was achieved using D-Xylose and sucrose fermentation tests if necessary (Facklam and Sahm, 1995). All isolates were stored at –80°C until testing.

(3) *Campylobacter*

Campylobacter isolation was performed by direct inoculation method onto Campylobacter blood-free selective agar (mCCDA: Oxoid, UK). Isolates were identified biochemically and molecularly using PCR (Linton et al., 1997). In principle, two isolates per

sample were selected for antimicrobial susceptibility testing. These isolates were suspended in 15% glycerin to which Buffered Peptone Water (Oxoid) had been added. They were then stored at –80°C until further use in tests.

(4) *Salmonella*

Salmonella isolates from diagnostic submissions of clinical cases were provided by the Livestock Hygiene Service Centres in various locations in Japan. After biochemical identification, serotype of isolates was determined by slide and tube agglutination according to the latest versions of the Kauffmann-White scheme. All isolates were stored at –80°C until testing.

3. Antimicrobial Susceptibility Testing

The minimum inhibitory concentrations (MICs) of *E. coli*, enterococci, and *Campylobacter* isolates between 2008 and 2009 were determined using the agar dilution method according to the guidelines of Clinical and Laboratory Standards Institutes (CLSI; formally, NCCLS). *Staphylococcus aureus* ATCC 29213, *E. coli* ATCC 25922 and *Pseudomonas aeruginosa* ATCC 27853 were used as quality control strains. *C. jejuni* ATCC33560 and *C. coli* ATCC33559 were used for quality control for MIC determination in *Campylobacter* organisms.

After 2009, MICs of isolates were determined using the broth microdilution method according to the CLSI guidelines. *Staphylococcus aureus* ATCC 29213 and *E. coli* ATCC 25922 were used as quality control strains. *C. jejuni* ATCC33560 was used for quality control for MIC determination in *Campylobacter* organisms.

MICs of *Salmonella* isolates were determined using the agar dilution method between 2008 and 2010 and the broth microdilution method after 2011 according to the CLSI guidelines.

4. Resistance Breakpoints

Resistance breakpoints were defined microbiologically in serial studies. The intermediate MIC of two peak distributions was defined as the breakpoints where the MICs for the isolates were bimodally distributed (Working Party of the British Society for Antimicrobial Chemotherapy, 1996).

The MICs of each antimicrobial established by the CLSI were interpreted using the CLSI criteria. The breakpoints of the other antimicrobial agents were microbiologically determined.

Table2.1. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=289), pigs(n=144), broilers(n=130) and layers(n=120) in 2008

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	7.6	4.8-11.3					3.8	29.4	50.2	8.3	0.7				0.7	2.1	4.8
	Pigs	31.3	23.8-39.5					5.6	29.9	27.8	4.9	0.7		0.7	1.4	4.2	7.6	17.4
	Broilers	48.5	39.6-57.4					6.2	21.5	23.8				1.5	3.8	9.2	5.4	28.5
	Layers	16.7	10.5-24.6						35.8	42.5	5.0					3.3	6.7	6.7
	Total	22.0	18.9-25.3					4.0	29.1	39.1	5.4	0.4		0.4	1.0	3.5	4.7	12.3
Cefazolin	Cattle	0	0-1.0			1.4	1.4	55.4	38.1	3.5		0.3						
	Pigs	0	0-2.1			0.7	2.8	54.9	28.5	9.7	3.5							
	Broilers	20.8	14.2-28.8				5.4	33.1	26.9	13.1	0.8			1.5	0.8		7.7	10.8
	Layers	0	0-2.5			0.8	5.0	49.2	38.3	5.8		0.8						
	Total	4.0	2.6-5.7			0.9	3.1	49.9	34.0	7.0	0.9	0.3		0.3	0.1		1.5	2.0
Ceftiofur	Cattle	0	0-1.0		7.6	24.2	60.9	7.3										
	Pigs	0	0-2.1		6.3	31.3	56.9	4.9	0.7									
	Broilers	17.7	11.6-25.4		3.8	29.2	40.8	6.9	0.8	0.8	3.8	5.4	3.8			0.8	3.8	
	Layers	0	0-2.5		4.2	30.0	59.2	6.7										
	Total	3.4	2.1-5.0		6.0	27.7	55.9	6.6	0.3	0.1	0.7	1.0	0.7			0.1	0.7	
Kanamycin	Cattle	1.4	0.4-3.5					7.6	40.1	42.6	7.6	0.3	0.3		0.7	0.3		0.3
	Pigs	15.3	9.8-22.2				1.4	9.0	38.2	31.9	4.2					0.7	4.2	10.4
	Broilers	24.6	17.5-32.9					1.5	33.8	34.6	5.4			0.8	0.8		3.1	20.0
	Layers	1.7	0.2-5.9					3.3	45.8	40.0	9.2					0.8	0.8	
	Total	8.8	6.7-11.2				0.3	6.0	39.5	38.4	6.7	0.1	0.1	0.1	0.4	0.4	1.6	6.1
Gentamicin	Cattle	0	0-1.0		0.7	8.3	27.7	56.4	6.9									
	Pigs	2.1	0.4-6.0		1.4	6.9	26.4	53.5	9.0	0.7				1.4	0.7			
	Broilers	4.6	1.3-8.7			4.6	25.4	59.2	6.2	0.8			2.3		0.8	0.8		
	Layers	0	0-2.5			5.8	25.8	52.5	10.8	5.0								
	Total	1.2	6.7-11.2		0.6	6.9	26.6	55.6	7.9	1.2			0.4	0.3	0.3	0.1		
Dihydrostreptomycin	Cattle	18.3	14.0-23.3		0.3			0.3	10.7	49.5	18.0	2.8	0.3	3.8	5.9	5.5	2.8	
	Pigs	50.7	42.2-59.1					3.5	5.6	29.9	6.9	3.5	3.5	4.2	6.9	11.8	11.1	13.2
	Broilers	40.8	32.2-49.7						14.6	32.3	8.5	3.8	1.5	3.8	7.7	6.9	11.5	9.2
	Layers	15.8	9.8-23.6						15.0	50.0	11.7	7.5	1.7	0.8	4.2	4.2	2.5	2.5
	Total	29.0	25.6-32.6		0.1			0.9	11.1	42.2	12.7	4.0	1.5	3.4	6.1	6.9	6.1	5.0

Table2.1. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=289), pigs(n=144), broilers(n=130) and layers(n=120) in 2008

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Oxytetracycline	Cattle	29.1	23.9-34.7					18.7	47.8	4.5		0.7	3.1	3.1	2.8	12.1	7.3	
	Pigs	62.5	54.1-70.4					11.8	23.6	2.1				2.1	8.3	27.8	24.3	
	Broilers	73.1	64.9-80.0				1.5	6.9	12.3	6.2				3.1	15.4	36.9	17.7	
	Layers	28.3	20.5-37.3				0.8	21.7	40.8	8.3				1.7	9.2	15.0	2.5	
	Total	44.4	40.6-48.2				0.4	15.5	34.7	5.0		0.3	1.3	2.6	7.5	20.6	12.0	
Chloramphenicol	Cattle	1.4	0.4-3.5		0.3			1.7	6.6	31.8	57.4	0.7			1.0			0.3
	Pigs	23.6	16.9-31.4						1.4	30.6	41.7	2.8	2.8	2.8	6.3	6.9	4.9	
	Broilers	16.2	10.3-23.6						7.7	30.8	40.8	4.6	1.5	5.4	3.1	5.4	0.8	
	Layers	3.3	0.9-8.3						7.5	34.2	47.5	7.5	1.7	0.8			0.8	
	Total	9.2	7.2-11.6		0.1			0.7	5.9	31.8	49.2	3.1	1.2	1.8	2.3	2.5	1.3	0.1
Colistin	Cattle	0.3	0-1.9				22.8	65.7	10.4	0.7		0.3						
	Pigs	1.4	0.2-4.9			2.1	25.0	63.2	3.5	2.8	2.1	0.7	0.7					
	Broilers	0	0-2.3				32.3	58.5	7.7		1.5							
	Layers	1.7	0.2-5.9				25.0	65.0	8.3							1.7		
	Total	0.7	0.2-1.7			0.4	25.5	63.7	8.1	0.9	0.7	0.3	0.1			0.3		
Nalidixic acid	Cattle	2.1	0.8-4.5		0.7	1.7		1.4	48.4	43.6	1.4	0.7	0.3		0.7	0.3	0.7	
	Pigs	6.9	3.4-12.4		6.3	0.7		4.9	41.0	36.8	1.4	2.1	0.7		2.8	2.1	0.7	0.7
	Broilers	30.8	23.0-39.5					5.4	36.2	26.9	0.8		1.5	1.5	10.8	5.4	3.8	7.7
	Layers	8.3	4.6-14.8			0.8		4.2	44.2	38.3	3.3	0.8	0.0	2.5	2.5	1.7		1.7
	Total	9.7	7.6-12.1		1.6	1.0		3.4	43.8	38.1	1.6	0.9	0.6	0.7	3.4	1.9	1.2	1.9
Enrofloxacin	Cattle	0.3	0-1.9		96.9	0.7	1.4	0.7	0.3									
	Pigs	1.4	0.2-4.9		93.1	2.8	0.7	2.1			0.7	0.7						
	Broilers	7.7	3.8-13.7		71.5	6.9	12.3	1.5	0.8	0.0	2.3	1.5	2.3	0.8				
	Layers	2.5	0.5-7.1		91.7	5.0	0.0	0.8	0.8	0.8				0.8				
	Total	2.3	1.3-3.8		90.3	3.1	3.1	1.2	0.4	0.1	0.6	0.4	0.4	0.3				
Trimethoprim	Cattle	2.8	1.2-5.4		4.5	4.5	27.3	45.7	13.8	1.4				0.3			0.3	2.1
	Pigs	32.6	25.1-40.9			5.6	20.8	33.3	5.6	2.1							2.8	29.9
	Broilers	32.3	24.4-41.1		0.8	3.8	28.5	24.6	9.2		0.8						0.8	31.5
	Layers	14.2	8.5-21.7		1.7	0.8	20.0	50.0	9.2	2.5	1.7							14.2
	Total	16.7	14.0-19.7		2.3	4.0	24.9	39.8	10.4	1.5	0.4			0.1			0.9	15.7

Table2.2. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=265), pigs(n=138), broilers(n=96) and layers(n=113) in 2009

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	9.4	6.2-13.6					7.9	29.4	40.8	11.3	1.1		0.4	0.8		1.1	7.2
	Pigs	28.3	20.9-36.6					8.0	40.6	15.9	6.5	0.7		0.7	0.7	3.6	5.8	17.4
	Broilers	43.8	33.6-54.3					5.2	20.8	21.9	8.3			5.2	9.4	1.0	6.3	21.9
	Layers	23.0	15.6-31.9			0.9		7.1	27.4	31.9	8.0	1.8			0.9	6.2	3.5	12.4
	Total	21.6	18.4-25.0			0.2		7.4	30.2	30.6	9.2	1.0		1.1	2.1	2.1	3.4	12.7
Cefazolin	Cattle	0.0	0-1.4				5.3	46.4	37.4	9.8	0.8	0.4						
	Pigs	0.0	0-2.1				5.1	42.8	31.9	19.6	0.7							
	Broilers	18.8	11.5-28.0				3.1	44.8	16.7	14.6	2.1			2.1	1.0	2.1	8.3	5.2
	Layers	2.7	0.6-7.6				1.8	42.5	40.7	8.8	3.5						1.8	0.9
	Total	3.4	2.1-5.2				4.2	44.6	33.5	12.6	1.5	0.2		0.3	0.2	0.3	1.6	1.0
Ceftiofur	Cattle	0.0	0-1.4		2.3	24.9	57.4	15.5										
	Pigs	0.0	0-2.1		3.6	33.3	52.2	10.9										
	Broilers	16.7	9.8-25.7		2.1	26.0	44.8	6.3	2.1	2.1	3.1	10.4	2.1		1.0			
	Layers	3.5	1.0-8.8		2.7	26.5	54.0	11.5	1.8			2.7						0.9
	Total	3.3	2.0-5.0		2.6	27.3	53.6	12.3	0.7	0.3	0.5	2.1	0.3		0.2			0.2
Kanamycin	Cattle	3.8	1.8-6.8					2.3	32.8	43.4	17.0	0.4	0.4		0.8		0.4	2.6
	Pigs	15.9	10.3-23.1					5.1	18.1	44.9	13.0	2.9				0.7	3.6	11.6
	Broilers	14.6	8.2-23.3					4.2	31.3	39.6	6.3	4.2			3.1			11.5
	Layers	3.5	1.0-8.8					0.9	23.0	58.4	14.2							3.5
	Total	8.2	6.1-10.6					2.9	27.5	45.9	13.9	1.5	0.2		0.8	0.2	1.0	6.2
Gentamicin	Cattle	0.0	0-1.4			1.1	24.9	54.3	15.8	3.0	0.8							
	Pigs	2.2	0.5-6.2			3.6	24.6	46.4	16.7	5.1	1.4		0.7				1.4	
	Broilers	3.1	0.6-8.9			5.2	19.8	47.9	20.8	3.1			2.1	1.0				
	Layers	0.9	0-4.8		0.9	1.8	15.9	56.6	18.6	4.4	0.9						0.9	
	Total	1.1	0.5-2.3		0.2	2.5	22.4	52.0	17.3	3.8	0.8		0.5	0.2			0.5	
Dihydrostreptomycin	Cattle	17.7	13.3-22.9					0.4	6.4	39.6	29.1	6.8	0.8	1.5	4.2	4.2	1.1	6.0
	Pigs	50.7	42.1-59.3					1.4	6.5	18.1	15.2	8.0	2.9	10.9	5.8	9.4	8.7	13.0
	Broilers	34.4	25.0-44.8						4.2	34.4	18.8	8.3	3.1	5.2	3.1	3.1	6.3	13.5
	Layers	11.5	6.3-18.9						12.4	38.1	33.6	4.4	0.9	0.9	3.5	1.8		4.4
	Total	26.6	23.2-30.3					0.5	7.2	33.7	25.2	6.9	1.6	4.1	4.2	4.7	3.4	8.5
Oxytetracycline	Cattle	20.0	15.4-25.3				1.1	21.1	43.0	14.7		0.4	2.6	2.3	4.2	6.0	4.2	0.4
	Pigs	65.2	56.6-73.1				1.4	15.2	13.8	3.6	0.7			1.4	13.8	27.5	19.6	2.9
	Broilers	51.0	40.6-61.4			1.0	2.1	14.6	21.9	9.4		1.0	1.0		4.2	25.0	15.6	4.2
	Layers	27.4	19.5-36.6				2.7	23.9	32.7	12.4	0.9	0.9	0.9	2.7	0.9	17.7	3.5	0.9
	Total	36.4	32.6-40.4			0.2	1.6	19.3	31.2	10.9	0.3	0.5	1.5	1.8	5.7	16.0	9.3	1.6

Table2.2. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=265), pigs(n=138), broilers(n=96) and layers(n=113) in 2009

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Chloramphenicol	Cattle	6.4	3.8-10.1					0.8	4.2	18.1	53.6	17.0	2.3	1.1	1.9	1.1		
	Pigs	26.1	19.0-34.2						2.9	14.5	42.8	13.8	5.1	7.2	1.4	5.1	7.2	
	Broilers	10.4	5.1-18.3						1.0	10.4	62.5	15.6	2.1	3.1	2.1	1.0	2.1	
	Layers	7.1	3.1-13.5					0.9	5.3	11.5	61.1	14.2	1.8	1.8	0.9	0.9	1.8	
	Total	11.6	9.2-14.4					0.5	3.6	14.9	53.9	15.5	2.8	2.9	1.6	2.0	2.3	
Colistin	Cattle	2.6	1.1-5.4				5.7	67.9	20.4	1.5	1.9	0.4				2.3		
	Pigs	2.2	0.5-6.2			0.7	8.7	55.1	23.2	8.7	1.4	0.7				1.4		
	Broilers	1.0	0-5.7				9.4	63.5	25.0	1.0						1.0		
	Layers	3.5	1.0-8.8			0.9	8.0	53.1	34.5							3.5		
	Total	2.5	1.4-4.0			0.3	7.4	61.6	24.3	2.8	1.1	0.3				2.1		
Nalidixic acid	Cattle	4.2	2.1-7.3					3.4	41.5	35.8	7.9	7.2	0.4	1.1	1.1	1.1	0.4	
	Pigs	10.1	5.7-16.4					3.6	39.9	39.1	4.3	2.9		2.2	6.5			1.4
	Broilers	38.5	28.8-49.0					4.2	31.3	26.0				9.4	8.3	5.2	4.2	11.5
	Layers	4.4	1.5-10.0					2.7	47.8	38.9	3.5	2.7		0.9	0.9			2.7
	Total	10.9	8.6-13.7					3.4	40.7	35.6	5.1	4.2	0.2	2.6	3.4	1.3	0.8	2.6
Enrofloxacin	Cattle	0.0	0-1.4		90.6	8.7	0.4	0.4										
	Pigs	2.2	0.4-6.2		82.6	10.9	3.6	0.7		0.7		0.7		0.7				
	Broilers	12.5	6.6-20.8		61.5	11.5	11.5	3.1	6.3	2.1		2.1	1.0	1.0				
	Layers	1.8	0.2-6.2		94.7	0.9	1.8	0.9						1.8				
	Total	2.8	1.6-4.4		85.0	8.2	3.1	1.0	1.0	0.5		0.5	0.2	0.7				
Trimethoprim	Cattle	3.8	1.8-6.8		6.0	6.4	27.2	45.7	9.1	1.9		0.4						3.4
	Pigs	23.9	17.1-31.9		5.8	6.5	29.7	24.6	6.5	2.2	0.7						2.9	21.0
	Broilers	30.2	21.3-40.4		2.1	5.2	21.9	33.3	7.3								3.1	27.1
	Layers	11.5	6.2-18.9		9.7	1.8	31.0	34.5	11.5								3.5	8.0
	Total	13.9	11.2-16.9		6.0	5.4	27.6	36.9	8.7	1.3	0.2	0.2					1.8	11.9

Table2.3. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=293), pigs(n=140), broilers(n=195) and layers(n=188) in 2010

