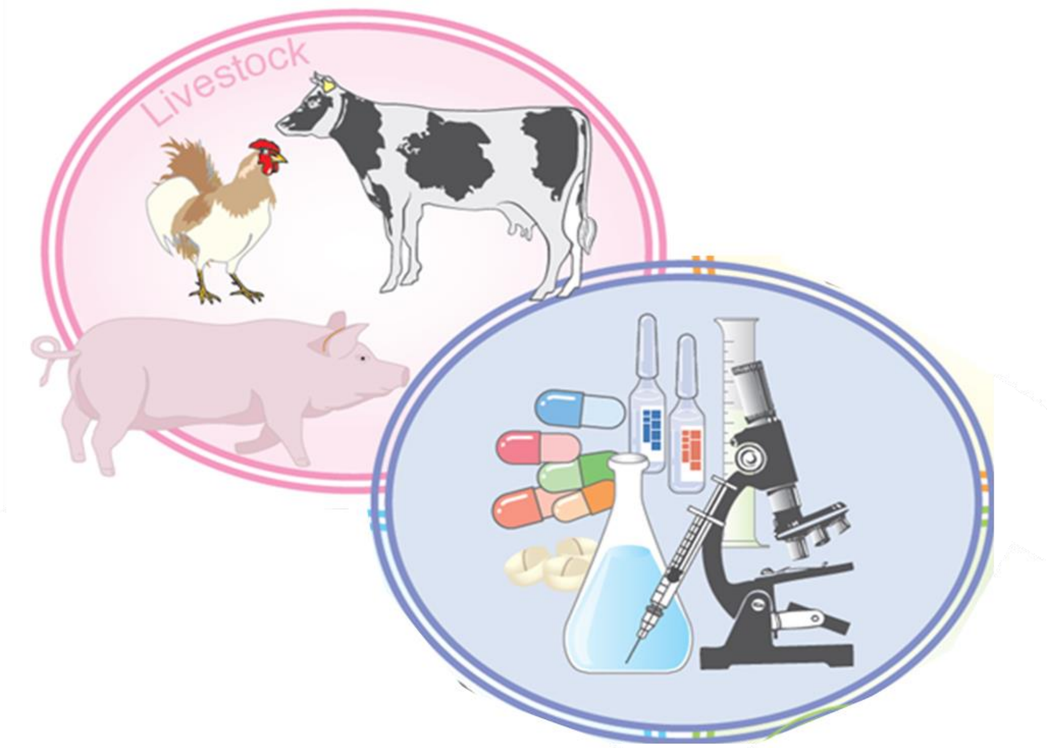
Report on the Japanese Veterinary Antimicrobial Resistance Monitoring System

-2012 to 2013-



National Veterinary Assay Laboratory

Ministry of Agriculture, Forestry and Fisheries

2016

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, which 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 in 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 international concern over 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 zoonotic bacteria and in indicator bacteria from healthy food-producing animals, and antimicrobial sales volume under the JVARM program from 2012 to 2013, are outlined in this report.

References

Swann, M.M. 1969. Report of the joint committee on the use of antibiotics in animal husbandry and veterinary medicine. HM Stationary Office. London.

Tamura, Y. 2003. The Japanese veterinary antimicrobial resistance monitoring system (JVARM) In: Bernard, V. editor. OIE International Standards on Antimicrobial Resistance. Paris, France: OIE (World organisation for animal health); 2003. pp 206-210.

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 sales 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) 1) monitoring the sales volume of antimicrobials used for animals, 2) monitoring resistance in zoonotic and indicator bacteria isolated from healthy animals, and 3) monitoring resistance in animal pathogens isolated from diseased animals. All bacteria were isolated from food-producing animals on farms until 2011. In order to enhance monitoring, samples were also collected in slaughterhouses starting in 2012.