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.02	0.03	0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	>128
Ampicillin	Cattle	7.2	4.5-10.7							4.1	13.7	63.1	11.6	0.3			0.7	6.5
	Pigs	32.9	25.2-41.3							3.6	12.1	48.6	2.9				1.4	31.4
	Broilers	42.1	35.0-49.3							3.1	19.0	32.3	3.6			0.5	3.1	38.5
	Layers	13.3	8.8-19.0							1.6	20.2	52.1	11.2	1.6	0.5			12.8
	Total	21.3	18.6-24.3							3.2	16.2	50.7	8.1	0.5	0.1	0.1	1.2	19.9
Cefazolin	Cattle	0.0	0-1.0							59.7	33.8	6.5						
	Pigs	2.9	0.8-7.2							55.0	21.4	15.0	4.3	1.4		0.7	0.7	1.4
	Broilers	20.5	15.1-26.9							41.0	25.6	6.7	5.1	1.0	0.5	1.5	1.0	17.4
	Layers	2.1	0.6-5.4							56.4	30.3	8.0	2.7	0.5	0.5		1.6	
	Total	5.9	4.4-7.7							53.7	28.9	8.3	2.6	0.6	0.2	0.5	0.7	4.4
Cefotaxime	Cattle	0.3	0-1.9						98.6		1.0	0.3						
	Pigs	1.4	0.2-5.1						97.1		1.4	0.7			0.7			
	Broilers	17.9	12.8-24.1						81.0	0.5	0.5	3.1	5.1	2.6	1.0	2.6	3.6	
	Layers	1.1	0.1-3.8						98.9			1.1						
	Total	4.9	3.5-6.6						94.2	0.1	0.7	1.2	1.2	0.6	0.4	0.6	0.9	
Kanamycin	Cattle	4.4	2.4-7.5							2.7	27.0	49.1	14.0	2.7				4.4
	Pigs	12.1	7.2-18.7								22.9	44.3	18.6	2.1				12.1
	Broilers	12.3	8.0-17.8							1.0	23.6	37.9	21.0	2.6	1.5		0.5	11.8
	Layers	3.2	1.2-6.8							2.1	22.3	47.3	19.7	4.8	0.5			3.2
	Total	7.4	5,7-9.4							1.7	24.4	45.2	17.8	3.1	0.5		0.1	7.2
Gentamicin	Cattle	0.0	0-1.0						72.4	21.2	5.8	0.7						
	Pigs	2.9	0.8-7.2						61.4	26.4	7.1	2.1		0.7	0.7	1.4		
	Broilers	3.6	1.5-7.3						63.6	21.5	10.8	0.5		2.1	0.5		1.0	
	Layers	0.0	0-1.6						68.1	21.8	8.0	2.1						
	Total	1.3	0.7-2,4						67.4	22.3	7.7	1.2		0.6	0.2	0.2	0.2	
Tetracycline	Cattle	20.1	15.7-25.2						2.4	21.8	38.6	11.9	5.1	1.4	0.7	8.9	9.2	
	Pigs	60.0	51.4-68.2						0.7	15.0	20.0	4.3			0.7	20.7	38.6	
	Broilers	56.4	49.1-63.5						2.1	14.4	21.5	5.1	0.5	0.5	7.2	23.6	25.1	
	Layers	27.7	21.4-34.6						2.7	22.3	28.2	18.1	1.1	0.5	1.6	13.3	12.2	
	Total	37.4	34.0-40.8						2.1	19.0	28.9	10.4	2.2	0.7	2.5	15.4	18.8	

Table2.3. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=293), pigs(n=140), broilers(n=195) and layers(n=188) in 2010

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs 0.02	0.03	0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	>128
Chloramphenicol	Cattle	3.4	1.6-6.2							1.0	1.4	29.4	58.7	6.1	0.3		1.4	1.7
	Pigs	25.0	18.1-33.0							0.7	0.7	23.6	48.6	1.4	2.1	9.3	6.4	7.1
	Broilers	10.8	6.8-16.0							0.5	3.1	21.5	60.0	4.1	4.1	1.5	1.5	3.6
	Layers	3.2	1.2-6.8							0.5	1.6	29.3	59.0	6.4	1.1	1.1	0.5	0.5
	Total	8.8	7.0-11.0							0.7	1.7	26.5	57.4	4.9	1.7	2.2	2.1	2.8
Colistin	Cattle	1.0	0.2-3.0				45.7	39.2	10.2	1.7	1.7	0.3			1.0			
	Pigs	0.0	0-2.1				25.0	39.3	17.9	5.7	7.1	4.3	0.7					
	Broilers	1.0	0.1-3.7				48.7	33.8	11.8	3.1	0.5	0.5	0.5	0.5	0.5			
	Layers	0.5	0-2.9				41.0	39.9	13.3	4.3		1.1		0.5				
	Total	0.7	0.3-1.6				41.8	38.1	12.6	3.3	2.0	1.2	0.2	0.2	0.5			
Nalidixic acid	Cattle	1.0	0.2-3.0							0.7	19.8	65.5	10.9	2.0	0.3		0.3	0.3
	Pigs	7.1	3.5-12.7								18.6	61.4	10.7	2.1			0.7	6.4
	Broilers	33.3	26.8-40.4							1.5	12.8	42.6	8.7	1.0	1.0	1.0	3.1	28.2
	Layers	12.8	8.4-18.4							1.6	14.4	54.3	14.4	2.7	1.1	0.5		11.2
	Total	12.5	10.3-15.0							1.0	16.7	56.7	11.2	2.0	0.6	0.4	1.0	10.5
Ciprofloxacin	Cattle	0.0	0-1.0		93.9	4.4	1.4	0.3										
	Pigs	1.4	0.2-5.1		87.1	4.3	0.7	2.9	2.9	0.7			1.4					
	Broilers	5.1	2.5-9.2		65.1	1.5	1.5	15.9	6.7	2.6	1.5	1.5	3.6					
	Layers	1.1	0.1-3.8		84.0	2.1	1.6	6.4	1.1	2.7	1.1		1.1					
	Total	1.7	0.9-2.9		83.6	3.2	1.3	5.9	2.3	1.3	0.6	0.4	1.3					

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs 0.03 /0.015	0.06 /0.03	1.19 /0.06	2.38 /0.12	4.75 /0.25	9.5 /0.5	19 /1	38 /2	76 /4	152 /8	304 /16	608 /32	1216 /64	2432 /128	>2432 /128
Trimethoprim -sulfamethoxazole	Cattle	3.4	1.6-6.2				73.7	12.6	7.8	1.7	0.7			3.4				
	Pigs	27.1	20.0-35.3				52.1	10.7	6.4	2.1	1.4			27.1				
	Broilers	25.6	19.7-32.4				49.2	11.8	10.8	2.1	0.5	0.5		25.1				
	Layers	4.3	1.9-8.2				68.6	16.0	9.6	1.6			1.6	2.7				
	Total	13.0	10.8- 15.5				63.0	12.9	8.7	1.8	0.6	0.1	0.4	12.5				

Table2.4. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=273), pigs(n=145), broilers(n=161) and layers(n=172) in 2011

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.02	0.03	0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	>128
Ampicillin	Cattle	5.9	3.4-9.3							5.1	20.9	59.0	9.2		0.4		1.5	4.0
	Pigs	22.1	15.6-29.7							3.4	22.1	43.4	7.6	1.4	0.7		2.8	18.6
	Broilers	42.9	35.1-50.9							3.1	16.8	31.7	5.0	0.6		0.6	3.1	39.1
	Layers	14.0	9.1-20.0							4.1	22.7	52.9	6.4		1.2		0.6	12.2
	Total	18.8	16.0-21.8							4.1	20.6	48.7	7.3	0.4	0.5	0.1	1.9	16.2
Cefazolin	Cattle	0.7	0.1-2.6							59.7	31.9	3.3	3.3	1.1	0.4	0.4		
	Pigs	2.1	0.4-5.9							49.7	38.6	6.2	3.4					2.1
	Broilers	19.9	14.0-26.9							32.3	31.7	11.8	3.1	1.2	1.2	0.6	0.6	17.4
	Layers	1.7	0.4-5.0							56.4	29.7	7.6	2.3	2.3	0.6	0.6		0.6
	Total	5.3	3.8-7.2							51.1	32.6	6.7	3.1	1.2	0.5	0.4	0.1	4.3
Cefotaxime	Cattle	0.4	0.0-2.0						98.9	0.7		0.4						
	Pigs	1.4	0.2-4.9						96.6	1.4	0.7		0.7		0.7			
	Broilers	18.6	12.9-25.5						80.1	0.6	0.6	5.0	5.6	4.3	0.6	2.5	0.6	
	Layers	0.0	0-1.7						97.7	1.7	0.6							
	Total	4.4	3.0-6.1						94.1	1.1	0.4	1.2	1.3	0.9	0.3	0.5	0.1	
Kanamycin	Cattle	1.8	0.6-4.2							6.6	25.6	48.4	16.1	1.5				1.8
	Pigs	6.9	3.4-12.3							4.1	18.6	46.9	20.7	2.8				6.9
	Broilers	14.3	9.3-20.7							4.3	16.8	37.3	19.9	6.2	1.2	0.6		13.7
	Layers	4.1	1.7-8.2							1.7	23.3	42.4	23.8	4.7			0.6	3.5
	Total	6.0	4.4-7.9							4.5	21.8	44.3	19.6	3.5	0.3	0.1	0.1	5.7
Gentamicin	Cattle	0.0	0-1.1						72.2	19.8	7.3	0.7						
	Pigs	1.4	0.2-4.9						57.2	31.7	8.3	1.4			0.7	0.7		
	Broilers	3.7	1.4-7.9						57.8	29.8	6.8	1.2	0.6	0.6	0.6	0.6	1.9	
	Layers	0.6	0.0-3.2						64.0	25.0	8.1	2.3					0.6	
	Total	1.2	0.5-2.3						64.3	25.4	7.6	1.3	0.1	0.1	0.3	0.3	0.5	
Streptomycin	Cattle	12.8	9.1-17.4							5.9	1.8	14.3	52.4	12.8	1.8	3.7	2.6	4.8
	Pigs	43.4	35.2-51.9							0.7	0.7	6.9	31.0	17.2	9.0	7.6	9.7	17.2
	Broilers	28.6	21.7-36.2							6.2	1.9	9.3	39.8	14.3	3.7	1.9	3.1	19.9
	Layers	14.5	9.6-20.7							3.5	2.9	10.5	44.8	23.8	4.1	1.7	0.6	8.1
	Total	22.5	19.6-25.7							4.4	1.9	10.9	43.8	16.5	4.1	3.6	3.6	11.2

Table2.4. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=273), pigs(n=145), broilers(n=161) and layers(n=172) in 2011

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.02	0.03	0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	>128
Tetracycline	Cattle	18.3	13.9-23.4						5.1	31.5	35.2	8.8	1.1	1.1	2.2	8.4	6.6	
	Pigs	58.6	50.2-66.7						2.1	17.2	15.9	4.1	2.1	1.4	6.9	23.4	26.9	
	Broilers	47.2	39.3-55.2						5.0	23.0	16.1	7.5	1.2	1.2	1.9	21.7	22.4	
	Layers	23.8	17.7-30.9						4.7	30.8	32.0	7.0	1.7	1.2	1.2	9.3	12.2	
	Total	33.6	30.2-37.1						4.4	26.8	26.6	7.2	1.5	1.2	2.8	14.4	15.2	
Chloramphenicol	Cattle	2.9	1.3-5.7							0.7	4.4	27.5	60.4	4.0	1.1		0.4	1.5
	Pigs	18.6	12.6-25.9								2.1	22.1	51.7	5.5	2.8	6.2	2.1	7.6
	Broilers	9.3	5.3-14.9							1.9	4.3	23.6	56.5	4.3	1.2	2.5	2.5	3.1
	Layers	1.2	0.1-4.1							1.2	5.2	23.3	64.5	4.7	0.6			0.6
	Total	6.9	5.2-9.0							0.9	4.1	24.6	58.9	4.5	1.3	1.7	1.1	2.8
Colistin	Cattle	0.0	0.0-2.0				8.4	60.4	15.8	7.7	5.1	1.5	1.1					
	Pigs	2.1	0.4-5.9				8.3	65.5	15.9	3.4	4.1		0.7		2.1			
	Broilers	0.6	0.0-3.4				8.1	60.2	16.8	9.3	3.7	1.2			0.6			
	Layers	1.7	0.4-5.0				7.6	56.4	22.1	7.0	4.7	0.6			1.7			
	Total	0.9	0.4-1.9				8.1	60.5	17.4	7.1	4.5	0.9	0.5		0.9			
Nalidixic acid	Cattle	2.9	1.3-5.7							2.6	22.3	66.3	5.9			0.4	0.4	2.2
	Pigs	9.7	5.4-15.7							2.8	22.8	57.2	6.2	1.4		1.4	2.1	6.2
	Broilers	31.7	24.6-39.5							1.2	14.3	44.7	5.0	3.1	3.1	3.1	3.7	21.7
	Layers	9.9	5.9-15.4							2.9	16.9	62.8	7.0	0.6		1.2	1.2	7.6
	Total	12.0	9.7-14.5							2.4	19.4	59.1	6.0	1.1	0.7	1.3	1.6	8.4
Ciprofloxacin	Cattle	0.7	0.1-2.6		88.3	7.3	0.4	0.7	0.7	1.5	0.4		0.7					
	Pigs	2.8	0.8-6.9		81.4	5.5	0.7	6.9	2.1	0.7			2.8					
	Broilers	5.0	2.2-9.6		63.4	4.3	4.3	12.4	7.5	2.5	0.6	1.2	3.7					
	Layers	0.6	0.0-3.2		83.1	4.1	1.7	8.1	1.2	1.2			0.6					
	Total	2.0	1.1-3.2		80.4	5.6	1.6	6.1	2.5	1.5	0.3	0.3	1.7					
Trimethoprim	Cattle	3.3	1.5-6.2					23.1	47.6	19.0	5.1	1.1	0.7	0.4	2.9			
	Pigs	26.2	19.3-34.2					12.4	42.8	16.6	0.7	1.4			26.2			
	Broilers	23.6	17.3-30.9					27.3	33.5	11.8	2.5	1.2		0.6	23.0			
	Layers	14.5	9.6-20.7					20.9	44.8	12.8	5.2		1.7		14.5			
	Total	14.6	12.2-17.4					21.4	43.0	15.6	3.7	0.9	0.7	0.3	14.4			

Table3.1. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=10), pigs(n=21), broilers(n=39) and layers(n=67) in 2008

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	0.0	0-25.9				10.0	90.0										
	Pigs	0.0	0-13.3				47.6	47.6	4.8									
	Broilers	0.0	0-7.4				59.0	41.0										
	Layers	0.0	0-4.4			1.5	40.3	58.2										
	Total	0.0	0-2.2			0.7	44.5	54.0	0.7									
Dihydrostreptomycin	Cattle	60.0	26.2-87.8											40.0	50.0			10.0
	Pigs	95.2	76.2-99.9											4.8	42.9			52.4
	Broilers	71.8	55.1-85.0										2.6	25.6	28.2		2.6	41.0
	Layers	62.7	50.0-74.2										7.5	29.9	40.3		3.0	19.4
	Total	70.1	61.7-77.6										4.4	25.5	38.0		2.2	29.9
Gentamicin	Cattle	30.0	6.7-65.2									70.0	30.0					
	Pigs	57.1	34.0-78.2								4.8	38.1	19.0					38.1
	Broilers	33.3	19.1-50.2									66.7	20.5			2.6		10.3
	Layers	23.9	14.3-35.9						1.5	1.5	11.9	61.2	20.9					3.0
	Total	32.1	24.4-40.6						0.7	0.7	6.6	59.9	21.2			0.7		10.2
Kanamycin	Cattle	20.0	2.5-55.6										10.0	70.0	10.0			10.0
	Pigs	61.9	38.4-81.9										9.5	28.6	9.5			52.4
	Broilers	41.0	25.6-57.9										20.5	38.5				41.0
	Layers	22.4	13.1-34.2					1.5			1.5		13.4	61.2	3.0			19.4
	Total	33.6	25.7-42.1					0.7			0.7		14.6	50.4	3.6			29.9
Oxytetracycline	Cattle	40.0	12.2-73.8					40.0	20.0				10.0	20.0	10.0			
	Pigs	90.5	69.6-98.8					9.5					23.8	28.6	33.3	4.8		
	Broilers	82.1	66.5-92.5				7.7	7.7			2.6		5.1	33.3	28.2	15.4		
	Layers	59.7	47.0-71.5			1.5	9.0	17.9	6.0		6.0	10.4	7.5	4.5	29.9	7.5		
	Total	69.3	60.9-76.9			0.7	6.6	15.3	4.4		3.6	5.1	9.5	17.5	28.5	8.8		
Chloramphenicol	Cattle	0.0	0-25.9								70.0	30.0						
	Pigs	33.3	14.6-57.0								38.1	28.6	4.8	23.8	4.8			
	Broilers	7.7	1.6-20.9							23.1	46.2	23.1		7.7				
	Layers	3.0	0.4-10.4					1.5		7.5	64.2	23.9			3.0			
	Total	8.8	4.6-14.8					0.7		10.2	55.5	24.8	0.7	5.8	2.2			

Table3.1. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=10), pigs(n=21), broilers(n=39) and layers(n=67) in 2008

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Bacitracin	Cattle	-	-												10.0	50.0	10.0	30.0
	Pigs	-	-											9.5	42.9	19.0	9.5	19.0
	Broilers	-	-									2.6		5.1	38.5	53.8		
	Layers	-	-											14.9	34.3	35.8	9.0	6.0
	Total	-	-									0.7		10.2	35.0	39.4	6.6	8.0
Erythromycin	Cattle	20.0	2.5-55.6				10.0	20.0	50.0								20.0	
	Pigs	61.9	38.4-81.9			4.8	4.8		19.0	9.5							33.3	28.6
	Broilers	64.1	47.2-78.8		2.6	2.6	2.6	17.9	10.3			2.6	5.1			7.7	41.0	7.7
	Layers	35.8	24.5-48.5		4.5	6.0	6.0	19.4	28.4			6.0				11.9	16.4	1.5
	Total	46.7	38.1-55.4		2.9	4.4	5.1	16.1	23.4	1.5		3.6	1.5			8.0	26.3	7.3
Lincomycin	Cattle	20.0	2.5-55.6										40.0	40.0				20.0
	Pigs	66.7	43.0-85.4									9.5	14.3	9.5		9.5		57.1
	Broilers	66.7	49.8-80.9									10.3	23.1			7.7	10.3	48.7
	Layers	35.8	24.5-48.5					1.5				13.4	46.3	3.0	3.0	3.0	17.9	11.9
	Total	48.2	39.6-56.9					0.7				10.9	34.3	5.8	1.5	5.1	11.7	29.9
Enrofloxacin	Cattle	10.0	0.3-44.5				10.0	80.0		10.0								
	Pigs	4.8	0.1-23.8				19.0	71.4	4.8			4.8						
	Broilers	5.1	0.6-17.3				10.3	61.5	23.1	2.6	2.6							
	Layers	4.5	0.9-12.5				16.4	64.2	14.9	3.0			1.5					
	Total	5.1	2.1-10.2				14.6	65.7	14.6	2.9	0.7	0.7	0.7					
Avilamycin	Cattle	0.0	0-25.9			10.0	10.0	20.0	40.0	20.0								
	Pigs	61.9	38.4-81.9					19.0	19.0							61.9		
	Broilers	5.1	0.6-17.3			2.6	5.1	30.8	35.9	15.4	5.1				2.6	2.6		
	Layers	0.0	0-4.4				3.0	31.3	34.3	26.9	4.5							
	Total	10.9	6.3-17.4			1.5	3.6	28.5	32.8	19.0	3.6				0.7	10.2		
Salinomycin	Cattle	-	-				20.0	80.0										
	Pigs	-	-				14.3	85.7										
	Broilers	-	-				7.7	79.5	2.6	10.3								
	Layers	-	-				19.4	73.1	3.0	1.5	3.0							
	Total	-	-				15.3	77.4	2.2	3.6	1.5							

Table3.1. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=10), pigs(n=21), broilers(n=39) and layers(n=67) in 2008

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	-	-				10.0		10.0	80.0								
	Pigs	-	-						9.5	66.7	14.3	9.5						
	Broilers	-	-					2.6	20.5	71.8	5.1							
	Layers	-	-			3.0			14.9	77.6	4.5							
	Total	-	-			1.5	0.7	0.7	15.3	74.5	5.8	1.5						

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=10), pigs(n=21), broilers(n=39) and layers(n=67) in 2008

Antomicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs																	
				0.00050	0.00099	0.00195	0.00391	0.00781	0.01563	0.03125	0.0625	0.125	0.25	0.5	1	2	4	8	16	32	>32
NHT	Cattle	-	-					20.0	70.0	10.0											
	Pigs	-	-					14.3	38.1	47.6											
	Broilers	-	-					7.7	56.4	35.9											
	Layers	-	-					14.9	40.3	43.3	1.5										
	Total	-	-					13.1	46.7	39.4	0.7										