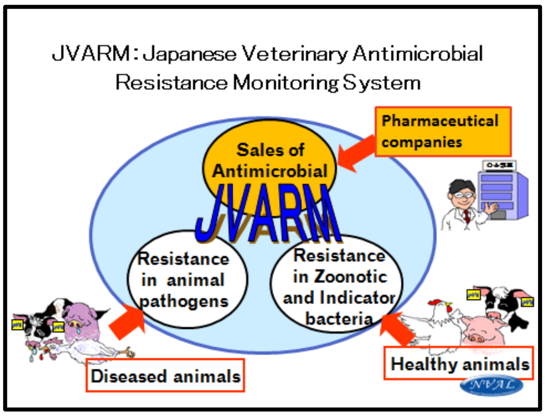


Fig.1 Outline of JVARM

(1) Monitoring of Antimicrobial Sales

The monitoring implementation system of antimicrobial sales volume 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 Act on Securing Quality, Efficacy, and Safety of Pharmaceuticals, Medical Devices, Regenerative and Cellular Therapy Products, Gene Therapy Products, and Cosmetics (Law No.145, Series of 1960)". NVAL subsequently collates, analyzes, and evaluates the data, and then posts this data in an annual report entitled "Amount of medicines and quasi-drugs for animal use" on the website (http://www.maff.go.jp/nval/iyakutou/hanbaidaka/index.html).

The annual weight in kilograms of the active ingredients in approved antimicrobials used for 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 sales volume for each target species, as one antimicrobial is frequently used for multiple animal species.

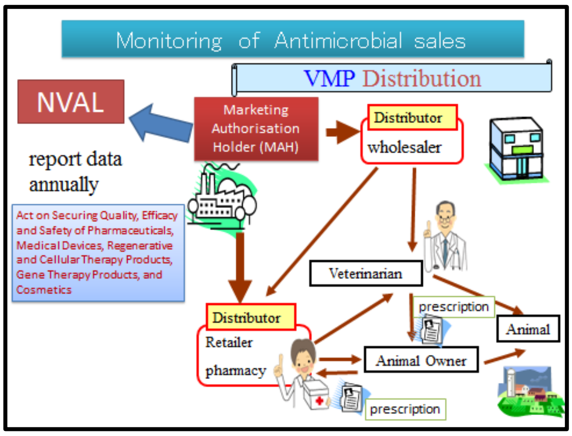


Fig. 2 Monitoring of Antimicrobial Sales

(2) Monitoring of Antimicrobial-Resistant Bacteria

Bacteria used in antimicrobial susceptibility testing were continuously collected and included zoonotic and indicator bacteria isolated from healthy animals and pathogenic bacteria isolated from diseased animals. Zoonotic bacteria include *Salmonella* species and *Campylobacter jejuni* or *Campylobacter coli*; indicator bacteria include *Escherichia coli* and *Enterococcus faecium* or *Enterococcus faecalis*. Animal pathogens, including certain species of *Staphylococcus* and *E. coli*, were collected over the duration of this report (data not shown). Minimum inhibitory concentrations (MICs) of antimicrobial agents for target bacteria were determined using the microdilution method as described by the Clinical and Laboratory Standards Institute (CLSI).

3. JVARM Implementation System

(1) Monitoring System in Farms

The JVARM implementation system in farms is shown in Figure 3. Livestock Hygiene Service Centers (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 analyzing all data, and reporting to MAFF headquarters. MIC measurement, data collation, and preservation of *E. faecium* and *E. faecalis* are conducted at the Food and Agricultural Materials Inspection Center (FAMIC).

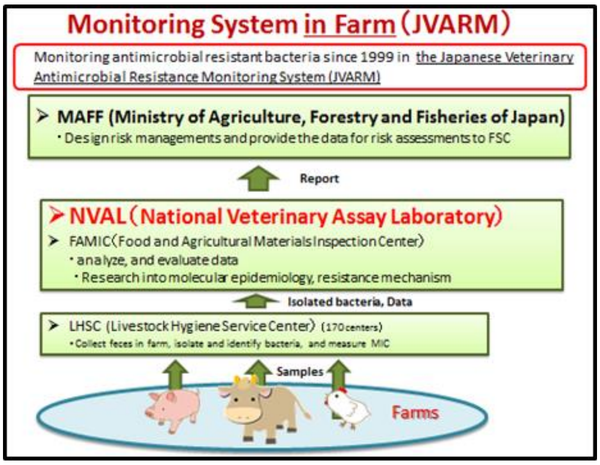


Fig. 3 Monitoring System in Farms

(2) Monitoring System in

Slaughterhouses

The JVARM implementation system in slaughterhouses is shown in Figure 4. MAFF contracts the isolation, identification, and MIC measurement of target bacteria to private research laboratories. These institutions send results and tested bacteria to NVAL, which is responsible for preserving the bacteria, collating and analyzing all data, and reporting to MAFF headquarters. Data collection and preservation of *E. faecium* and *E. faecalis* are conducted at the FAMIC.

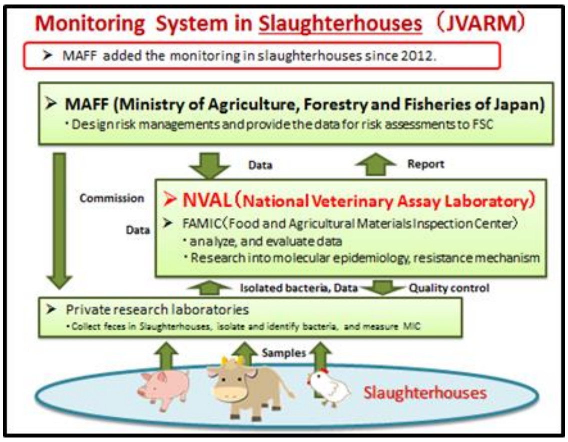


Fig. 4 Monitoring System in Slaughterhouses

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 testing procedures, the performance of the reagents used, 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, every year, NVAL holds a national training course for LHSC staff on antimicrobial resistance to provide training in standardized laboratory methods for the isolation, identification, and antimicrobial susceptibility testing of target bacteria. NVAL also conducts inspections of the private research laboratories.

5. Publication of Data

Because the issue of antimicrobial resistance 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 publicize such information, first through the MAFF weekly newspaper entitled “Animal Hygiene News”, followed by publication in scientific journals, and finally via the NVAL website (http://www.maff.go.jp/nval/yakuzai/yakuzai_p3.html). Furthermore, NVAL conducts research into the molecular epidemiology and resistance mechanisms of the bacteria and publishes in the scientific paper (http://www.maff.go.jp/nval/yakuzai/pdf/jvarm_publications_list_20150916.pdf).

References

Clinical and Laboratory Standards Institute. 2008. Performance standards for antimicrobial disk and dilution susceptibility tests for bacteria isolated from animals; Approved standard-Third edition. CLSI document M31-A3. Clinical and Laboratory Standards Institute, Wayne, PA.

Franklin, A., Acar, J., Anthony, F., Gupta, R., Nicholls, T., Tamura, Y., Thompson, S., Threlfall, E.J., Vose, D., van Vuuren, M., White, D.G., Wegener, H.C., Costarrica, M.L. 2001. Antimicrobial resistance: harmonization of national antimicrobial resistance monitoring and surveillance programs in animals and in animal-derived food. Rev. Sci. Tech./Off. Int. Epizoot. 20:859-870.

Office International des Epizooties. 1999. Proceedings of European Scientific Conference on the use of antibiotics in animals ensuring the protection of public health. Paris, France, 24-26 March 1999.

Tamura, Y. 2003. The Japanese veterinary antimicrobial resistance monitoring system (JVARM) In: Bernard, V. editor. OIE International Standards on Antimicrobial Resistance. Paris, France: OIE (World organisation for animal health); 2003. pp 206-210.

White, D.G., Acar, J., Anthony, F., Franklin, A., Gupta, R., Nicholls, T., Tamura, Y., Thompson, S., Threlfall, E.J., Vose, D., van Vuuren, M., Wegener, H.C., Costarrica, M.L. 2001. Antimicrobial resistance: standardization and harmonization of laboratory methodologies for the detection and quantification of antimicrobial resistance. Rev. Sci. Tech./Off. Int. Epizoot. 20:849-858.

World Health Organization Report. 1997. The medical impact of the use of antimicrobials in food animals. Report of a WHO meeting. Berlin, Germany, 13-17 October 1999.

World Health Organization Report. 1998. Use of quinolones in food animals and potential impact on human health. Report of a WHO meeting. Geneva, Switzerland, 2-5 June 1998.

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

The number of animals slaughtered for meat in slaughterhouses and poultry slaughtering plants between 2011 and 2013 is shown in Table 1.1 In the last decade, there has been no remarkable change in the number of meat animals produced (Figure 5). The scale of pig and poultry farms has increased each year (data not shown). However, the number of farmers in Japan has decreased because of the absence of successors.