White fields represent the range of dilutions tested. MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table3.2. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=8), pigs(n=18), broilers(n=50) and layers(n=65) in 2009

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	0.0	0-31.2				62.5	25.0	12.5									
	Pigs	0.0	0-15.3			11.1	22.2	66.7										
	Broilers	0.0	0-5.8		2.0	4.0	42.0	52.0										
	Layers	0.0	0-4.5			4.6	40.0	55.4										
	Total	0.0	0-2.1		0.7	5.0	39.7	53.9	0.7									
Dihydrostreptomycin	Cattle	37.5	8.5-75.5										12.5	50.0	37.5			
	Pigs	72.2	46.5-90.3										5.6	22.2	11.1		11.1	50.0
	Broilers	68.0	53.3-80.5											32.0	24.0		4.0	40.0
	Layers	46.2	33.7-59.0										3.1	50.8	26.2	3.1		16.9
	Total	56.7	48.1-65.0										2.8	40.4	24.1	1.4	2.8	28.4
Gentamicin	Cattle	12.5	0.3-52.7							12.5	37.5	37.5	12.5					
	Pigs	5.6	0.1-27.3						11.1	11.1		72.2						5.6
	Broilers	4.0	0.5-13.7							4.0	20.0	72.0						4.0
	Layers	7.7	2.5-17.0							3.1	18.5	70.8	7.7					
	Total	6.4	3.0-11.8						1.4	5.0	17.7	69.5	4.3					2.1
Kanamycin	Cattle	0.0	0-31.2									25.0	25.0	50.0				
	Pigs	38.9	17.3-64.3								11.1	11.1	5.6	33.3			11.1	27.8
	Broilers	28.0	16.2-42.5										18.0	54.0				28.0
	Layers	10.8	4.4-20.9									6.2	10.8	72.3		1.5		9.2
	Total	19.9	13.6-27.4								1.4	5.7	13.5	59.6		0.7	1.4	17.7
Oxytetracycline	Cattle	12.5	0.3-52.7					50.0	37.5						12.5			
	Pigs	88.9	65.3-98.6				5.6	5.6				5.6		27.8	27.8	27.8		
	Broilers	90.0	78.2-96.7				2.0	8.0				16.0	12.0	16.0	32.0	14.0		
	Layers	64.6	51.8-76.1				3.1	26.2	6.2			6.2	13.8	10.8	30.8	3.1		
	Total	73.8	65.7-80.8				2.8	18.4	5.0			9.2	10.6	14.2	29.8	9.9		
Chloramphenicol	Cattle	0.0	0-31.2							75.0	12.5	12.5						
	Pigs	27.8	9.7-53.5							27.8	16.7	27.8		22.2	5.6			
	Broilers	14.0	5.8-26.7							24.0	42.0	20.0	2.0	12.0				
	Layers	6.2	1.7-15.0							33.8	50.8	9.2		6.2				
	Total	11.3	6.6-17.8							31.9	41.1	15.6	0.7	9.9	0.7			

Table3.2. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=8), pigs(n=18), broilers(n=50) and layers(n=65) in 2009

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Bacitracin	Cattle	-	-													100		
	Pigs	-	-											16.7	38.9	22.2	5.6	16.7
	Broilers	-	-									2.0		10.0	16.0	50.0	4.0	18.0
	Layers	-	-											3.1	12.3	58.5	20.0	6.2
	Total	-	-									0.7		7.1	16.3	53.2	11.3	11.3
Erythromycin	Cattle	0.0	0-31.2				25.0	25.0	37.5	12.5								
	Pigs	72.2	46.5-90.3				5.6		16.7	5.6						5.6	55.6	11.1
	Broilers	44.0	30.0-58.7		4.0	10.0	4.0	28.0	6.0	4.0	2.0	2.0	2.0	4.0	2.0	4.0	26.0	2.0
	Layers	35.4	23.9-48.2		10.8	7.7	12.3	18.5	15.4		1.5	1.5			1.5	3.1	23.1	4.6
	Total	41.1	32.9-49.7		6.4	7.1	9.2	19.9	13.5	2.8	1.4	1.4	0.7	1.4	1.4	3.5	27.0	4.3
Lincomycin	Cattle	0.0	0-31.2										75.0	25.0				
	Pigs	88.9	65.3-98.6										5.6	5.6		5.6	5.6	77.8
	Broilers	46.0	31.8-60.7									4.0	32.0	18.0		8.0	8.0	30.0
	Layers	35.4	23.9-48.2									4.6	29.2	30.8	3.1	3.1		29.2
	Total	44.0	35.6-52.6									3.5	29.8	22.7	1.4	5.0	3.5	34.0
Enrofloxacin	Cattle	0.0	0-31.2					62.5	37.5									
	Pigs	0.0	0-15.3				16.7	66.7	16.7									
	Broilers	0.0	0-5.8				36.0	62.0	2.0									
	Layers	0.0	0-4.5			6.2	9.2	73.8	10.8									
	Total	0.0	0-2.1			2.8	19.1	68.1	9.9									
Avilamycin	Cattle	12.5	0.3-52.7						50.0	25.0	12.5	12.5						
	Pigs	50.0	26.0-74.0					11.1	22.2	16.7					5.6	44.4		
	Broilers	4.0	0.5-13.7				2.0	18.0	42.0	22.0	12.0	2.0				2.0		
	Layers	0.0	0-4.5					13.8	50.8	27.7	7.7							
	Total	8.5	4.5-14.4				0.7	14.2	44.0	24.1	8.5	1.4			0.7	6.4		
Salinomycin	Cattle	-	-					62.5	37.5									
	Pigs	-	-					61.1	38.9									
	Broilers	-	-				2.0	46.0	28.0	18.0	6.0							
	Layers	-	-				1.5	76.9	18.5	3.1								
	Total	-	-				1.4	63.1	25.5	7.8	2.1							

Table3.2. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=8), pigs(n=18), broilers(n=50) and layers(n=65) in 2009

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	-	-					12.5	12.5	62.5	12.5							
	Pigs	-	-						44.4	50.0	5.6							
	Broilers	-	-				2.0		8.0	76.0	14.0							
	Layers	-	-					1.5	21.5	64.6	12.3							
	Total	-	-				0.7	1.4	19.1	66.7	12.1							

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=8), pigs(n=18), broilers(n=50) and layers(n=65) in 2009

Antomicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs																	
				0.00050	0.00099	0.00195	0.00391	0.00781	0.01563	0.03125	0.0625	0.125	0.25	0.5	1	2	4	8	16	32	>32
Nosiheptide	Cattle	-	-					37.5	50.0	12.5											
	Pigs	-	-					33.3	66.7												
	Broilers	-	-				4.0	44.0	44.0	8.0											
	Layers	-	-				1.5	33.8	56.9	7.7											
	Total	-	-				2.1	37.6	53.2	7.1											

White fields represent the range of dilutions tested. MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table3.3. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=6), pigs(n=30), broilers(n=124) and layers(n=123) in 2010

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	0.0	0-39.3			16.7	83.3											
	Pigs	0.0	0-9.5			10.0	83.3	6.7										
	Broilers	0.0	0-2.4		0.8	10.5	77.4	11.3										
	Layers	0.0	0-2.4		0.8	5.7	86.2	7.3										
	Total	0.0	0-1.1		0.7	8.5	82.0	8.8										
Dihydrostreptomycin	Cattle	50.0	11.8-88.2										50.0		50.0			
	Pigs	70.0	50.6-85.3										3.3	26.7	26.7		3.3	40.0
	Broilers	57.3	48.1-66.1									0.8	4.0	37.9	23.4	1.6	4.0	28.2
	Layers	56.1	46.9-65.0									1.6	1.6	40.7	27.6	1.6		26.8
	Total	58.0	52.0-63.8									1.1	3.9	37.1	26.1	1.4	2.1	28.3
Gentamicin	Cattle	0.0	0-39.3						16.7	33.3		50.0						
	Pigs	13.3	3.8-30.7						10.0	3.3	16.7	56.7	3.3				3.3	6.7
	Broilers	12.9	7.6-20.1			0.8			0.8	3.2	24.2	58.1	6.5	0.8	0.8			4.8
	Layers	15.4	9.6-23.1						0.8	2.4	17.1	64.2	11.4	3.3				0.8
	Total	13.8	10.0-18.4			0.4			2.1	3.5	19.8	60.4	8.1	1.8	0.4		0.4	3.2
Kanamycin	Cattle	0.0	0-39.3								16.7	33.3		50.0				
	Pigs	36.7	19.9-56.1							3.3	3.3	6.7	10.0	40.0				36.7
	Broilers	41.1	32.4-50.3									1.6	6.5	50.8	4.8	1.6	3.2	31.5
	Layers	29.3	21.4-38.2								0.8	2.4	8.1	59.3	4.1			25.2
	Total	34.6	29.1-40.5							0.4	1.1	3.2	7.4	53.4	3.9	0.7	1.4	28.6
Oxytetracycline	Cattle	16.7	0.4-64.1				33.3	33.3	16.7			16.7						
	Pigs	66.7	47.2-82.7				3.3	23.3	6.7				6.7	10.0	16.7	26.7	6.7	
	Broilers	76.6	68.2-83.7					21.8			1.6	8.9	8.9	8.1	35.5	14.5	0.8	
	Layers	61.0	51.8-69.6				4.9	29.3	4.1		0.8	6.5	8.9	6.5	28.5	8.9	1.6	
	Total	67.5	61.7-72.9				3.2	25.4	2.8		1.1	7.1	8.5	7.4	29.7	13.1	1.8	
Chloramphenicol	Cattle	0.0	0-39.3							66.7	33.3							
	Pigs	50.0	31.3-68.7							16.7	33.3		3.3	43.3	3.3			
	Broilers	11.3	6.3-18.2							14.5	71.0	3.2		10.5	0.8			
	Layers	8.1	4.0-14.4						0.8	13.8	71.5	5.7		7.3	0.8			
	Total	13.8	10.0-18.4						0.4	15.5	66.4	3.9	0.4	12.4	1.1			

Table3.3. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=6), pigs(n=30), broilers(n=124) and layers(n=123) in 2010

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Bacitracin	Cattle	-	-											16.7	33.3	50.0		
	Pigs	-	-											6.7	10.0	50.0	33.3	
	Broilers	-	-									0.8		0.8	9.7	53.2	13.7	21.8
	Layers	-	-										0.8	0.8	7.3	52.8	30.9	7.3
	Total	-	-									0.4	0.4	1.8	9.2	52.7	23.0	12.7
Erythromycin	Cattle	0.0	0-39.3						100									
	Pigs	60.0	40.6-77.3					3.3	33.3	3.3		3.3					46.7	10.0
	Broilers	52.4	43.3-61.5		3.2	2.4	8.9	10.5	18.5	4.0	0.8		0.8		0.8	1.6	40.3	8.1
	Layers	33.3	25.1-42.4		0.8	8.9	5.7	9.8	31.7	9.8		0.8					30.1	2.4
	Total	43.8	38.0-49.8		1.8	4.9	6.4	9.2	27.6	6.4	0.4	0.7	0.4		0.4	0.7	35.7	5.7
Lincomycin	Cattle	0.0	0-39.3										33.3	66.7				
	Pigs	56.7	37.4-74.5										13.3	30.0			3.3	53.3
	Broilers	52.4	43.3-61.5					0.8	0.8		0.8	0.8	22.6	21.8	0.8	2.4	2.4	46.8
	Layers	33.3	25.1-42.4					0.8					33.3	32.5	0.8	0.8	2.4	29.3
	Total	43.5	37.6-49.5					0.7	0.4		0.4	0.4	26.5	28.3	0.7	1.4	2.5	38.9
Enrofloxacin	Cattle	16.7	0.4-64.1					66.7	16.7	16.7								
	Pigs	10.0	2.1-26.5					63.3	26.7			6.7	3.3					
	Broilers	1.6	0.2-5.7				14.5	71.0	12.9	1.6								
	Layers	0.0	0-2.4			1.6	11.4	72.4	14.6									
	Total	2.1	0.8-4.6			0.7	11.3	70.7	15.2	1.1		0.7	0.4					
Tylosin	Cattle	0.0	0-39.3						66.7	33.3								
	Pigs	56.7	37.4-74.5						40.0	3.3						6.7	43.3	6.7
	Broilers	52.4	43.3-61.5					2.4	39.5	5.6					0.8	4.0	40.3	7.3
	Layers	33.3	25.1-42.4					0.8	56.1	8.9	0.8					1.6	30.1	1.6
	Total	43.5	37.6-49.5					1.4	47.3	7.4	0.4				0.4	3.2	35.3	4.6
Salinomycin	Cattle	-	-					50.0	50.0									
	Pigs	-	-					90.0	10.0									
	Broilers	-	-				1.6	63.7	12.1	15.3	7.3							
	Layers	-	-				1.6	88.6	4.1	4.1	1.6							
	Total	-	-				1.4	77.0	9.2	8.5	3.9							

Table3.3. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=6), pigs(n=30), broilers(n=124) and layers(n=123) in 2010

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	-	-					50.0		50.0								
	Pigs	-	-					6.7	16.7	60.0	13.3	3.3						
	Broilers	-	-			0.8	1.6	2.4	22.6	67.7	4.8							
	Layers	-	-			0.8	1.6	0.8	15.4	74.8	6.5							
	Total	-	-			0.7	1.4	3.2	18.4	69.6	6.4	0.4						

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=6), pigs(n=30), broilers(n=124) and layers(n=123) in 2010

Antomicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs																	
				0.00050	0.00099	0.00195	0.00391	0.00781	0.01563	0.03125	0.0625	0.125	0.25	0.5	1	2	4	8	16	32	>32
Nosiheptide	Cattle	-	-					50.0	50.0												
	Pigs	-	-					10.0	50.0	40.0											
	Broilers	-	-				0.8	12.9	54.0	29.8	2.4										
	Layers	-	-			0.8	1.6	13.8	43.9	38.2	1.6										
	Total	-	-			0.4	1.1	13.8	49.1	33.9	1.8										

White fields represent the range of dilutions tested. MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table3.4. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=8), pigs(n=13), broilers(n=54) and layers(n=65) in 2011

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	0.0	0-31.2			12.5	50.0	37.5										
	Pigs	0.0	0-20.6				15.4	76.9	7.7									
	Broilers	0.0	0-5.4			1.9	7.4	85.2	3.7		1.9							
	Layers	0.0	0-4.5			3.1	4.6	92.3										
	Total	0.0	0-2.1			2.9	9.3	85.0	2.1		0.7							
Dihydrostreptomycin	Cattle	25.0	3.2-65.1										50.0	25.0	25.0			
	Pigs	92.3	64.0-99.8											7.7				92.3
	Broilers	61.1	46.9-74.1										3.7	35.2	22.2	1.9		37.0
	Layers	47.7	35.1-60.5										6.2	46.2	33.8			13.8
	Total	55.7	47.1-64.1										7.1	37.1	25.7	0.7		29.3
Gentamicin	Cattle	12.5	0.3-52.7							62.5		25.0	12.5					
	Pigs	23.1	5.0-53.8								15.4	61.5	7.7				15.4	
	Broilers	1.9	0.05-9.9						1.9		18.5	77.8	1.9					
	Layers	13.8	6.5-24.7						1.5	4.6	15.4	64.6	7.7				6.2	
	Total	10.0	5.6-16.2						1.4	5.7	15.7	67.1	5.7				4.3	
Kanamycin	Cattle	12.5	0.3-52.7									50.0	12.5	25.0	12.5			
	Pigs	61.5	31.6-86.1										7.7	30.8	7.7		7.7	46.2
	Broilers	35.2	22.7-49.4									1.9	3.7	59.3	5.6	1.9	1.9	25.9
	Layers	26.2	16.0-38.5									6.2	4.6	63.1	6.2			20.0
	Total	32.1	24.5-40.6									6.4	5.0	56.4	6.4	0.7	1.4	23.6
Oxytetracycline	Cattle	50.0	15.7-84.3				37.5	12.5				12.5	37.5					
	Pigs	100.0	79.4-100									7.7	7.7	7.7	76.9			
	Broilers	64.8	50.6-77.3			1.9	18.5	3.7			11.1	3.7	9.3	9.3	42.6			
	Layers	36.9	25.3-49.8		1.5	1.5	52.3	4.6	1.5		1.5	3.1	4.6	6.2	23.1			
	Total	54.3	45.7-62.7		0.7	1.4	33.6	4.3	0.7		5.0	4.3	8.6	7.1	34.3			
Chloramphenicol	Cattle	0.0	0-31.2							62.5	37.5							
	Pigs	61.5	31.6-86.1								30.8	7.7			61.5			
	Broilers	5.6	1.2-15.4							20.4	72.2	1.9		3.7	1.9			
	Layers	0.0	0-4.5						1.5	26.2	67.7	4.6						
	Total	7.9	4.0-13.6						0.7	23.6	64.3	3.6		1.4	6.4			

Table3.4. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=8), pigs(n=13), broilers(n=54) and layers(n=65) in 2011

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Bacitracin	Cattle	-	-										12.5		12.5	75.0		
	Pigs	-	-												7.7	76.9	7.7	7.7
	Broilers	-	-											3.7	25.9	50.0	1.9	18.5
	Layers	-	-					1.5					1.5		23.1	64.6	4.6	4.6
	Total	-	-					0.7					1.4	1.4	22.1	60.7	3.6	10.0
Erythromycin	Cattle	0.0	0-31.2			25.0		25.0	37.5	12.5								
	Pigs	76.9	46.2-95.0					7.7	15.4							76.9		
	Broilers	50.0	36.1-63.9		1.9	1.9	1.9	9.3	29.6	5.6	3.7	3.7	5.6	1.9		35.2		
	Layers	21.5	12.3-33.5		4.6	3.1	9.2	21.5	32.3	7.7						21.5		
	Total	36.4	28.5-45.0		2.9	3.6	5.0	15.7	30.0	6.4	1.4	1.4	2.1	0.7		30.7		
Lincomycin	Cattle	0.0	0-31.2										75.0	25.0				
	Pigs	76.9	46.2-95.0									7.7	15.4				76.9	
	Broilers	51.9	37.8-65.7									5.6	40.7	1.9	3.7	9.3	38.9	
	Layers	23.1	13.5-35.2									7.7	56.9	12.3	1.5		21.5	
	Total	37.9	29.8-46.4									6.4	47.9	7.9	2.1	3.6	32.1	
Enrofloxacin	Cattle	0.0	0-31.2					87.5	12.5									
	Pigs	15.4	1.9-45.4				30.8	38.5	15.4	15.4								
	Broilers	11.1	4.2-22.6				29.6	59.3			1.9	1.9	7.4					
	Layers	1.5	0.04-8.3				27.7	66.2	4.6	1.5								
	Total	6.4	3.0-11.9				27.1	62.1	4.3	2.1	0.7	0.7	2.9					
Tylosin	Cattle	0.0	0-31.2						12.5	75.0	12.5							
	Pigs	76.9	46.2-95.0							15.4	7.7						76.9	
	Broilers	50.0	36.1-63.9						35.2	14.8					1.9	9.3	38.9	
	Layers	21.5	12.3-33.5					3.1	55.4	18.5	1.5					1.5	20.0	
	Total	36.4	28.5-45.0					1.4	40.0	20.0	2.1				0.7	4.3	31.4	
Salinomycin	Cattle	-	-						87.5	12.5								
	Pigs	-	-					38.5	53.8	7.7								
	Broilers	-	-					31.5	31.5	14.8	22.2							
	Layers	-	-				1.5	43.1	44.6	6.2	4.6							
	Total	-	-				0.7	35.7	42.9	10.0	10.7							

Table3.4. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=8), pigs(n=13), broilers(n=54) and layers(n=65) in 2011

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	-	-					12.5	62.5		25.0							
	Pigs	-	-					7.7	7.7	23.1	46.2	15.4						
	Broilers	-	-						5.6	64.8	27.8	1.9						
	Layers	-	-				1.5		7.7	50.8	40.0							
	Total	-	-				0.7	1.4	10.0	50.7	35.0	2.1						

White fields represent the range of dilutions tested.

MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.

MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table4.1. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=53), pigs(n=35), broilers(n=63) and layers(n=33) in 2008

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	0.0	0-5.5		1.9	1.9	17.0	43.4	34.0	1.9								
	Pigs	0.0	0-8.2			2.9	8.6	40.0	28.6	20.0								
	Broilers	4.8	1.0-13.3		1.6	11.1	6.3	22.2	9.5	36.5	7.9		4.8					
	Layers	0.0	0-8.7			15.2	21.2	27.3	21.2	15.2								
	Total	1.6	0.3-4.7		1.1	7.6	12.5	32.6	22.3	19.6	2.7		1.6					
Dihydrostreptomycin	Cattle	15.1	6.7-27.6									5.7	34.0	45.3	13.2	1.9		
	Pigs	48.6	31.4-66.0										34.3	17.1	2.9		17.1	28.6
	Broilers	38.1	26.1-51.2										30.2	31.7	6.3	1.6	7.9	22.2
	Layers	18.2	7.0-35.5									3.0	42.4	36.4	6.1	3.0		9.1
	Total	29.9	23.4-37.1									2.2	34.2	33.7	7.6	1.6	6.0	14.7
Gentamicin	Cattle	1.9	0.05-10.1						7.5	30.2	43.4	17.0	1.9					
	Pigs	5.7	0.7-19.2					5.7	11.4	45.7	22.9	8.6		2.9	2.9			
	Broilers	1.6	0.04-8.5					1.6	1.6	33.3	44.4	17.5						1.6
	Layers	6.1	0.7-20.2						6.1	27.3	54.5	6.1	6.1					
	Total	3.3	1.2-7.0					1.6	6.0	33.7	41.8	13.6	1.6	0.5	0.5			0.5
Kanamycin	Cattle	1.9	0.05-10.1									22.6	37.7	37.7				1.9
	Pigs	25.7	12.5-43.3									20.0	31.4	22.9			2.9	22.9
	Broilers	19.0	10.2-30.9								3.2	12.7	34.9	30.2				19.0
	Layers	24.2	11.1-42.3								6.1	18.2	27.3	24.2	9.1	6.1		9.1
	Total	16.3	11.3-22.5								2.2	17.9	33.7	29.9	1.6	1.1	0.5	13.0
Oxytetracycline	Cattle	15.1	6.7-27.6		1.9	41.5	41.5					3.8	1.9	5.7		3.8		
	Pigs	74.3	56.7-87.5			20.0	2.9	2.9				5.7	5.7	17.1	8.6	28.6	8.6	
	Broilers	76.2	63.8-86.0		3.2	17.5		1.6			1.6	4.8	1.6	12.7	30.2	25.4	1.6	
	Layers	42.4	25.5-60.8		3.0	39.4	6.1	9.1				6.1	6.1	6.1	18.2	6.1		
	Total	52.2	44.7-59.6		2.2	28.8	13.6	2.7			0.5	4.9	3.3	10.3	15.2	16.3	2.2	
Chloramphenicol	Cattle	0.0	0-5.5							66.0	32.1	1.9						
	Pigs	2.9	0.07-14.9							57.1	20.0	20.0	2.9					
	Broilers	3.2	0.4-11.0						9.5	58.7	19.0	9.5	3.2					
	Layers	0.0	0-8.7						6.1	66.7	18.2	9.1						
	Total	1.6	0.3-4.7						4.3	62.0	22.8	9.2	1.6					

Table4.1. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=53), pigs(n=35), broilers(n=63) and layers(n=33) in 2008

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Bacitracin	Cattle	-	-							1.9	20.8	41.5	3.8	3.8	15.1	9.4	1.9	1.9
	Pigs	-	-								8.6	17.1	2.9	17.1	31.4	11.4		11.4
	Broilers	-	-							4.8	9.5	3.2	1.6	14.3	22.2	4.8	9.5	30.2
	Layers	-	-						3.0		6.1	3.0	9.1	15.2	33.3	27.3	3.0	
	Total	-	-						0.5	2.2	12.0	16.8	3.8	12.0	23.9	11.4	4.3	13.0
Erythromycin	Cattle	3.8	0.5-13.0		69.8	3.8	1.9	9.4	5.7	5.7	1.9	1.9						
	Pigs	28.6	14.6-46.3		22.9	2.9	2.9	14.3	20.0	8.6						5.7	8.6	14.3
	Broilers	34.9	23.3-48.0		23.8	9.5	6.3	14.3	3.2	7.9	7.9	3.2				1.6	20.6	1.6
	Layers	15.2	5.1-31.9		30.3	6.1	9.1	30.3	9.1			3.0				3.0	6.1	3.0
	Total	21.2	15.5-27.8		38.0	6.0	4.9	15.8	8.2	6.0	3.3	2.2				2.2	9.8	3.8
Lincomycin	Cattle	3.8	0.5-13.0			9.4	18.9	3.8	3.8		1.9	28.3	30.2		1.9	1.9		
	Pigs	45.7	28.8-63.4			5.7	2.9	8.6	2.9		5.7	17.1	11.4			5.7	17.1	22.9
	Broilers	33.3	22.0-46.3			3.2	12.7	1.6		3.2	17.5	22.2		6.3	6.3	9.5	9.5	7.9
	Layers	18.2	7.0-35.5				15.2	9.1	6.1		15.2	21.2	15.2		3.0	3.0	9.1	3.0
	Total	24.5	18.4-31.3			4.9	13.0	4.9	2.7	1.1	10.3	22.8	13.6	2.2	3.3	5.4	8.2	7.6
Enrofloxacin	Cattle	18.9	9.4-32.0				15.1	56.6	9.4	7.5	7.5	3.8						
	Pigs	62.9	44.9-78.5			2.9	5.7	14.3	14.3	25.7	25.7	11.4						
	Broilers	65.1	52.0-76.7				3.2	9.5	22.2	41.3	19.0	1.6	1.6	1.6				
	Layers	63.6	45.1-79.6				6.1	24.2	6.1	30.3	33.3							
	Total	51.1	43.6-58.5			0.5	7.6	26.6	14.1	26.6	19.6	3.8	0.5	0.5				
Avilamycin	Cattle	0.0	0-5.5				1.9	39.6	37.7	20.8								
	Pigs	14.3	4.8-30.3				2.9	37.1	28.6	17.1						14.3		
	Broilers	28.6	17.9-41.3		1.6	1.6	12.7	14.3	20.6	19.0	1.6	1.6		3.2	7.9	15.9		
	Layers	3.0	0.08-15.8			3.0	6.1	39.4	33.3	12.1	3.0			3.0				
	Total	13.0	8.5-18.8		0.5	1.1	6.5	30.4	29.3	17.9	1.1	0.5		1.6	2.7	8.2		
Salinomycin	Cattle	-	-				3.8	67.9	28.3									
	Pigs	-	-				5.7	82.9	8.6	2.9								
	Broilers	-	-			1.6	6.3	39.7	17.5	28.6	6.3							
	Layers	-	-				24.2	69.7	3.0	3.0								
	Total	-	-			0.5	8.7	61.4	16.3	10.9	2.2							

Table4.1. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=53), pigs(n=35), broilers(n=63) and layers(n=33) in 2008

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	-	-			26.4	13.2	37.7	22.6									
	Pigs	-	-			8.6	17.1	42.9	22.9	2.9	2.9		2.9					
	Broilers	-	-		1.6	7.9	12.7	58.7	7.9	6.3	1.6		3.2					
	Layers	-	-			6.1	24.2	48.5	12.1	9.1								
	Total	-	-		0.5	13.0	15.8	47.8	15.8	4.3	1.1		1.6					

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=53), pigs(n=35), broilers(n=63) and layers(n=33) in 2008

Antomicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs																	
				0.00050	0.00099	0.00195	0.00391	0.00781	0.01563	0.03125	0.0625	0.125	0.25	0.5	1	2	4	8	16	32	>32
Nosiheptide	Cattle	-	-				13.2	17.0	30.2	37.7	1.9										
	Pigs	-	-			2.9	28.6	22.9	31.4	14.3											
	Broilers	-	-		1.6		12.7	23.8	27.0	19.0		3.2						1.6	3.2	1.6	6.3
	Layers	-	-			3.0	12.1	33.3	24.2	27.3											
	Total	-	-		0.5	1.1	15.8	23.4	28.3	25.0	0.5	1.1						0.5	1.1	0.5	2.2

White fields represent the range of dilutions tested. MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table4.2. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=24), pigs(n=21), broilers(n=31) and layers(n=23) in 2009

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	0.0	0-11.7		4.2		8.3	79.2	8.3									
	Pigs	0.0	0-13.3			4.8		81.0	4.8	4.8	4.8							
	Broilers	6.5	0.8-21.4			12.9	9.7	16.1	9.7	45.2			3.2		3.2			
	Layers	0.0	0-12.2			8.7	17.4	56.5	13.0	4.3								
	Total	2.0	0.2-7.1		1.0	7.1	9.1	54.5	9.1	16.2	1.0		1.0		1.0			
Dihydrostreptomycin	Cattle	8.3	1.0-27.0									8.3	29.2	54.2		8.3		
	Pigs	47.6	25.7-70.2										42.9	9.5	4.8	9.5		33.3
	Broilers	29.0	14.2-48.0									9.7	35.5	25.8	9.7	12.9		6.5
	Layers	4.3	0.1-21.9										52.2	43.5			4.3	
	Total	22.2	14.5-31.7									5.1	39.4	33.3	4.0	8.1	1.0	9.1
Gentamicin	Cattle	0.0	0-11.7					4.2		54.2	41.7							
	Pigs	0.0	0-13.3						9.5	61.9	28.6							
	Broilers	0.0	0-9.2						12.9	64.5	19.4	3.2						
	Layers	0.0	0-12.2						4.3	56.5	39.1							
	Total	0.0	0-3.0					1.0	7.1	59.6	31.3	1.0						
Kanamycin	Cattle	25.0	9.8-46.7								4.2		25.0	45.8	20.8	4.2		
	Pigs	28.6	11.3-52.2									19.0	38.1	14.3				28.6
	Broilers	16.1	5.5-33.7								3.2	6.5	48.4	25.8	6.5			9.7
	Layers	13.0	2.8-33.6									17.4	34.8	34.8	13.0			
	Total	20.2	12.8-29.5								2.0	10.1	37.4	30.3	10.1	1.0		9.1
Oxytetracycline	Cattle	12.5	2.7-32.4			4.2	54.2	29.2							4.2	8.3		
	Pigs	42.9	21.8-66.0			19.0	23.8	14.3				4.8	4.8	14.3	9.5	9.5		
	Broilers	61.3	42.2-78.2			3.2	22.6	9.7		3.2				22.6	19.4	19.4		
	Layers	30.4	13.2-52.9		4.3		47.8	8.7	8.7			4.3	4.3	8.7	8.7	4.3		
	Total	38.4	28.8-48.7		1.0	6.1	36.4	15.2	2.0	1.0		2.0	2.0	12.1	11.1	11.1		
Chloramphenicol	Cattle	0.0	0-11.7							95.8	4.2							
	Pigs	0.0	0-13.3							90.5	4.8	4.8						
	Broilers	0.0	0-9.2						3.2	80.6	6.5	9.7						
	Layers	0.0	0-12.2						21.7	69.6	8.7							
	Total	0.0	0-3.0						6.1	83.8	6.1	4.0						

Table4.2. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=24), pigs(n=21), broilers(n=31) and layers(n=23) in 2009

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Bacitracin	Cattle	-	-								8.3			8.3	20.8	45.8	4.2	12.5
	Pigs	-	-										4.8	4.8	38.1	42.9	9.5	
	Broilers	-	-							3.2	12.9			3.2	19.4	12.9	9.7	38.7
	Layers	-	-								4.3	13.0	4.3	13.0	26.1	21.7	8.7	8.7
	Total	-	-							1.0	7.1	3.0	2.0	7.1	25.3	29.3	8.1	17.2
Erythromycin	Cattle	20.8	7.1-42.2		4.2	12.5	8.3		20.8	33.3	8.3						12.5	
	Pigs	19.0	5.4-41.9		9.5			9.5	38.1	23.8	9.5						4.8	4.8
	Broilers	22.6	9.6-41.1		38.7		6.5	9.7	9.7	12.9	3.2	3.2					16.1	
	Layers	8.7	1.1-28.0			8.7	21.7	26.1	21.7	13.0	4.3	4.3						
	Total	18.2	11.1-27.2		15.2	5.1	9.1	11.1	21.2	20.2	6.1	2.0					9.1	1.0
Lincomycin	Cattle	8.3	1.0-27.0				4.2			16.7	12.5	45.8	12.5					8.3
	Pigs	33.3	14.6-57.0				9.5			9.5	14.3	28.6		4.8			23.8	9.5
	Broilers	32.3	16.7-51.4				12.9	6.5			6.5	35.5		6.5	12.9		9.7	9.7
	Layers	0.0	0-12.2				21.7	13.0			8.7	39.1	17.4					
	Total	19.2	12.0-28.3				12.1	5.1		6.1	10.1	37.4	7.1	3.0	4.0		8.1	7.1
Enrofloxacin	Cattle	25.0	9.8-46.7					45.8	29.2	12.5	12.5							
	Pigs	33.3	14.6-57.0			9.5	4.8	47.6	4.8	4.8	14.3	14.3						
	Broilers	61.3	42.2-78.2			3.2	3.2	19.4	12.9	25.8	35.5							
	Layers	43.5	23.2-65.5			4.3	8.7	21.7	21.7	34.8	8.7							
	Total	42.4	32.5-52.8			4.0	4.0	32.3	17.2	20.2	19.2	3.0						
Avilamycin	Cattle	0.0	0-11.7					29.2	33.3	20.8	16.7							
	Pigs	4.8	0.1-23.8					23.8	57.1	14.3						4.8		
	Broilers	41.9	24.5-60.9				6.5	12.9	22.6	16.1		3.2		3.2	3.2	32.3		
	Layers	0.0	0-12.2			8.7	13.0	8.7	30.4	39.1								
	Total	14.1	8.0-22.6			2.0	5.1	18.2	34.3	22.2	4.0	1.0		1.0	1.0	11.1		
Salinomycin	Cattle	-	-					25.0	66.7		8.3							
	Pigs	-	-					47.6	52.4									
	Broilers	-	-					19.4	61.3	6.5	12.9							
	Layers	-	-					69.6	30.4									
	Total	-	-					38.4	53.5	2.0	6.1							

Table4.2. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=24), pigs(n=21), broilers(n=31) and layers(n=23) in 2009

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	-	-			4.2		37.5	58.3									
	Pigs	-	-				14.3	38.1	42.9			4.8						
	Broilers	-	-			9.7	19.4	41.9	16.1			12.9						
	Layers	-	-			8.7	30.4	26.1	30.4	4.3								
	Total	-	-			6.1	16.2	36.4	35.4	1.0		5.1						

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=24), pigs(n=21), broilers(n=31) and layers(n=23) in 2009

Antomicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs																	
				0.00050	0.00099	0.00195	0.00391	0.00781	0.01563	0.03125	0.0625	0.125	0.25	0.5	1	2	4	8	16	32	>32
Nosiheptide	Cattle	-	-				16.7	33.3	45.8	4.2											
	Pigs	-	-				14.3	76.2	9.5												
	Broilers	-	-			3.2	25.8	35.5	12.9	12.9						3.2				3.2	3.2
	Layers	-	-			8.7	17.4	47.8	26.1												
	Total	-	-			3.0	19.2	46.5	23.2	5.1						1.0				1.0	1.0

White fields represent the range of dilutions tested. MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table4.3. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=16), pigs(n=33), broilers(n=40) and layers(n=30) in 2010

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	0.0	0-17.1			6.3	25.0	68.8										
	Pigs	0.0	0-8.7			12.1	18.2	48.5	18.2	3.0								
	Broilers	0.0	0-7.2		5.0	12.5	30.0	20.0	20.0	12.5								
	Layers	0.0	0-9.5			6.7	23.3	53.3	6.7	10.0								
	Total	0.0	0-2.5		1.7	10.1	24.4	42.9	13.4	7.6								
Dihydrostreptomycin	Cattle	12.5	1.6-38.3									12.5	31.3	43.8	6.3		6.3	
	Pigs	21.2	9.0-38.9								3.0	3.0	24.2	48.5		3.0	9.1	9.1
	Broilers	20.0	9.1-35.6									5.0	47.5	27.5	5.0		5.0	10.0
	Layers	23.3	9.9-42.3									3.3	46.7	26.7	3.3	6.7		13.3
	Total	20.2	13.4-28.5								0.8	5.0	38.7	35.3	3.4	2.5	5.0	9.2
Gentamicin	Cattle	0.0	0-17.1							43.8	56.3							
	Pigs	3.0	0.08-15.8						9.1	36.4	39.4	12.1			3.0			
	Broilers	10.0	2.8-23.7						2.5	37.5	37.5	12.5	10.0					
	Layers	13.3	3.8-30.7						10.0	20.0	50.0	6.7	13.3					
	Total	7.6	3.5-13.9						5.9	33.6	43.7	9.2	6.7		0.8			
Kanamycin	Cattle	6.3	0.2-30.2									25.0	31.3	37.5	6.3			
	Pigs	30.3	15.6-48.7									6.1	33.3	30.3	12.1			18.2
	Broilers	27.5	14.6-43.9									7.5	25.0	40.0	10.0	5.0		12.5
	Layers	20.0	7.7-38.6									20.0	20.0	40.0	16.7			3.3
	Total	23.5	16.2-32.2									12.6	26.9	37.0	11.8	1.7		10.1
Oxytetracycline	Cattle	6.3	0.2-30.2			6.3	31.3	56.3								6.3		
	Pigs	51.5	33.5-69.2			3.0	33.3	6.1	6.1				15.2	9.1	6.1	15.2	6.1	
	Broilers	55.0	38.5-70.7			10.0	27.5	2.5		2.5	2.5	2.5	5.0	7.5	10.0	30.0		
	Layers	30.0	14.7-49.4			6.7	53.3	10.0				16.7				13.3		
	Total	41.2	32.2-50.6			6.7	36.1	12.6	1.7	0.8	0.8	5.0	5.9	5.0	5.0	18.5	1.7	
Chloramphenicol	Cattle	0.0	0-17.1							56.3	43.8							
	Pigs	9.1	1.9-24.3							51.5	36.4	3.0	9.1					
	Broilers	0.0	0-7.2						2.5	50.0	47.5							
	Layers	0.0	0-9.5					3.3		50.0	43.3	3.3						
	Total	2.5	0.5-7.2					0.8	0.8	51.3	42.9	1.7	2.5					

Table4.3. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=16), pigs(n=33), broilers(n=40) and layers(n=30) in 2010