Table 1.1 Number of animals slaughtered in slaughterhouses and poultry slaughtering plants (1,000 heads/birds).

	Cattle	Calf	Horse	Pig	Broiler	Fowl*
2013	1177.9	7.1	13.7	16940.4	653999	86227
2012	1190.6	8.9	12.3	16776.2	649629	90656
2011	1165.9	8.3	11.9	16395.2	617176	88879

*Most of these fowls are old layer chickens.

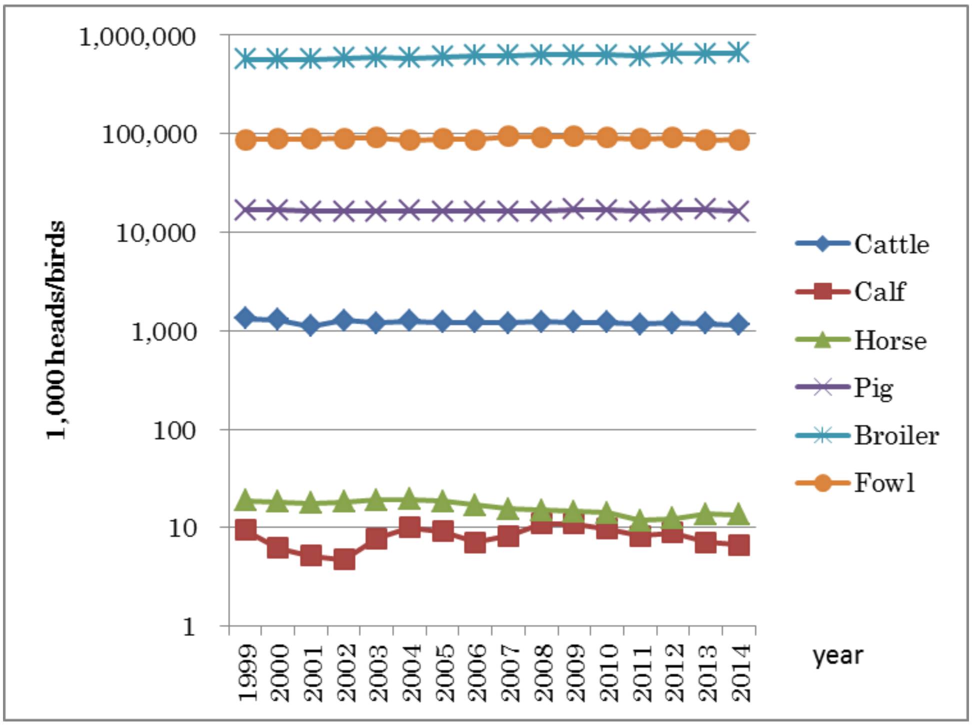


Fig. 5 Trends in the number of animals slaughtered in slaughterhouses and poultry slaughtering plants (1,000 heads/birds).

The total antimicrobial sales volume for animals decreased gradually between 2001 and 2013 (Figure 6). Antimicrobials were used most frequently in pigs, compared with cattle and poultry. Tetracycline accounted for 46% of total sales volume of veterinary antimicrobials, whereas fluoroquinolones and cephalosporins were used restrictively (less than 1% of total sales volume of veterinary antimicrobials) in 2013.

The use of antimicrobial feed additives commenced in the 1950s.

The current trends in the amount of feed additives manufactured (converted to bulk products) are shown in Figure 7. From 2007 to 2009, the total volume was fairly constant, averaging 171 tons. After 2009, the total volume increased, which was associated with an increase of ionophores. Ionophores composed a large percentage of feed additives (136 tons [68.2%]) in 2013, and ionophores are widely used in the EU and USA without prescription.

Other compounds, polypeptides, tetracyclines, and macrolides, composed 17.6%, 0.8%, and 2.8% of the total volume in 2013, respectively.