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Bacitracin	Cattle	-	-											12.5	18.8	12.5	37.5	18.8
	Pigs	-	-										6.1		18.2	42.4	21.2	12.1
	Broilers	-	-						2.5		5.0	12.5	7.5		12.5	25.0	17.5	17.5
	Layers	-	-									6.7	6.7		6.7	40.0	33.3	6.7
	Total	-	-						0.8		1.7	5.9	5.9	1.7	13.4	31.9	25.2	13.4
Erythromycin	Cattle	43.8	19.8-70.1		6.3	6.3		6.3		37.5	31.3	12.5						
	Pigs	36.4	20.4-54.9		21.2	9.1		3.0	18.2	12.1	3.0	9.1	3.0		3.0	6.1	12.1	
	Broilers	32.5	18.6-49.1		25.0	10.0	5.0	12.5	10.0	5.0	2.5	7.5				2.5	20.0	
	Layers	46.7	28.3-65.7		13.3		3.3	6.7	13.3	16.7	10.0	30.0					6.7	
	Total	38.7	29.9-48.0		18.5	6.7	2.5	7.6	11.8	14.3	8.4	14.3	0.8		0.8	2.5	11.8	
Lincomycin	Cattle	6.3	0.2-30.2				12.5	25.0				18.8	37.5				6.3	
	Pigs	24.2	11.1-42.3			3.0		3.0	6.1		6.1	30.3	24.2	3.0			6.1	18.2
	Broilers	25.0	12.7-41.2			5.0	15.0	5.0	2.5		10.0	22.5	10.0	5.0	2.5	2.5	5.0	15.0
	Layers	6.7	0.8-22.1				20.0	10.0	3.3			20.0	26.7	13.3		3.3	3.3	
	Total	17.6	11.3-25.7			2.5	11.8	8.4	3.4		5.0	23.5	21.8	5.9	0.8	1.7	5.0	10.1
Enrofloxacin	Cattle	43.8	19.8-70.1					31.3	25.0	6.3	18.8	18.8						
	Pigs	18.2	7.0-35.5		3.0	3.0	12.1	33.3	30.3	9.1	9.1							
	Broilers	50.0	33.8-66.2				5.0	32.5	12.5	27.5	17.5	5.0						
	Layers	56.7	37.4-74.5					23.3	20.0	10.0	40.0	6.7						
	Total	42.0	33.0-51.4		0.8	0.8	5.0	30.3	21.0	15.1	21.0	5.9						
Tylosin	Cattle	0.0	0-17.1					6.3	43.8	18.8	31.3							
	Pigs	21.2	9.0-38.9					3.0	30.3	24.2	21.2					6.1	12.1	3.0
	Broilers	22.5	10.8-38.5					22.5	32.5	12.5	10.0					7.5	12.5	2.5
	Layers	10.0	2.1-26.5					20.0	20.0	23.3	26.7					3.3	6.7	
	Total	16.0	9.9-23.8					14.3	30.3	19.3	20.2					5.0	9.2	1.7
Salinomycin	Cattle	-	-					31.3	68.8									
	Pigs	-	-					12.1	87.9									
	Broilers	-	-					30.0	45.0	15.0	10.0							
	Layers	-	-					36.7	60.0	3.3								
	Total	-	-					26.9	63.9	5.9	3.4							

Table4.3. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=16), pigs(n=33), broilers(n=40) and layers(n=30) in 2010

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	-	-			18.8	18.8	43.8	18.8									
	Pigs	-	-				18.2	36.4	36.4		3.0	6.1						
	Broilers	-	-		2.5	20.0	22.5	45.0	7.5	2.5								
	Layers	-	-			23.3	16.7	43.3	13.3	3.3								
	Total	-	-		0.8	15.1	19.3	42.0	18.5	1.7	0.8	1.7						

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=16), pigs(n=33), broilers(n=40) and layers(n=30) in 2010

Antomicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs																	
				0.00050	0.00099	0.00195	0.00391	0.00781	0.01563	0.03125	0.0625	0.125	0.25	0.5	1	2	4	8	16	32	>32
Nosiheptide	Cattle	-	-			6.3	6.3	25.0	50.0	12.5											
	Pigs	-	-				9.1	48.5	27.3	15.2											
	Broilers	-	-		2.5		7.5	30.0	32.5	15.0	2.5	2.5	2.5							5.0	
	Layers	-	-			3.3	10.0	43.3	30.0	13.3											
	Total	-	-		0.8	1.7	8.4	37.8	32.8	14.3	0.8	0.8	0.8							1.7	

White fields represent the range of dilutions tested. MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table4.4. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=38), pigs(n=30), broilers(n=49) and layers(n=42) in 2011

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	0.0	0-7.6				5.3	44.7	50.0									
	Pigs	0.0	0-9.5		3.3		13.3	13.3	50.0	3.3	16.7							
	Broilers	4.1	0.5-14.0			2.0	2.0	16.3	24.5	22.4	28.6		2.0	2.0				
	Layers	0.0	0-6.9		4.8	7.1	14.3	16.7	52.4		4.8							
	Total	1.3	0.2-4.5		1.9	2.5	8.2	22.6	42.8	7.5	13.2		0.6	0.6				
Dihydrostreptomycin	Cattle	10.5	2.9-24.8										55.3	34.2	2.6			7.9
	Pigs	43.3	25.5-62.6										13.3	43.3	10.0			33.3
	Broilers	18.4	8.8-32.0										12.2	69.4	4.1		6.1	8.2
	Layers	7.1	1.5-19.5									4.8	26.2	61.9	2.4			4.8
	Total	18.2	12.6-25.1									1.3	26.4	54.1	4.4		1.9	11.9
Gentamicin	Cattle	0.0	0-7.6							50.0	47.4	2.6						
	Pigs	3.3	0.08-17.2							40.0	30.0	26.7			3.3			
	Broilers	6.1	1.3-16.9							12.2	59.2	22.4	2.0				4.1	
	Layers	0.0	0-6.9						11.9	19.0	57.1	11.9						
	Total	2.5	0.7-6.3						3.1	28.3	50.3	15.7	0.6		0.6		1.3	
Kanamycin	Cattle	36.8	21.8-54.0										13.2	50.0	26.3	7.9		2.6
	Pigs	53.3	34.3-71.7											46.7	10.0	16.7		26.7
	Broilers	40.8	27.0-55.8										12.2	46.9	28.6	6.1		6.1
	Layers	47.6	32.0-63.6										19.0	33.3	38.1	9.5		
	Total	44.0	36.2-52.1										11.9	44.0	27.0	9.4		7.5
Oxytetracycline	Cattle	23.7	11.4-40.2			52.6	23.7					2.6		5.3	15.8			
	Pigs	56.7	37.4-74.5			30.0	13.3						13.3	6.7	36.7			
	Broilers	65.3	50.4-78.3		2.0	26.5	4.1			2.0		4.1	6.1	14.3	40.8			
	Layers	11.9	4.0-25.6		2.4	64.3	19.0				2.4	2.4	7.1		2.4			
	Total	39.6	32.0-47.7		1.3	43.4	14.5			0.6	0.6	2.5	6.3	6.9	23.9			
Chloramphenicol	Cattle	2.6	0.07-13.8							86.8	10.5		2.6					
	Pigs	3.3	0.08-17.2							46.7	40.0	10.0	3.3					
	Broilers	2.0	0.05-10.9						10.2	71.4	12.2	4.1	2.0					
	Layers	0.0	0-6.9							69.0	28.6	2.4						
	Total	1.9	0.4-5.4						3.1	69.8	21.4	3.8	1.9					
Bacitracin	Cattle	-	-										5.3	7.9	15.8	39.5	10.5	21.1
	Pigs	-	-												10.0	36.7	40.0	13.3
	Broilers	-	-								8.2	6.1			10.2	38.8	4.1	32.7
	Layers	-	-											4.8	7.1	47.6	28.6	11.9
	Total	-	-								2.5	1.9	1.3	3.1	10.7	40.9	18.9	20.8

Table4.4. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=38), pigs(n=30), broilers(n=49) and layers(n=42) in 2011

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Erythromycin	Cattle	28.9	15.4-45.9		15.8	7.9	2.6	13.2	18.4	13.2	15.8					13.2		
	Pigs	33.3	17.3-52.8			16.7		6.7	16.7	26.7	3.3					30.0		
	Broilers	24.5	13.3-38.9		34.7		12.2		18.4	10.2	14.3			2.0		8.2		
	Layers	19.0	8.6-34.1		9.5	9.5	4.8	9.5	23.8	23.8	19.0							
	Total	25.8	19.2-33.3		17.0	7.5	5.7	6.9	19.5	17.6	13.8			0.6		11.3		
Lincomycin	Cattle	10.5	2.9-24.8				7.9			5.3	13.2	55.3	7.9				10.5	
	Pigs	43.3	25.5-62.6				6.7	3.3		6.7	3.3	23.3	13.3		6.7		36.7	
	Broilers	18.4	8.8-32.0			2.0	2.0	6.1		4.1	26.5	26.5	10.2	4.1		6.1	12.2	
	Layers	2.4	0.06-12.6				11.9	9.5			19.0	40.5	16.7		2.4			
	Total	17.0	11.5-23.7			0.6	6.9	5.0		3.8	17.0	36.5	11.9	1.3	1.9	1.9	13.2	
Enrofloxacin	Cattle	34.2	19.6-51.4			5.3	2.6	28.9	28.9	13.2	21.1							
	Pigs	40.0	22.7-59.4				6.7	26.7	26.7	6.7	20.0	13.3						
	Broilers	65.3	50.4-78.3				6.1	20.4	8.2	36.7	22.4	6.1						
	Layers	40.5	25.6-56.7				14.3	19.0	26.2	23.8	16.7							
	Total	46.5	38.6-54.6			1.3	7.5	23.3	21.4	22.0	20.1	4.4						
Tylosin	Cattle	7.9	1.7-21.4						13.2	36.8	42.1						7.9	
	Pigs	30.0	14.7-49.4						13.3	33.3	16.7	6.7					30.0	
	Broilers	8.2	2.3-19.6					8.2	44.9	24.5	8.2	4.1	2.0				8.2	
	Layers	0.0	0-6.9						31.0	33.3	28.6	7.1						
	Total	10.1	5.9-15.8					2.5	27.7	31.4	23.3	4.4	0.6				10.1	
Salinomycin	Cattle	-	-					23.7	68.4	5.3		2.6						
	Pigs	-	-					6.7	83.3	3.3	6.7							
	Broilers	-	-					18.4	38.8	14.3	26.5	2.0						
	Layers	-	-					31.0	61.9	7.1								
	Total	-	-					20.8	60.4	8.2	9.4	1.3						
Virginiamycin	Cattle	-	-				7.9	31.6	57.9	2.6								
	Pigs	-	-				10.0	6.7	63.3	13.3	6.7							
	Broilers	-	-			4.1	16.3	42.9	28.6	2.0	4.1		2.0					
	Layers	-	-				21.4	16.7	61.9									
	Total	-	-			1.3	14.5	26.4	50.9	3.8	2.5		0.6					

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table5.1. Distribution of MICs and resistance(%) in *Campylobacter jejuni* from cattle(n=33), broilers(n=34) and layers(n=33) in 2008

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs																
				0.02	0.03	0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle		0-8.7					6.1	6.1	6.1	30.3	39.4	12.1							
	Broilers	14.7	5.0-31.1							20.6	11.8	17.6	5.9	29.4	2.9	11.8				
	Layers	27.3	13.3-45.5							6.1	12.1	21.2	18.2	15.2	3.0	24.2				
	Total	14.0	7.9-22.4					2.0	2.0	11.0	18.0	26.0	12.0	15.0	2.0	12.0				
Gentamicin	Cattle		0-8.7					42.4	48.5	9.1										
	Broilers		0-8.4					61.8	32.4	5.9										
	Layers		0-8.7					75.8	24.2											
	Total		0-3.0					60.0	35.0	5.0										
Dihydrostreptomycin	Cattle		0-8.7						12.1	66.7	15.2	6.1								
	Broilers		0-8.4						44.1	47.1	8.8									
	Layers		0-8.7					3.0	42.4	45.5	9.1									
	Total		0-3.0					1.0	33.0	53.0	11.0	2.0								
Erythromycin	Cattle		0-8.7						3.0	48.5	39.4	9.1								
	Broilers		0-8.4						8.8	52.9	26.5	11.8								
	Layers		0-8.7						33.3	39.4	18.2	9.1								
	Total		0-3.0						15.0	47.0	28.0	10.0								
Oxytetracycline	Cattle	18.2	7.0-35.5				9.1	3.0	15.2	27.3	27.3			3.0	6.1	9.1				
	Broilers	29.4	15.1-47.5					11.8	17.6	32.4		8.8				5.9	8.8	11.8	2.9	
	Layers	39.4	22.9-57.9					0.0	3.0	39.4	12.1	6.1				24.2	12.1	3.0	0.0	
	Total	29.0	20.3-38.9				3.0	5.0	12.0	33.0	13.0	5.0		1.0	2.0	13.0	7.0	5.0	1.0	
Chloramphenicol	Cattle		0-8.7							9.1	66.7	24.2								
	Broilers	2.9	0-15.3							2.9	73.5	2.9	17.6	2.9						
	Layers		0-8.7							3.0	60.6	27.3	9.1							
	Total	1.0	0-5.4							5.0	67.0	18.0	9.0	1.0						
Nalidixic acid	Cattle	33.3	18.0-51.8								30.3	33.3	3.0				9.1	24.2		
	Broilers	14.7	5.0-31.1								38.2	35.3	5.9	5.9			5.9	8.8		
	Layers	3.0	0-15.8								27.3	51.5	18.2					3.0		
	Total	17.0	10.2-25.8								32.0	40.0	9.0	2.0			5.0	12.0		
Enrofloxacin	Cattle	30.3	15.6-48.7			51.5	18.2					24.2	6.1							
	Broilers	14.7	5.0-31.1			61.8	14.7	8.8			2.9		11.8							
	Layers	3.0	0-15.8			63.6	21.2	12.1				3.0								
	Total	16.0	9.4-24.7			59.0	18.0	7.0			1.0	9.0	6.0							

Table5.2. Distribution of MICs and resistance(%) in *Campylobacter jejuni* from cattle(n=45), broilers(n=58) and layers(n=49) in 2009

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs																
				0.015	0.03	0.06	0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	8.9	2.5-21.2						8.9	17.8	28.9	31.1	4.4		2.2	6.7				
	Broilers	19.0	9.9-31.4						1.7	5.2	10.3	36.2	20.7	6.9	3.4	10.3	1.7	1.7	1.7	
	Layers	12.2	4.6-24.8								24.5	24.5	20.4	18.4	6.1	6.1				
	Total	13.8	8.8-20.3						3.3	7.2	20.4	30.9	15.8	8.6	3.9	7.9	0.7	0.7	0.7	
Gentamicin	Cattle		0-6.4			4.4		24.4	44.4	24.4	2.2									
	Broilers		0-5.0				1.7	24.1	53.4	19.0	1.7									
	Layers		0-5.9				2.0	34.7	51.0	12.2										
	Total		0-2.0			1.3	1.3	27.6	50.0	18.4	1.3									
Dihydrostreptomycin	Cattle		0-6.4						11.1	51.1	31.1	6.7								
	Broilers		0-5.0					3.4	10.3	72.4	13.8									
	Layers	8.2	2.2-19.6						20.4	53.1	18.4								8.2	
	Total	2.6	0.7-6.6					1.3	13.8	59.9	20.4	2.0							2.6	
Erythromycin	Cattle		0-6.4						22.2	24.4	48.9	4.4								
	Broilers		0-5.0						8.6	39.7	43.1	6.9	1.7							
	Layers		0-5.9						10.2	38.8	36.7	14.3								
	Total		0-2.0						13.2	34.9	42.8	8.6	0.7							
Oxytetracycline	Cattle	35.6	21.9-51.2					6.7	20.0	26.7	6.7	4.4			17.8	8.9	2.2	6.7		
	Broilers	46.6	33.3-60.1					3.4	15.5	27.6		6.9			5.2	17.2	20.7	3.4		
	Layers	28.6	16.6-43.3					8.2	20.4	18.4	14.3	8.2	2.0		10.2	14.3	2.0	2.0		
	Total	37.5	29.8-45.7					5.9	18.4	24.3	6.6	6.6	0.7		10.5	13.8	9.2	3.9		
Chloramphenicol	Cattle		0-6.4						4.4	8.9	77.8	6.7	2.2							
	Broilers		0-5.0							6.9	65.5	22.4	5.2							
	Layers		0-5.9							4.1	69.4	16.3	10.2							
	Total		0-2.0						1.3	6.6	70.4	15.8	5.9							
Nalidixic acid	Cattle	33.3	20.0-49.0								8.9	40.0	4.4	13.3	6.7	6.7	8.9	11.1		
	Broilers	27.6	16.7-40.9								13.8	39.7	15.5	3.4			13.8	13.8		
	Layers	20.4	10.2-34.3								8.2	46.9	24.5		2.0		6.1	12.2		
	Total	27.0	20.1-34.8								10.5	42.1	15.1	5.3	2.6	2.0	9.9	12.5		
Enrofloxacin	Cattle	24.4	12.9-39.5			48.9	17.8	8.9			6.7	11.1	6.7							
	Broilers	27.6	16.7-40.9		3.45	32.8	29.3	3.4	3.4			13.8	13.8							
	Layers	20.4	10.2-34.3			30.6	38.8	8.2	2.0			14.3	6.1							
	Total	24.3	17.8-32.0			36.8	28.9	6.6	2.0		2.0	13.2	9.2							

Table5.3. Distribution of MICs and resistance(%) in *Campylobacter jejuni* from cattle(n=51), broilers(n=56) and layers(n=60) in 2010

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs															
				0.015	0.03	0.06	0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	512
Ampicillin	Cattle	2.0	0.1-10.4					3.9	5.9	13.7	23.5	45.1	5.9		2.0				
	Broilers	25.0	14.4-38.4						5.4	14.3	14.3	19.6	19.6	1.8	12.5	8.9	3.6		
	Layers	23.3	13.4-36.0						1.7	8.3	13.3	33.3	13.3	6.7	13.3	10.0			
	Total	17.4	11.9-24.0					1.2	4.2	12.0	16.8	32.3	13.2	3.0	9.6	6.6	1.2		
Gentamicin	Cattle		0-5.7					5.9	60.8	33.3									
	Broilers		0-5.2						39.3	57.1	3.6								
	Layers		0-4.9					1.7	46.7	51.7									
	Total		0-1.8					2.4	48.5	47.9	1.2								
Erythromycin	Cattle		0-5.7					25.5	39.2	33.3	2.0								
	Broilers		0-5.2				1.8	16.1	50.0	14.3	17.9								
	Layers		0-4.9				3.3	25.0	38.3	16.7	15.0		1.7						
	Total		0-1.8				1.8	22.2	42.5	21.0	12.0		0.6						
Tetracycline	Cattle	49.0	34.8-.1				43.1	2.0	2.0			3.9		2.0	27.5	9.8	7.8	2.0	
	Broilers	46.4	33.0-60.3				48.2	5.4						1.8	19.6		5.4	19.6	
	Layers	45.0	32.1-58.4				41.7	8.3	1.7	3.3				1.7	23.3	3.3	16.7		
	Total	46.7	40.1-55.8				44.3	5.4	1.2	1.2		1.2		1.8	23.4	4.2	10.2	7.2	
Chloramphenicol	Cattle		0-5.7						7.8	72.5	19.6								
	Broilers		0-5.2						1.8	51.8	33.9	12.5							
	Layers		0-4.9						10.0	41.7	38.3	10.0							
	Total		0-1.8						6.6	54.5	31.1	7.8							
Nalidixic acid	Cattle	37.3	24.1-51.9								17.6	43.1	2.0			3.9	9.8	23.5	
	Broilers	33.9	21.8-47.8								16.1	28.6	17.9	3.6	1.8	3.6	23.2	5.4	
	Layers	3.3	0.4-11.5								11.7	58.3	25.0	1.7		1.7	1.7		
	Total	24.0	17.7-31.2								15.0	43.7	15.6	1.8	0.6	3.0	11.4	9.0	
Ciprofloxacin	Cattle	37.3	24.1-51.9			3.9	33.3	25.5				3.9	21.6	11.8					
	Broilers	33.9	21.8-47.8				21.4	25.0	17.9	1.8			7.1	16.1	5.4	5.4			
	Layers	3.3	0.4-11.5			1.7	28.3	38.3	25.0	3.3			0.0	3.3					
	Total	24.0	17.7-31.2			1.8	27.5	29.9	15.0	1.8		1.2	9.0	10.2	1.8	1.8			

Table5.4. Distribution of MICs and resistance(%) in *Campylobacter jejuni* from cattle(n=51), pigs(n=1), broilers(n=55) and layers(n=91) in 2011

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs															
				0.015	0.03	0.06	0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	512
Ampicillin	Cattle		0-5.7				3.9	7.8	5.9	9.8	31.4	39.2	2.0						
	Pigs		0-95.0							100.0									
	Broilers	25.5	14.7-39.0					1.8	3.6	9.1	16.4	20.0	12.7	10.9	10.9	12.7	1.8		
	Layers	22.0	14.0-31.9					2.2	5.5	12.1	7.7	30.8	16.5	3.3	11.0	7.7		3.3	
	Total	17.2	12.2-23.2				1.0	3.5	5.1	11.1	16.2	29.8	11.6	4.5	8.1	7.1	0.5	1.5	
Gentamicin	Cattle		0-5.7				2.0	17.6	47.1	33.3									
	Pigs		0-95.0							100.0									
	Broilers		0-5.3					23.6	50.9	20.0		1.8	1.8	1.8					
	Layers		0-3.2				2.2	20.9	51.6	24.2			1.1						
	Total		0-1.5				1.5	20.7	50.0	25.8		0.5	1.0		0.5				
Streptomycin	Cattle	3.9	0.5-13.5					9.8	27.5	49.0	7.8	2.0						3.9	
	Pigs		0-95.0							100.0									
	Broilers		0-5.3					10.9	36.4	41.8	9.1	1.8							
	Layers	2.2	0.3-7.7.					11.0	42.9	35.2	2.2	4.4		2.2	2.2				
	Total	2.0	0.6-5.1					10.6	36.9	40.9	5.6	3.0		1.0	1.0			1.0	
Erythromycin	Cattle		0-5.7				9.8	35.3	45.1	5.9	2.0	2.0							
	Pigs		0-95.0						100.0										
	Broilers		0-5.4				5.6	48.1	29.6	13.0	3.7					0.0			
	Layers		0-3.2				12.1	36.3	36.3	13.2	2.2							0.0	
	Total		0-1.5				9.6	39.4	36.9	11.1	2.5	0.5				0.0		0.0	
Tetracycline	Cattle	37.3	24.1-51.9				51.0	2.0	3.9			2.0	3.9	2.0	11.8	19.6	3.9		
	Pigs	100.0	5.0-100.0														100.0		
	Broilers	52.7	38.8-66.3				34.5	12.7						3.6	12.7	21.8	7.3	7.3	
	Layers	39.6	29.5-50.4.				46.2	3.3	6.6		1.1	2.2	1.1	2.2	8.8	15.4	9.9	3.3	
	Total	42.9	35.9-50.1				43.9	5.6	4.0		0.5	1.5	1.5	2.5	10.6	18.2	8.1	3.5	
Chloramphenicol	Cattle		0-5.7					5.9	11.8	72.5	7.8	2.0							
	Pigs		0-95.0							100.0									
	Broilers		0-5.3						10.9	54.5	27.3	3.6	3.6						
	Layers	2.2	0.3-7.7					1.1	8.8	63.7	17.6	6.6		2.2					
	Total	1.0	0.1-3.6					2.0	10.1	63.6	17.7	4.5	1.0	1.0					
Nalidixic acid	Cattle	31.4	19.1-45.9					2.0		2.0	21.6	39.2	3.9		7.8	9.8	11.8	2.0	
	Pigs	100.0	5.0-100.0															100.0	
	Broilers	34.5	22.2-48.6							1.8	9.1	43.6	10.9		5.5	9.1	18.2	1.8	
	Layers	22.0	14.0-31.9							1.1	25.3	40.7	7.7	3.3		3.3	6.6	12.1	
	Total	28.3	22.1-35.1					0.5		1.5	19.7	40.9	7.6	1.5	3.5	6.6	11.1	7.1	
Ciprofloxacin	Cattle	29.4	17.5-43.8			15.7	43.1	9.8	2.0			5.9	15.7	3.9	3.9				
	Pigs	100.0	5.0-100.0											100.0					
	Broilers	30.9	19.1-44.8			5.5	45.5	7.3	9.1		1.8	3.6	9.1	14.5	3.6				
	Layers	17.6	10.4-27.0			8.8	50.5	16.5	5.5	1.1			2.2	8.8	3.3	3.3			
	Total	24.7	18.9-31.4			9.6	47.0	12.1	5.6	0.5	0.5	2.5	7.6	9.6	3.5	1.5			

Table6.1.Distribution of MICs and resistance(%) in *Campylobacter coli* from cattle(n=3), pigs(n=42), broilers(n=4) and layers(n=8) in 2008

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs																
				0.015	0.03	0.06	0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	33.3	0.8-90.6										33.3	33.3			33.3			
	Pigs	4.8	0.6-16.2						4.8	16.7	38.1	23.8	4.8	7.1	2.4	2.4				
	Broilers		0-52.7							25.0	25.0		50.0							
	Layers	25.0	3.2-65.1										62.5	12.5	12.5	12.5				
	Total	8.8	2.9-19.3						3.5	14.0	29.8	17.5	17.5	8.8	3.5	3.5	1.8			
Gentamicin	Cattle		0-63.2							100.0										
	Pigs		0-6.9					4.8	50.0	21.4	23.8									
	Broilers		0-52.7					50.0	50.0											
	Layers		0-31.2					12.5	87.5											
	Total		0-5.1					8.8	52.6	21.1	17.5									
Dihydrostreptomycin	Cattle	100.0	36.8-100															33.3		66.7
	Pigs	54.8	38.7-70.2							7.1	23.8	14.3				2.4	9.5	4.8	2.4	35.7
	Broilers	25.0	0.6-80.6						50.0	25.0								25.0		
	Layers		0-31.2							100.0										
	Total	47.4	34.0-61.0						3.5	21.1	17.5	10.5				1.8	7.0	7.0	1.8	29.8
Erythromycin	Cattle	33.3	0.8-90.6									33.3	33.3							33.3
	Pigs	61.9	45.6-76.4							2.4	19.0	16.7							4.8	57.1
	Broilers		0-52.7					50.0			25.0		25.0							
	Layers		0-31.2							12.5	25.0	12.5	37.5	12.5						
	Total	47.4	34.0-61.0					3.5		3.5	19.3	15.8	8.8	1.8					3.5	43.9
Oxytetracycline	Cattle	66.7	9.4-99.2									33.3				33.3	33.3			
	Pigs	92.9	80.5-98.5							2.4	4.8				7.1	11.9	31.0	26.2	14.3	2.4
	Broilers	75.0	19.4-99.4									25.0		25.0		25.0	25.0			
	Layers	12.5	0.3-52.7							25.0	25.0	25.0	12.5		12.5					
	Total	78.9	66.1-88.6							5.3	7.0	7.0	1.8	1.8	7.0	12.3	26.3	19.3	10.5	1.8
Chloramphenicol	Cattle	33.3	0.8-90.6										66.7	33.3						
	Pigs	28.6	15.7-44.6								14.3	47.6	9.5	4.8	11.9	11.9				
	Broilers		0-52.7							25.0	50.0		25.0							
	Layers	12.5	0.3-52.7								37.5	25.0	25.0	12.5						
	Total	24.6	14.1-37.8							1.8	19.3	38.6	15.8	7.0	8.8	8.8				
Nalidixic acid	Cattle	66.7	9.4-99.2									33.3			33.3		33.3			
	Pigs	42.9	27.7-59.0								2.4	23.8	23.8	7.1	2.4	2.4	11.9	26.2		
	Broilers	50.0	6.8-93.2									25.0		25.0		25.0	25.0			
	Layers		0-31.2								25.0	37.5	25.0	12.5						
	Total	38.6	26.0-51.6								5.3	26.3	21.1	8.8	3.5	3.5	12.3	19.3		
Enrofloxacin	Cattle	33.3	0.8-90.6			33.3		33.3					33.3							
	Pigs	40.5	25.6-56.7			33.3	26.2					21.4	16.7	2.4						
	Broilers	50.0	6.8-93.2			25.0		25.0			50.0									
	Layers		0-31.2			62.5	37.5													
	Total	35.1	22.9-48.9			36.8	24.6	3.5			3.5	15.8	14.0	1.8						

Table6.2. Distribution of MICs and resistance(%) in *Campylobacter coli* from cattle(n=6), pigs(n=62), broilers(n=6) and layers(n=7) in 2009.

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs																
				0.015	0.03	0.06	0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle		0-39.3						16.7			33.3	16.7	33.3						
	Pigs	11.3	4.7-21.9						1.6	8.1	21.0	11.3	32.3	14.5	3.2	4.8	3.2			
	Broilers	50.0	11.8-88.2										33.3	16.7	16.7	33.3				
	Layers	57.1	18.4-90.1											42.9	28.6		14.3	14.3		
	Total	17.3	9.8-27.3						2.5	6.2	16.0	11.1	28.4	18.5	6.2	6.2	3.7	1.2		
Gentamicin	Cattle		0-39.3					16.7	50.0		33.3									
	Pigs		0-4.7					1.6	25.8	41.9	30.6									
	Broilers		0-39.3						66.7	33.3										
	Layers		0-34.8						57.1	42.9										
	Total		0-3.6					2.5	33.3	38.3	25.9									
Dihydrostreptomycin	Cattle		0-39.3					16.7			50.0	33.3								
	Pigs	66.1	53.0-77.7						1.6		17.7	14.5				6.5	4.8	24.2	11.3	19.4
	Broilers		0-39.3							66.7	33.3									
	Layers		0-34.8								85.7	14.3								
	Total	50.6	39.3-61.9					1.2	1.2	4.9	27.2	14.8				4.9	3.7	18.5	8.6	14.8
Erythromycin	Cattle		0-39.3								16.7	66.7		16.7						
	Pigs	48.4	35.5-61.4							4.8	19.4	14.5	6.5	6.5	3.2				6.5	38.7
	Broilers		0-39.3						33.3	33.3			33.3							
	Layers		0-34.8						14.3	14.3	57.1	14.3								
	Total	37.0	26.6-48.5						3.7	7.4	21.0	17.3	7.4	6.2	2.5				4.9	29.6
Oxytetracycline	Cattle	50.0	11.8-88.2								33.3	16.7						16.7		33.3
	Pigs	85.5	74.2-93.1					3.2			3.2	1.6	6.5	9.7	8.1	12.9	16.1	21.0	11.3	6.5
	Broilers	66.7	22.3-95.7						16.7	16.7						16.7	16.7	16.7	16.7	
	Layers	57.1	18.4-90.1							28.6		14.3				28.6		28.6		
	Total	79.0	68.5-87.3					2.5	1.2	3.7	4.9	3.7	4.9	7.4	6.2	13.6	13.6	21.0	9.9	7.4
Chloramphenicol	Cattle		0-39.3								50.0	33.3	16.7							
	Pigs	29.0	18.2-41.9							6.5	25.8	29.0	9.7	4.8	14.5	9.7				
	Broilers	16.7	0.4-64.1								66.7		16.7	16.7						
	Layers		0-34.8								57.1		42.9							
	Total	23.5	14.8-34.2							4.9	33.3	24.7	13.6	4.9	11.1	7.4				
Nalidixic acid	Cattle	50.0	11.8-88.2								16.7		33.3				16.7	33.3		
	Pigs	51.6	38.6-64.5									9.7	22.6	16.1	4.8	8.1	29.0	8.1	1.6	
	Broilers		0-39.3									66.7		33.3						
	Layers	14.3	0.4-57.9									57.1	28.6				14.3			
	Total	44.4	33.4-55.9								1.2	17.3	22.2	14.8	3.7	6.2	24.7	8.6	1.2	
Enrofloxacin	Cattle	50.0	11.8-88.2		16.7		33.3					16.7	16.7	16.7						
	Pigs	48.4	35.5-61.4			4.8	38.7	8.1				17.7	25.8	4.8						
	Broilers		0-39.3			50.0	33.3	16.7												
	Layers		0-34.8			57.1	42.9													
	Total	40.7	29.9-52.2		1.2	12.3	38.3	7.4				14.8	21.0	4.9						

Table6.3. Distribution of MICs and resistance(%) in *Campylobacter coli* from cattle(n=3), pigs(n=62), broilers(n=12) and layers(n=10) in 2010

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs															
				0.015	0.03	0.06	0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	512
Ampicillin	Cattle		0-63.2									33.3	66.7						
	Pigs		0-4.7				1.6	1.6	8.1	21.0	30.6	16.1	16.1	4.8					
	Broilers		0-22.1							33.3	16.7	16.7	33.3						
	Layers		0-25.9							10.0		20.0	50.0	20.0					
	Total		0-3.4				1.1	1.1	5.7	20.7	24.1	17.2	24.1	5.7					
Gentamicin	Cattle		0-63.2							66.7	33.3								
	Pigs		0-4.7						8.1	58.1	33.9								
	Broilers		0-22.1						16.7	75.0	8.3								
	Layers		0-25.9						30.0	70.0									
	Total		0-3.4						11.5	62.1	26.4								
Erythromycin	Cattle		0-63.2								100.0								
	Pigs	59.7	46.5-71.9						6.5	16.1	12.9	4.8					3.2	56.5	
	Broilers	16.7	2.1-48.4				16.7	33.3	25.0	8.3								16.7	
	Layers		0-25.9					10.0	10.0	60.0	10.0	10.0							
	Total	44.8	34.1-55.9				2.3	5.7	9.2	19.5	13.8	4.6					2.3	42.5	
Tetracycline	Cattle	33.3	0.8-90.6				33.3	33.3									33.3		
	Pigs	79.0	66.8-88.3				1.6	4.8	8.1				6.5	9.7	6.5	17.7	37.1	8.1	
	Broilers	58.3	27.7-84.8				16.7	16.7					8.3		33.3	8.3	16.7		
	Layers	50.0	18.7-81.3				50.0								10.0	20.0	20.0		
	Total	71.3	60.6-80.5				10.3	6.9	5.7				5.7	6.9	10.3	16.1	32.2	5.7	
Chloramphenicol	Cattle		0-63.2								33.3	66.7							
	Pigs	21.0	11.7-33.2							24.2	33.9	19.4	1.6	1.6	16.1	3.2			
	Broilers	16.7	2.1-48.4							33.3	50.0					16.7			
	Layers		0-25.9							30.0	50.0	20.0							
	Total	17.2	10.0-26.8							25.3	37.9	18.4	1.1	1.1	11.5	4.6			
Nalidixic acid	Cattle	33.3	0.8-90.6										66.7					33.3	
	Pigs	43.5	31.0-56.7									29.0	24.2	3.2		16.1	24.2	3.2	
	Broilers	33.3	9.9-65.1								8.3	41.7	16.7			33.3			
	Layers	10.0	0.3-44.5									70.0	20.0			10.0			
	Total	37.9	27.7-49.0								1.1	34.5	24.1	2.3		17.2	17.2	3.4	
Ciprofloxacin	Cattle	33.3	0.8-90.6					66.7						33.3					
	Pigs	43.5	31.0-56.7			4.8	29.0	14.5	6.5	1.6		1.6	16.1	17.7	8.1				
	Broilers	33.3	9.9-65.1				50.0	8.3	8.3				25.0	8.3					
	Layers	10.0	0.3-44.5					30.0	60.0			10.0							
	Total	37.9	27.7-49.0			3.4	27.6	17.2	12.6	1.1		2.3	14.9	14.9	5.7				

Table6.4. Distribution of MICs and resistance(%) in *Campylobacter coli* from cattle(n=9), pigs(n=45), broilers(n=17) and layers(n=17) in 2011

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs															
				0.015	0.03	0.06	0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	512
Ampicillin	Cattle	11.1	0.3-48.3							11.1	11.1	22.2	44.4					11.1	
	Pigs	2.2	0.1-11.8						4.4	26.7	20.0	26.7	13.3	6.7	2.2				
	Broilers		0-16.2							5.9	5.9	17.6	35.3	35.3					
	Layers	11.8	1.5-36.4								17.6	23.5	23.5	23.5			11.8		
	Total	4.5	1.3-11.2						2.3	15.9	15.9	23.9	22.7	14.8	1.1		2.3	1.1	
Gentamicin	Cattle		0-28.3						22.2	77.8									
	Pigs		0-6.4						22.2	48.9	22.2	6.7							
	Broilers		0-16.2						35.3	47.1	17.6								
	Layers		0-16.2						41.2	52.9	5.9								
	Total		0-3.3						28.4	52.3	15.9	3.4							
Streptomycin	Cattle	77.8	40.0-97.2							44.4	33.3							22.2	
	Pigs	55.6	40.0-70.4						2.2	11.1	8.9	13.3	8.9		4.4	6.7	4.4	40.0	
	Broilers		0-16.2						17.6	23.5	41.2	11.8	5.9						
	Layers	5.9	0.1-28.7						17.6	47.1	23.5	5.9						5.9	
	Total	31.8	22.3-42.7						8.0	23.9	20.5	10.2	5.7		2.3	3.4	2.3	23.9	
Erythromycin	Cattle	22.2	2.8-60.0							11.1	33.3	33.3						22.2	
	Pigs	44.4	29.6-60.0					4.4	4.4	24.4	11.1	11.1					11.1	33.3	
	Broilers	11.8	1.5-36.4						29.4	23.5	17.6	17.6				5.9		5.9	
	Layers	5.9	0.1-28.7				11.8	5.9	17.6	58.8								5.9	
	Total	28.4	19.3-39.0				2.3	3.4	11.4	29.5	12.5	12.5				1.1	5.7	21.6	
Tetracycline	Cattle	44.4	13.7-78.8				44.4	11.1							11.1	11.1		22.2	
	Pigs	73.3	58.1-85.4				2.2		11.1			2.2	11.1	13.3	17.8	11.1	20.0	11.1	
	Broilers	35.3	14.2-61.7				23.5	23.5	17.6						5.9	5.9	17.6	5.9	
	Layers	58.8	32.9-81.6				23.5	17.6						11.8	5.9	17.6		23.5	
	Total	60.2	49.2-70.5				14.8	9.1	9.1			1.1	5.7	9.1	12.5	11.4	13.6	13.6	
Chloramphenicol	Cattle	22.2	2.8-60.0							11.1	33.3	33.3			22.2				
	Pigs	17.8	8.0-32.1						8.9	22.2	28.9	22.2		2.2	8.9	6.7			
	Broilers		0-16.2						17.6	11.8	52.9	5.9	11.8						
	Layers		0-16.2						5.9	29.4	47.1	11.8	5.9						
	Total	11.4	5.6-19.9						9.1	20.5	37.5	18.2	3.4	1.1	6.8	3.4			
Nalidixic acid	Cattle	55.6	21.2-8.63									22.2	22.2		11.1	44.4			
	Pigs	73.3	58.1-85.4								4.4	15.6	6.7		15.6	17.8	24.4	15.6	
	Broilers	29.4	10.3-56.0								11.8	23.5	35.3		11.8	11.8		5.9	
	Layers	35.3	14.2-61.7								17.6	23.5	23.5		11.8	17.6		5.9	
	Total	55.7	44.7-66.3								8.0	19.3	17.0		13.6	19.3	12.5	10.2	
Ciprofloxacin	Cattle	55.6	21.2-8.63				22.2	22.2					11.1	22.2	22.2				
	Pigs	71.1	55.7-83.6			6.7	13.3	8.9					22.2	31.1	15.6	2.2			
	Broilers	29.4	10.3-56.0				29.4	5.9	11.8	23.5			11.8	5.9	11.8				
	Layers	23.5	6.8-49.9				17.6	35.3	23.5			5.9	11.8	5.9					
	Total	52.3	41.4-63.0			3.4	18.2	14.8	6.8	4.5		1.1	17.0	20.5	12.5	1.1			