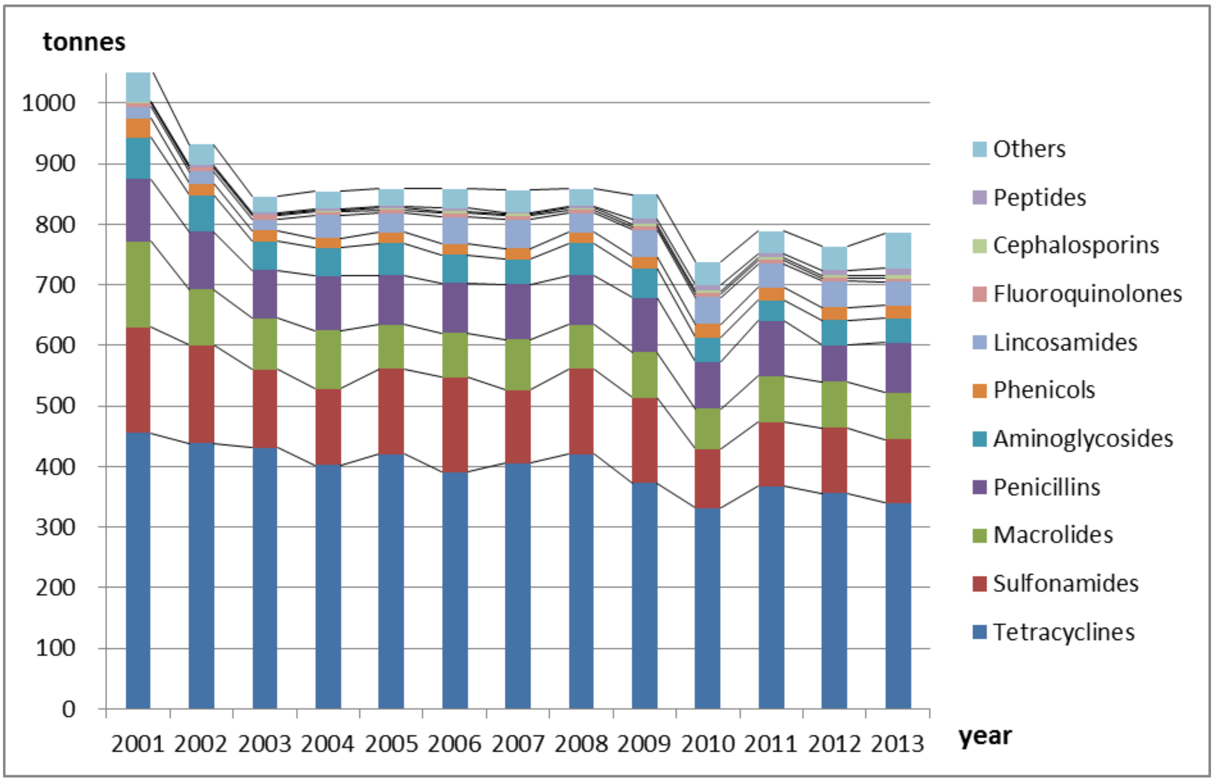


Fig. 6 Trends in veterinary antimicrobials sold from pharmacies in Japan (in tons of active compound).