Table7.1. Distribution of MICs and resistance(%) in *Salmonella* from cattle(n=73), pigs(n=92) and chickens(n=57) in 2008

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs																
				0.015	0.031	0.063	0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	43.8	32.2-55.9						1.4	50.7	4.1								1.4	42.5
	Pigs	47.8	37.3-58.5					1.1	3.3	33.7	5.4	8.7							8.7	39.1
	Chickens	8.8	2.9-19.3						1.8	71.9	17.5				1.8				1.8	5.3
	Total	36.5	30.1-43.2					0.5	2.3	49.1	8.1	3.6			0.5				4.5	31.5
Cefazolin	Cattle	1.4	0-7.4							56.2	4.1	23.3	15.1							1.4
	Pigs		0-3.2							46.7	22.8	15.2	6.5	8.7						
	Chickens	5.3	1.1-14.6							64.9	26.3	1.8	1.8							5.3
	Total	1.8	0.5-4.5							54.5	17.6	14.4	8.1	3.6						1.8
Gentamicin	Cattle		0-4.0						42.5	57.5										
	Pigs	15.2	8.6-24.2					2.2	53.3	28.3	1.1			5.4	7.6	2.2				
	Chickens		0-5.1					1.8	71.9	26.3										
	Total	6.3	3.5-10.4					1.4	54.5	37.4	0.5			2.3	3.2	0.9				
Kanamycin	Cattle	17.8	9.8-28.5								31.5	50.7					4.1		2.7	11.0
	Pigs	20.7	12.9-30.4								40.2	35.9	3.3				1.1		5.4	14.1
	Chickens	19.3	10.0-31.9							3.5	42.1	33.3	1.8						1.8	17.5
	Total	19.4	14.4-25.2							0.9	37.8	40.1	1.8				1.8		3.6	14.0
Dihydrostreptomycin	Cattle	69.9	58.0-80.1									1.4		28.8	21.9	6.8	1.4	12.3	17.8	9.6
	Pigs	93.5	86.3-97.6											6.5	10.9	8.7	0.0	3.3	23.9	46.7
	Chickens	59.6	45.8-72.4									1.8	5.3	33.3	12.3	3.5	33.3	7.0		3.5
	Total	77.0	70.9-82.3									0.9	1.4	20.7	14.9	6.8	9.0	7.2	15.8	23.4
Oxytetracycline	Cattle	42.5	31.0-54.6							20.5	37.0					1.4	12.3	26.0	2.7	
	Pigs	81.5	72.1-88.9							13.0	5.4						7.6	45.7	28.3	
	Chickens	50.9	37.3-64.4							24.6	24.6						7.0	38.6	5.3	
	Total	60.8	54.1-67.3							18.5	20.7					0.5	9.0	37.4	14.0	
Chloramphenicol	Cattle	21.9	13.1-33.1									16.4	61.6						21.9	
	Pigs	26.1	17.5-36.3							1.1		26.1	31.5	15.2			2.2	6.5	17.4	
	Chickens	1.8	0-9.4									21.1	71.9	5.3					1.8	
	Total	18.5	13.6-24.2							0.5		21.6	51.8	7.7			0.9	2.7	14.9	
Colistin	Cattle		0-4.0							53.4	45.2		1.4							
	Pigs		0-3.2						1.1	72.8	20.7		5.4							
	Chickens		0-5.1							52.6	40.4	5.3	1.8							
	Total		0-1.3						0.5	61.3	33.8	1.4	3.2							
Nalidixic acid	Cattle		0-4.0							1.4	13.7	82.2		2.7						
	Pigs	20.7	12.9-30.4						1.1		4.3	53.3	18.5	2.2					2.2	18.5
	Chickens	10.5	3.96-21.5							1.8	17.5	68.4	1.8					3.5	5.3	1.8
	Total	11.3	7.4-16.2						0.5	0.9	10.8	66.7	8.1	1.8				0.9	2.3	8.1

Table7.1. Distribution of MICs and resistance(%) in *Salmonella* from cattle(n=73), pigs(n=92) and chickens(n=57) in 2008

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs																
				0.015	0.031	0.063	0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Enrofloxacin	Cattle		0-4.0		39.7	57.5	2.7													
	Pigs		0-3.2		15.2	45.7	16.3	9.8	7.6	5.4										
	Chickens		0-5.1		61.4	29.8		7.0		1.8										
	Total		0-1.3		35.1	45.5	7.7	5.9	3.2	2.7										
Trimethoprim	Cattle	4.1	0.9-11.5				5.5	45.2	39.7	5.5										4.1
	Pigs	32.6	23.2-43.2				23.9	28.3	7.6	7.6								0.0	1.1	31.5
	Chickens	15.8	7.5-27.9				1.8	68.4	14.0									5.3	1.8	8.8
	Total	18.9	14.0-24.7				12.2	44.1	19.8	5.0								1.4	0.9	16.7
Bicozamycin	Cattle	2.7	0.3-9.5											28.8	68.5					2.7
	Pigs	2.2	0.3-7.6											76.1	20.7	1.1				2.2
	Chickens	12.3	5.1-23.7											54.4	31.6	1.8				12.3
	Total	5.0	2.5-8.7											55.0	39.2	0.9				5.0

Table7.2. Distribution of MICs and resistance(%) in *Salmonella* from cattle(n=84), pigs(n=22) and chickens(n=36) in 2009

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	512	512<
Ampicillin	Cattle	26.2	17.2-36.9	.				70.2	2.4	1.2								26.2
	Pigs	40.9	20.7-63.6					36.4	18.2	4.5							9.1	31.8
	Chickens	5.6	0.7-18.7					91.7	2.8					2.8				2.8
	Total	23.2	16.6-31.1					70.4	4.9	1.4				0.7			1.4	21.1
Cefazolin	Cattle		0-3.5					66.7	7.1	23.8	2.4							
	Pigs		0-12.7					45.5	36.4	18.2								
	Chickens	2.8	0.1-14.5					80.6	13.9	2.8							2.8	
	Total	0.7	0-3.9					66.9	13.4	17.6	1.4						0.7	
Gentamicin	Cattle		0-3.5					42.9	57.1									
	Pigs	18.2	5.2-40.3					59.1	22.7				13.6	4.5				
	Chickens		0-8.0				5.6	27.8	66.7									
	Total	2.8	0.8-7.1				1.4	41.5	54.2				2.1	0.7				
Kanamycin	Cattle	21.4	13.2-31.7						6.0	66.7	6.0							21.4
	Pigs	27.3	10.7-50.2						13.6	59.1							9.1	18.2
	Chickens	27.8	14.2-45.2					2.8	19.4	47.2	2.8							27.8
	Total	23.9	17.2-31.8					0.7	10.6	60.6	4.2						1.4	22.5
Dihydrostreptomycin	Cattle	91.7	83.6-96.6							1.2	2.4	4.8	51.2	8.3	1.2	2.4	10.7	17.9
	Pigs	100.0	87.3-100										27.3		9.1		9.1	54.5
	Chickens	77.8	60.8-89.9							5.6	16.7		44.4	11.1	16.7	5.6		
	Total	89.4	83.2-94.0							2.1	5.6	2.8	45.8	7.7	6.3	2.8	7.7	19.0
Oxytetracycline	Cattle	33.3	23.4-44.5					17.9	48.8						3.6	21.4	8.3	
	Pigs	72.7	49.8-89.3				4.5	13.6	9.1						4.5	50.0	18.2	
	Chickens	25.0	12.1-42.2					55.6	19.4						16.7	8.3	0.0	
	Total	37.3	29.4-45.8				0.7	26.8	35.2						7.0	22.5	7.7	
Chloramphenicol	Cattle	2.4	0.3-8.3							13.1	84.5						2.4	
	Pigs	27.3	10.7-50.2						4.5	18.2	45.5	4.5			4.5	13.6	9.1	
	Chickens		0-8.0					2.8	11.1	25.0	58.3	2.8						
	Total	5.6	2.5-10.8					0.7	3.5	16.9	71.8	1.4			0.7	2.1	2.8	
Colistin	Cattle		0-3.5					22.6	73.8	1.2	2.4							
	Pigs		0-12.7					63.6	36.4									
	Chickens	2.8	0.1-14.5					13.9	58.3	19.4	5.6	2.8						
	Total	0.7	0-3.9					26.8	64.1	5.6	2.8	0.7						
Nalidixic acid	Cattle	1.2	0-6.5						11.9	85.7	1.2						1.2	
	Pigs	13.6	2.9-34.9						27.3	54.5	4.5						4.5	9.1
	Chickens	2.8	0.1-14.5						36.1	50.0		11.1				2.8		
	Total	3.5	1.1-8.0						20.4	71.8	1.4	2.8				0.7	1.4	1.4
Enrofloxacin	Cattle		0-3.5		98.8		1.2											
	Pigs		0-12.7		86.4		9.1	4.5										
	Chickens		0-8.0		86.1		5.6	8.3										
	Total		0-3.9		93.7		3.5	2.8										
Trimethoprim	Cattle		0-3.5			3.6	35.7	47.6	13.1									
	Pigs	27.3	10.7-50.2		4.5	9.1	40.9	18.2	0.0									27.3
	Chickens	22.2	10.1-39.2			2.8	52.8	19.4	2.8			2.8		2.8		2.8	2.8	11.1
	Total	9.9	5.5-16.0		0.7	4.2	40.8	35.9	8.5			0.7		0.7		0.7	0.7	7.0

Table7.2. Distribution of MICs and resistance(%) in *Salmonella* from cattle(n=84), pigs(n=22) and chickens(n=36) in 2009

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.06	0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	512	512<
Bicozamycin	Cattle	6.0	2.0-13.3									17.9	76.2		1.2			4.8
	Pigs		0-12.7									59.1	40.9					
	Chickens	13.9	4.7-29.5									22.2	63.9					13.9
	Total	7.0	3.4-12.6									25.4	67.6		0.7			6.3

Table7.3. Distribution of MICs and resistance(%) in *Salmonella* from cattle(n=94), pigs(n=59) and chickens(n=33) in 2010

Antimicrobial agent	Animal species	%Resistant	95% Confidence	Distribution(%) of MICs														
				0.02	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	>128
Ampicillin	Cattle	54.3	43.7-64.6							23.4	20.2	2.1						54.3
	Pigs	37.3	25.0-50.9							39.0	20.3	3.4						37.3
	Chickens	3.0	0.1-15.8							57.6	39.4						3.0	
	Total	39.6	32.5-47.0							34.8	23.5	2.1					0.5	39.0
Cefazolin	Cattle	1.1	0-5.8							27.7	21.3	33.0	14.9	2.1	1.1			
	Pigs	1.7	0-9.1							47.5	32.2	8.5	5.1	5.1			1.7	
	Chickens	3.0	0.1-15.8							57.6	39.4							3.0
	Total	1.6	0.3-4.6							39.6	27.8	19.3	9.1	2.7	0.5		0.5	0.5
Cefotaxime	Cattle		0-3.1						98.9	1.1								
	Pigs	1.7	0-9.1						98.3								1.7	
	Chickens	3.0	0.1-15.8						97.0				3.0					
	Total	1.1	0.1-3.8						98.4	0.5			0.5				0.5	
Gentamicin	Cattle		0-3.1						92.6	6.4	1.1							
	Pigs	20.3	10.1-32.8						71.2	8.5				1.7	13.6	5.1		
	Chickens		0-8.7						93.9	3.0	3.0							
	Total	6.4	3.4-10.9						86.1	6.4	1.1			0.5	4.3	1.6		
Kanamycin	Cattle	23.4	15.3-33.3							0.0	41.5	31.9	1.1		2.1		1.1	22.3
	Pigs	22.0	12.3-34.7							1.7	35.6	39.0	1.7					22.0
	Chickens	6.1	0.7-20.2							12.1	42.4	39.4						6.1
	Total	19.8	14.3-26.2							3.2	39.6	35.3	1.1		1.1		0.5	19.3
Tetracycline	Cattle	53.2	42.6-63.6							7.4	38.3	1.1			8.5	24.5	20.2	
	Pigs	71.2	57.9-82.2							3.4	25.4				3.4	22.0	45.8	
	Chickens	12.1	3.4-28.2							24.2	60.6	3.0			0.0	12.1		
	Total	51.3	43.9-58.7							9.6	38.0	1.1			5.3	21.4	24.6	
Chloramphenicol	Cattle	25.5	19.9-39.0									10.6	58.5	5.3	1.1			24.5
	Pigs	6.8	1.9-16.5									45.8	42.4	5.1				6.8
	Chickens		0-8.7								9.1	15.2	63.6	12.1				
	Total	15.0	10.2-21.0								2.1	22.5	54.0	6.4	0.5			14.4
Colistin	Cattle		0-3.1					26.6	60.6	6.4	4.3	2.1						
	Pigs		0-5.0					33.9	61.0	1.7	1.7	1.7						
	Chickens		0-8.7					12.1	42.4	15.2	15.2	15.2						
	Total		0-1.6				0.5	26.2	57.2	6.4	5.3	4.3						

Table7.3. Distribution of MICs and resistance(%) in *Salmonella* from cattle(n=94), pigs(n=59) and chickens(n=33) in 2010

Antimicrobial agent	Animal species	%Resistant	95% Confidence	Distribution(%) of MICs														
				0.02	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	>128
Nalidixic acid	Cattle	7.4	3.0-14.7									59.6	30.9	2.1	1.1			6.4
	Pigs	3.4	0.4-11.7									44.1	47.5	5.1				3.4
	Chickens	6.1	0.7-20.2								6.1	51.5	33.3	3.0				6.1
	Total	5.9	3.0-10.7								1.1	53.5	36.4	3.2	0.5			5.3
Ciprofloxacin	Cattle		0-3.1		86.2	5.3	4.3	3.2	1.1									
	Pigs		0-5.0		83.1	11.9	1.7		1.7	1.7								
	Chickens		0-8.7		72.7	21.2	3.0	3.0										
	Total		0-1.6		82.9	10.2	3.2	2.1	1.1	0.5								

Antimicrobial agent	Animal species	%Resistant	95% Confidence	Distribution(%) of MICs														
				0.03 /0.015	0.06 /0.03	1.19 /0.06	2.38 /0.12	4.75 /0.25	9.5 /0.5	19 /1	38 /2	76 /4	152 /8	304 /16	608 /32	1216 /64	2432 /128	>2432 /128
Trimethoprim -sulfamethoxazol	Cattle	4.3	1.2-10.5				45.7	45.7	4.3					4.3				
	Pigs	33.9	22.1-47.4				33.9	22.0	10.2					33.9				
	Chickens	3.0	0-15.8				66.7	27.3	3.0					3.0				
	Total	13.4	8.8-19.1				46.0	34.8	5.9					13.4				

Table7.4. Distribution of MICs and resistance(%) in *Salmonella* from cattle(n=50), pigs(n=63) and chickens(n=25) in 2011

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	>128
Ampicillin	Cattle	28.0	16.2-42.5							54.0	18.0							28.0
	Pigs	25.4	15.3-37.9							54.0	11.1	9.5						25.4
	Chickens	12.0	2.5-31.2							84.0	4.0							12.0
	Total	23.9	17.1-31.9							59.4	12.3	4.3						23.9
Cefazolin	Cattle	10.0	3.3-21.8							54.0	22.0	12.0	2.0					10.0
	Pigs		0-4.6							54.0	30.2	12.7	3.2					
	Chickens		0-11.3							76.0	20.0	4.0						
	Total	3.6	1.2-8.3							58.0	25.4	10.9	2.2					3.6
Cefotaxime	Cattle	10.0	3.3-21.8						90.0							10.0		
	Pigs		0-4.6						98.4	1.6								
	Chickens		0-11.3						100.0									
	Total	3.6	1.2-8.3						95.7	0.7						3.6		
Gentamicin	Cattle		0-5.8						92.0	8.0								
	Pigs	6.3	1.8-15.5						87.3	6.3				3.2	1.6		1.6	
	Chickens		0-11.3						100.0									
	Total	2.9	0.8-7.3						91.3	5.8				1.4	0.7		0.7	
Kanamycin	Cattle	12.0	4.5-24.3							6.0	40.0	36.0	6.0					12.0
	Pigs	9.5	3.6-19.6							6.3	46.0	33.3	3.2	1.6				9.5
	Chickens	24.0	9.4-45.1							8.0	48.0	16.0	4.0					24.0
	Total	13.0	7.9-19.8							6.5	44.2	31.2	4.3	0.7				13.0
Tetracycline	Cattle	30.0	17.9-44.6							26.0	44.0				2.0	2.0	26.0	
	Pigs	61.9	48.8-73.9							14.3	15.9	6.3	1.6		3.2	6.3	52.4	
	Chickens	36.0	18.0-57.5							40.0	24.0				4.0	28.0	4.0	
	Total	45.7	37.2-54.3							23.2	27.5	2.9	0.7		2.9	8.7	34.1	
Chloramphenicol	Cattle	14.0	5.8-26.7									22.0	64.0					14.0
	Pigs	12.7	5.6-23.5								7.9	50.8	23.8	4.8			6.3	6.3
	Chickens		0-11.3							4.0	8.0	32.0	48.0	8.0				
	Total	10.9	6.2-17.3							0.7	5.1	37.0	42.8	3.6			2.9	8.0
Colistin	Cattle		0-5.8					16.0	62.0	16.0	4.0	2.0						
	Pigs		0-4.6					38.1	46.0	12.7	1.6	1.6						
	Chickens		0-11.3					16.0	44.0	16.0	16.0	8.0						
	Total		0-2.1					26.1	51.4	14.5	5.1	2.9						
Nalidixic acid	Cattle	2.0	0.1-10.6								16.0	72.0	10.0					2.0
	Pigs	15.9	7.9-27.3									66.7	15.9	1.6	1.6			14.3
	Chickens	8.0	1.0-26.0								4.0	72.0	16.0					8.0
	Total	9.4	5.1-15.6								6.5	69.6	13.8	0.7	0.7			8.7

Table7.4. Distribution of MICs and resistance(%) in *Salmonella* from cattle(n=50), pigs(n=63) and chickens(n=25) in 2011

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	>128
Ciprofloxacin	Cattle		0-5.8		96.0	2.0				2.0								
	Pigs		0-4.6		68.3	14.3	1.6	12.7	1.6	1.6								
	Chickens		0-11.3		88.0	4.0		8.0										
	Total		0-2.1		81.9	8.0	0.7	7.2	0.7	1.4								

Antimicrobial agent	Animal species	%Resistant	95% Confidence interval	Distribution(%) of MICs														
				0.03 /0.015	0.06 /0.03	1.19 /0.06	2.38 /0.12	4.75 /0.25	9.5 /0.5	19 /1	38 /2	76 /4	152 /8	304 /16	608 /32	1216 /64	2432 /128	>2432 /128
Trimethoprim -sulfamethoxazole	Cattle	2.0	0.1-10.6				72.0	18.0	6.0		2.0			2.0				
	Pigs	25.4	15.3-37.9				57.1	9.5	4.8		3.2			25.4				
	Chickens	20.0	6.8-40.7				52.0	24.0	4.0					20.0				
	Total	15.9	10.3-23.1				61.6	15.2	5.1		2.2			15.9				