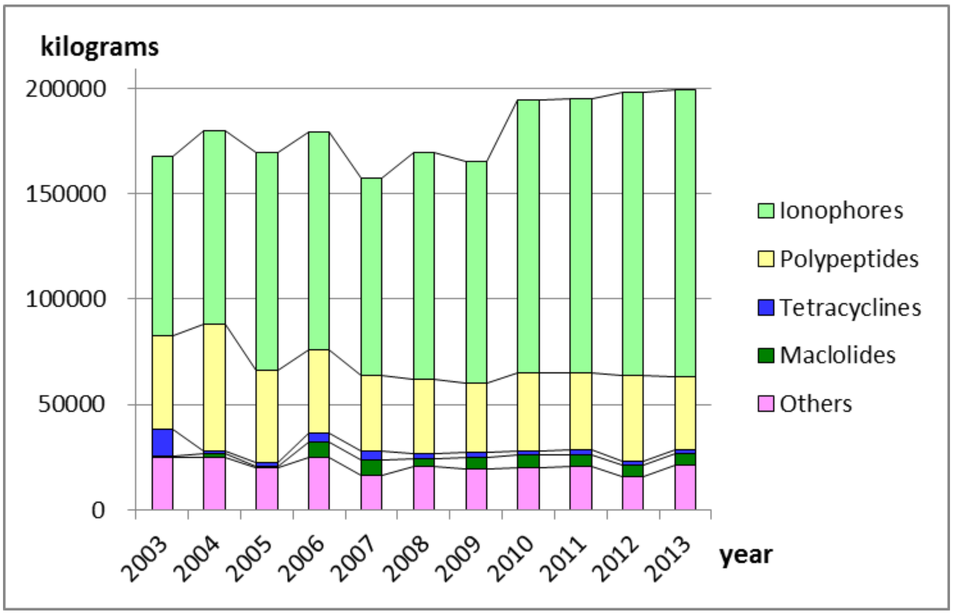


Fig. 7 Trends in the amount of manufactured antimicrobial feed additives in Japan (in kg of active compound).

III. Monitoring of Antimicrobial Resistance

1. Monitoring System in Farms

Table1.2 shows the total number of bacteria isolated from food producing animals on farms. All isolates were subjected to antimicrobial susceptibility testing.

(1) *Escherichia coli*

In total, 1,482 isolates of *E. coli* (539 from cattle, 275 from pigs, 337 from broiler chickens, and 331 from layer chickens) collected between 2012 and 2013 were available for antimicrobial susceptibility testing. The MIC distributions during 2012–2013 are shown in Tables 2.1 and 2.2

Antimicrobial resistance was found for all antimicrobials tested except for colistin resistance in *E. coli* isolated from cattle and pigs. Resistance was frequently found against tetracycline, streptomycin, 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 isolates was most common against streptomycin (resistance rate in pigs and broilers, 39.9–43.9% and 38.0–38.9% respectively), tetracycline (53.8–60.1% and 58.5–61.1%, respectively), ampicillin (28.7–30.3% and 44.9–47.3%, respectively), kanamycin (7.0–7.6% and 24.4–27.8%, respectively), chloramphenicol (22.0–26.6% and 16.6–22.1%, respectively), and trimethoprim (28.0–35.0% and 33.2–40.5%, respectively).

Incidence of nalidixic acid resistance was high in the *E. coli* isolates from broilers (30.2–35.1%), intermediate in those isolates from pigs (9.8%) and layers (9.6–16.4%), and low in those isolates from cattle (1.3–3.7%). Frequency of ciprofloxacin (0–7.8%), cefazolin (0–9.7%), and cefotaxime (0–8.7%) resistance in all animal species was low.

Resistance rates against most antimicrobials studied in the fifth stage were stable compared to the third and fourth stages (Table 1.3). However, the frequency of kanamycin, chloramphenicol, and trimethoprim-sulfamethoxazole resistance in *E. coli* from broilers, and ceftiofur-cefotaxime and chloramphenicol resistance in *E. coli* from layers in the fifth stage increased relative to those of the fourth stage ($p<0.05$). The frequency of ceftiofur–cefotaxime resistance in *E. coli* from cattle and nalidixic acid resistance from *E. coli* in layers in the fifth stage increased compared to those of the third stage ($p<0.05$). However, the resistance rate of cefotaxime in *E. coli* from cattle (0–2.0%) and layers (2.9–3.6%) was still very limited.

Conversely, the frequency of

kanamycin resistance in *E. coli* from pigs in the fifth stage decreased relative to those of the third stage (p<0.05). In addition, the frequency of cefazolin and ceftiofur or cefotaxime resistance in *E. coli* from broilers decreased compared to those of the third and fourth stages (p<0.05). (This observation was described in detail in section IV of JVARM Topics).

(2) *Enterococci*

A total of 366 *E. faecalis* and 321 *E. faecium* isolates collected between 2012 and 2013 were subjected to antimicrobial susceptibility testing. *Enterococcus faecium* was isolated from feces of all four food-producing animal species, whereas *E. faecalis* was isolated mainly from the feces of pigs, layers, and broilers. The MIC distributions during 2012–2013 are shown in Tables 3.1–3.2 and 4.1–4.2.

The extent of resistance rates to each antimicrobial varied with the bacterial species and animal species. Antimicrobial resistance was more frequently found in *E. faecalis* isolates than *E. faecium* isolates.