Table8.1 *Salmonella* serovars isolated from food-producing animals between 2008 and 2011

Serovar	Cattle					Pigs					Chickens					Total
	2008	2009	2010	2011	subtotal	2008	2009	2010	2011	subtotal	2008	2009	2010	2011	subtotal	
Typhimurium	32	35	54	13	134	44	7	19	38	108	1		1		2	244
Choleraesuis					0	36	5	28	14	83				2	2	85
Infantis	1	1	3	1	6	1	1	2	3	7	13	9	8	5	35	48
Enteritidis		2	9		11					0	2	3	6	2	13	24
Agona		5	2		7		1			1	13	2			15	23
Barenderup	3	2	1	1	7					0	6	5	1	1	13	20
Thompson	2	5	3		10	1				1	2	2	1	1	6	17
Derby		1			1	3	4	4	3	14					0	15
Schwarzengrund					0					0	4	4	1	5	14	14
Bareilly				4	4					0	4	1	4		9	13
Rissen				13	13					0					0	13
Newport	3	1	3	5	12					0					0	12
Mbandaka		3	1	2	6					0	2		1	1	4	10
Nagoya		2	1	3	6					0	1	3			4	10
Stanley	3	1	3	1	8					0					0	8
London		1			1	3	1	1		5					0	6
Montevideo	2	2	2	1	7					0					0	7
Narashino	6				6					0					0	6
Othmarschen					0					0	1	1	2	2	6	6
Saintpaul	3	1			4					0					0	4

Table8.2 *Salmonella* serovars isolated from food-producing animals between 2008and 2011

Serovars	Cattle	Pig	Chicken	Total	Rate(%)
Typhimurium	134	108	2	244	35.5
Choleraesuis		83	2	85	12.4
Infantis	6	7	35	48	7.0
Enteritidis	11	0	13	24	3.5
Agona	7	1	15	23	3.3
Braenderup	7	0	13	20	2.9
Thompson	10	1	6	17	2.5
Derby	1	14	0	15	2.2
Schwarzengrund		0	14	14	2.0
Bareilly	4	0	9	13	1.9
Rissen	13	0	0	13	1.9
Newport	12	0	0	12	1.7
Mbandaka	6	0	4	10	1.5
Nagoya	6	0	4	10	1.5
Stanley	8	0	0	8	1.2
London	1	5	0	6	0.9
Montevideo	5	0	1	6	0.9
Narashino	6	0	0	6	0.9
Othmarschen		0	6	6	0.9
Saintpaul	4	0	0	4	0.6

Fig.7 Resistance(%) in *Escherichia coli* isolates from animals (2000-2011)

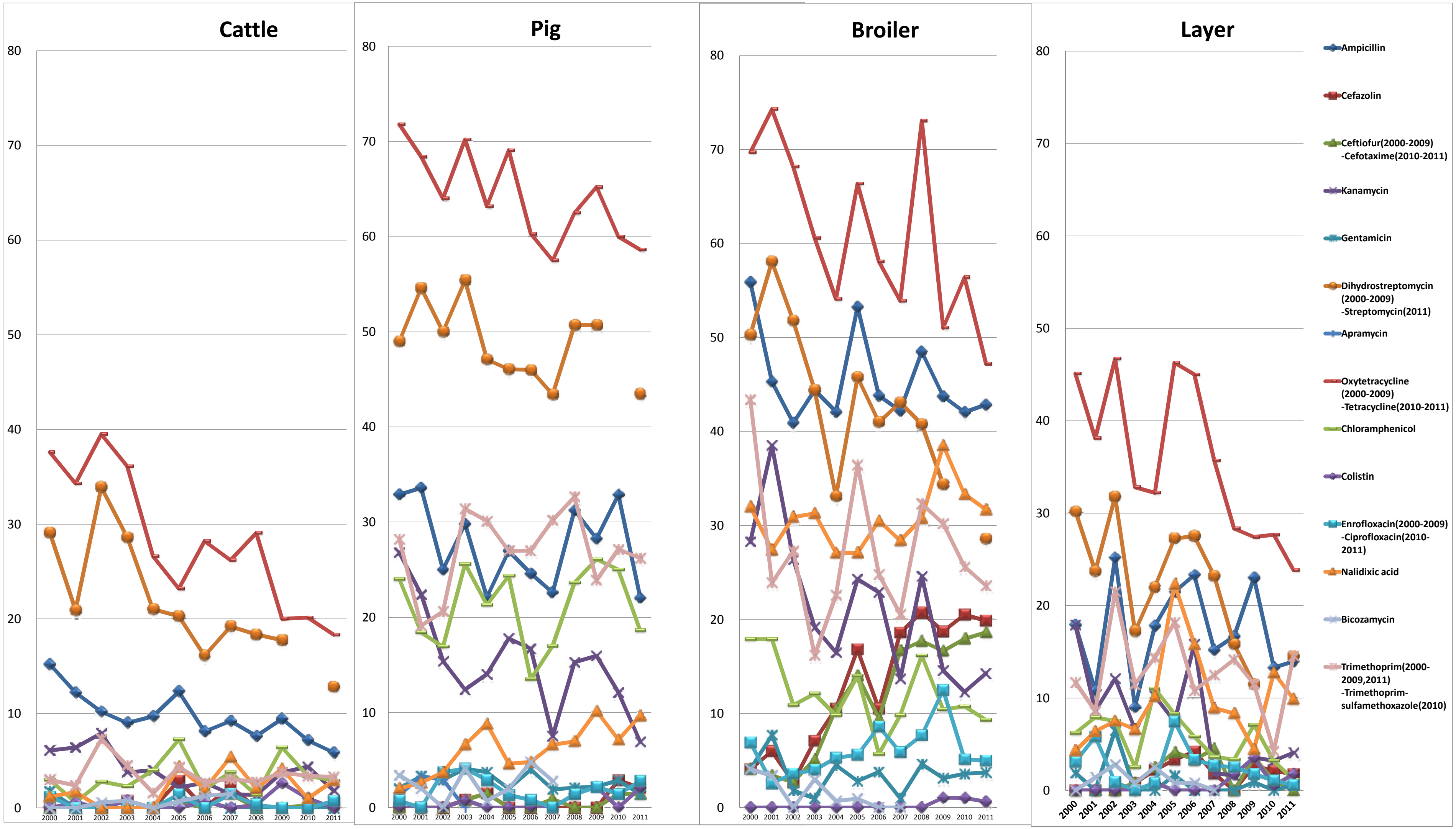


Fig8. Resistance(%) in *Enterococcus faecalis* isolates from animals (2000-2011)

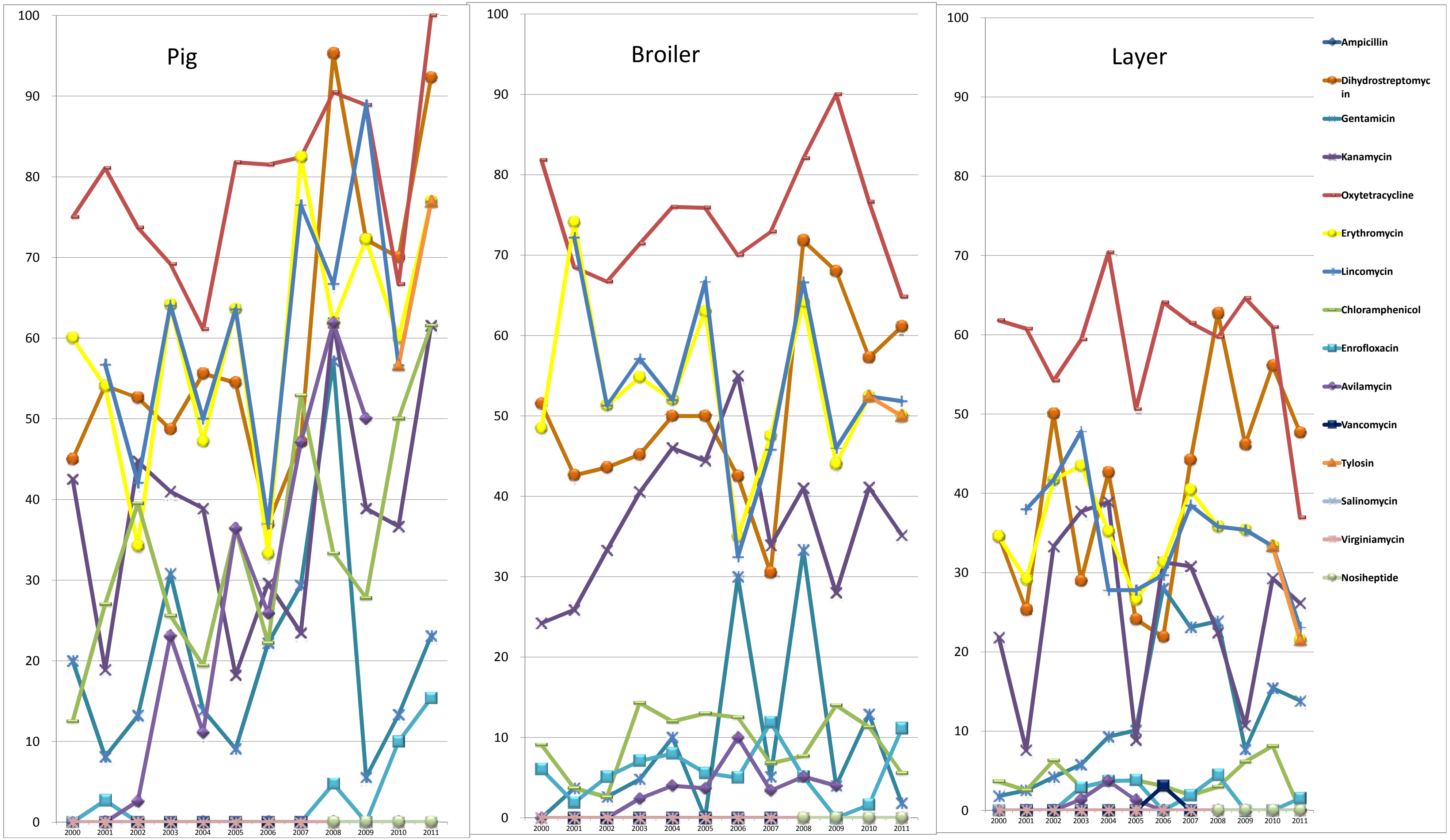


Fig9. Resistance(%) in *Enterococcus faecium* isolates from animals (2000-2011)

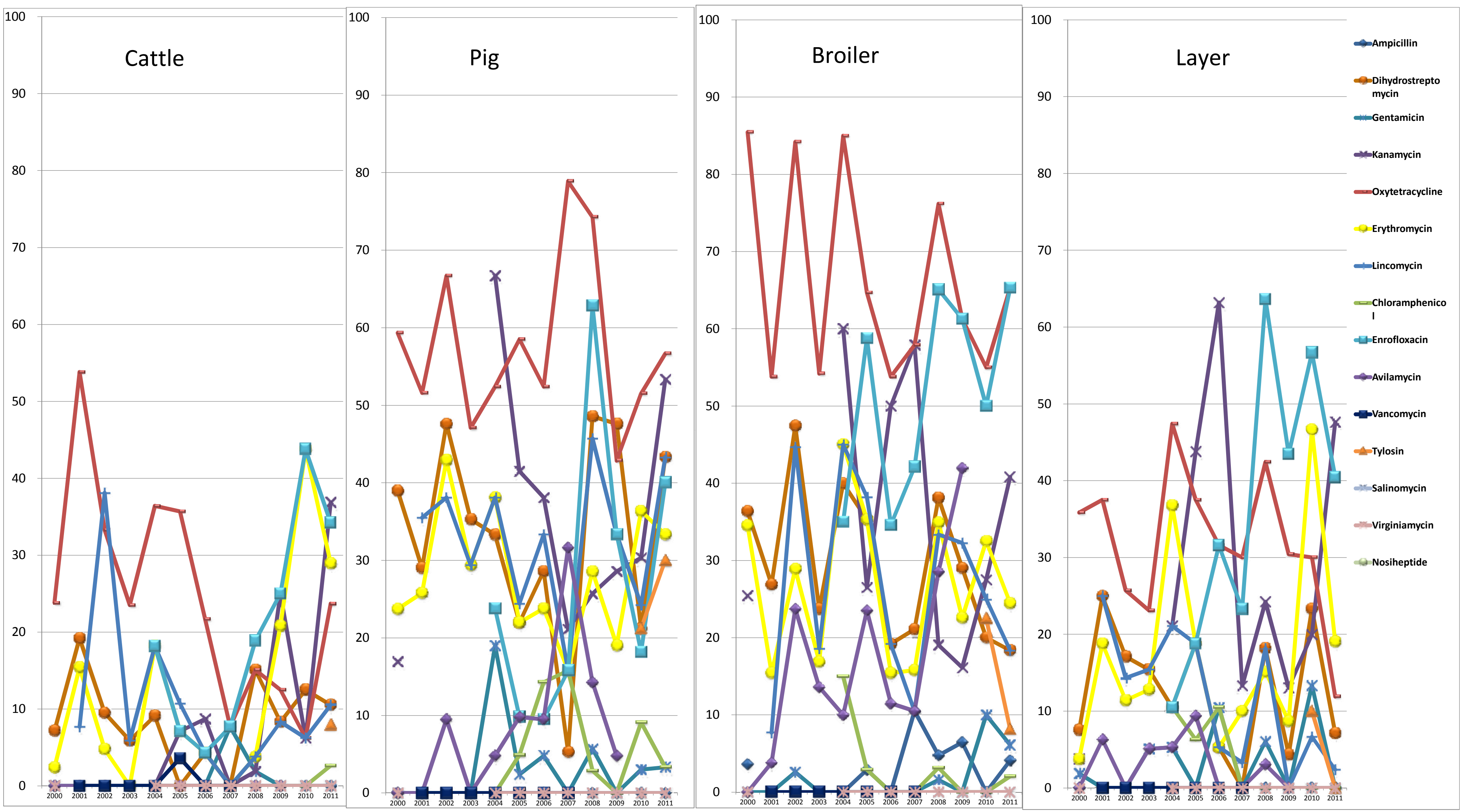
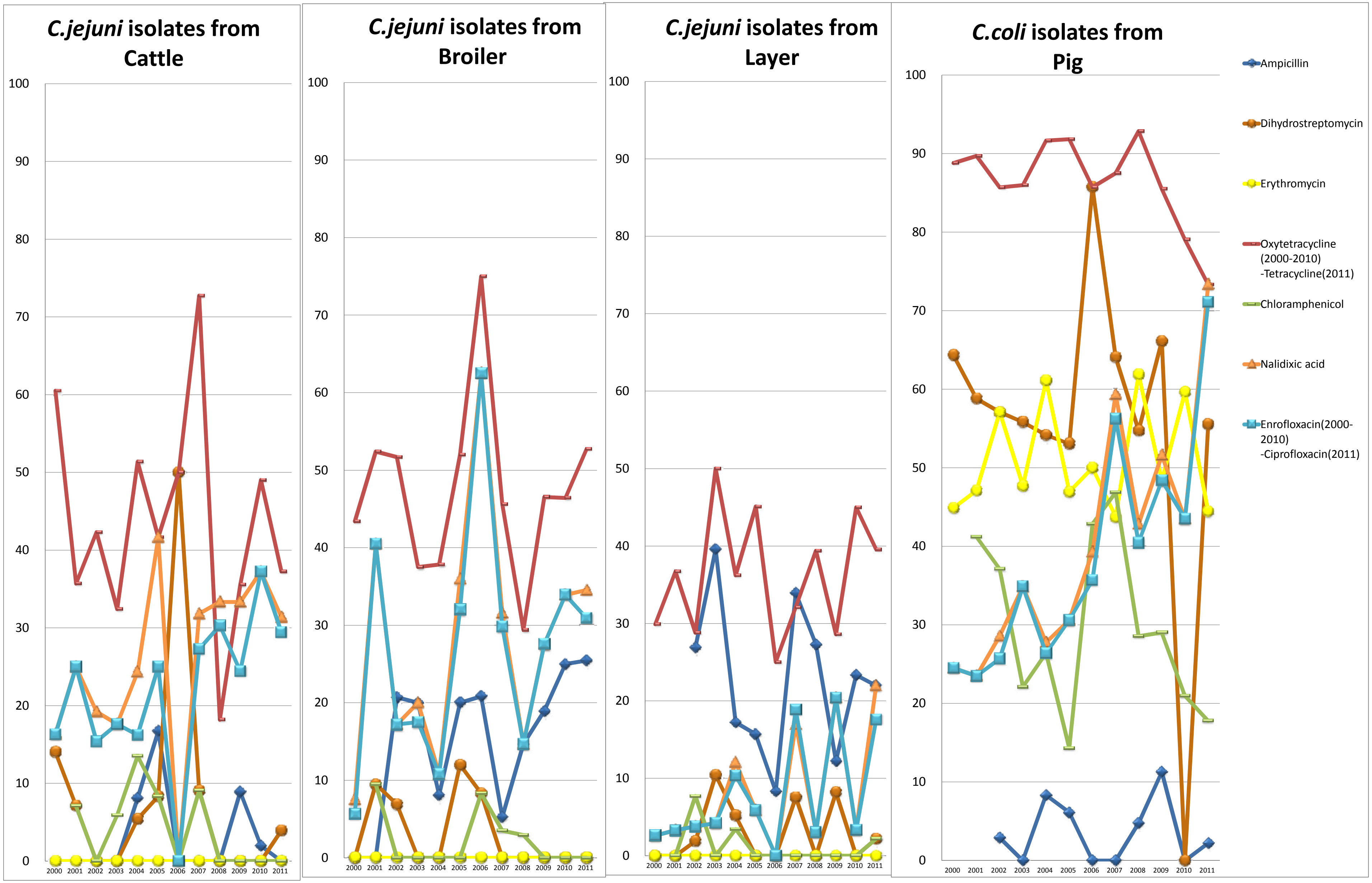
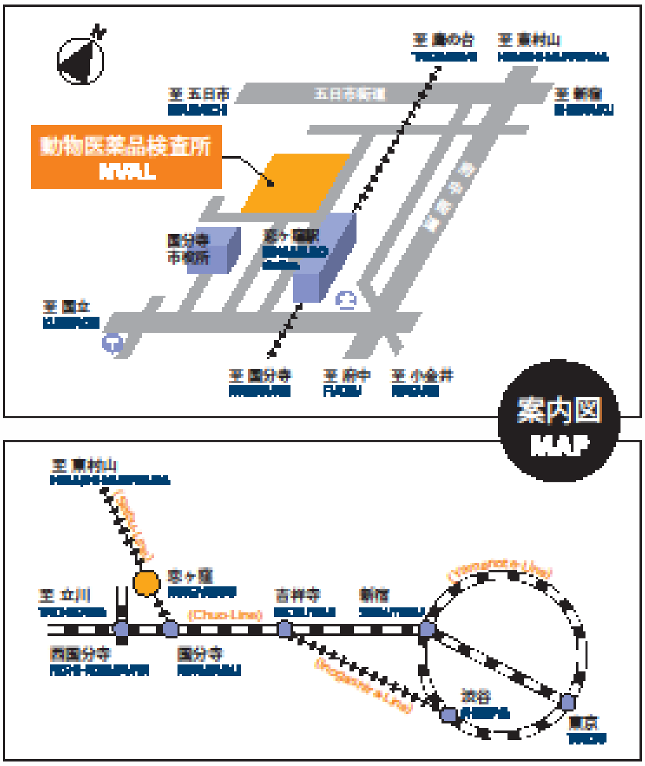


Fig.10 Resistance(%) in *Campylobacter jejuni* and *C. coli* isolates from animals (2000-2011)





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