Resistance in pig and broiler isolates was frequently found against oxytetracycline (respective resistance rates in *E. faecalis and E. faecium* were 61.5–85.5% and 42.4–67.4%), dihydrostreptomycin (40.0–80.0% and 15.2–32.1%, respectively), kanamycin (27.3–50.9% and 30.3–73.9%, respectively), erythromycin (49.1–59.1% and 15.2–50.0%, respectively), and lincomycin (50.9–63.6% and 28.3–39.4%). The enrofloxacin resistance rate in *E. faecium* isolates (38.9–87.0%) was higher than in *E. faecalis* (0–5.5%).

Resistance rates against most antimicrobials studied in this the fifth were stable compared to those of the third and fourth stages. However, the frequency of kanamycin resistance in *E. faecium* from cattle, broilers, and layers in the fifth stage increased compared to those of the third stage (p<0.05) (Table 1.4).

By contrast, frequencies of dihydrostreptomycin, gentamicin, and oxytetracycline resistance in *E. faecalis* from pigs in the fifth stage decreased compared to those of the third stage (p<0.05). The frequency of fluoroquinolone resistance in *E. faecalis* from pigs decreased in the fifth stage compared to that of the fourth stage (p<0.05).

Frequencies of oxytetracycline and lincomycin resistance in *E. faecium* from layers decreased in the fifth stage compared to those of the third stage (p<0.05). The frequency of erythromycin resistance in *E. faecium* in cattle and layers decreased in the fifth stage compared to those of the fourth stage (p<0.05).

(3) *Campylobacter*

A total of 326 *C. jejuni* and 138

C. coli isolates collected between 2012 and 2013 were subjected to antimicrobial susceptibility testing. *C. jejuni* was isolated mainly from cattle, layer, and broiler feces, whereas *C. coli* was isolated mainly from pig feces. The MIC distributions from 2012 to 2013 are shown in Tables 5.1–5.2 and 6.1–6.2.

Antimicrobial resistance was found for all antimicrobials tested except gentamicin. However, the extent of resistance rates to each antimicrobial varied by bacterial species and animal species. *C. 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 antimicrobials, resistance was more frequently detected against tetracyclines (oxytetracycline, 2008–2009; tetracycline, 2010–2011) in *C. coli* (62.3–75.0%) and *C. jejuni* (36.4–45.7%). Resistance in *C. jejuni* and *C. coli* isolates was also found against ampicillin (resistance rate in *C. jejuni* and *C. coli*, 15.3–17.3% and 4.9–6.5%, respectively), streptomycin (1.7–1.9% and 39.3–51.9%, respectively), erythromycin (0% and 29.5–33.8%, respectively), chloramphenicol (0.8–1.0% and 13.1–22.1%, respectively), nalidixic acid (22.6–37.3% and 32.5–52.5%, respectively), and ciprofloxacin, (22.1–31.4% and 28.6–42.6%, respectively).

Resistance rates against most antimicrobials studied in the fifth stage were stable compared to those of the third and fourth stages (Table 1.5). However, the frequency of oxytetracycline-tetracycline resistance in *C. jejuni* from cattle in the fifth stage increased compared to that of the third stage (p<0.05). The frequency of fluoroquinolone resistance gradually increased in *C. jejuni* from cattle from the third stage to the fifth stage, but the increase was not significant.

Conversely, the frequencies of dihydrostreptomycin-streptomycin resistance in *C. jejuni* from layers and oxytetracycline-tetracycline resistance in *C. coli* from pigs in the fifth stage decreased compared to those of the third stage (p<0.05). The frequency of fluoroquinolone resistance decreased in *C. coli* from pigs in the fifth stage compared to that of the fourth stage (p<0.05).

Erythromycin resistance was not found in *C. jejuni* isolates from any animal but was frequently found in *C. coli* isolates from pigs (42.1–42.9%).

(4) *Salmonella*

In total, 365 *Salmonella* isolates (140 from cattle, 143 from pigs, and 82 from chickens) collected between 2012 and 2013 were available for antimicrobial susceptibility testing. The MIC distributions during the years 2012–2013 are shown in Tables 7.1–7.2.

The predominant serovars were *Salmonella* Typhimurium (119 isolates, 37.5%), O4:i:- (42 isolates, 13.2%), *Salmonella* Choleraesuis (40 isolates, 12.6%), and *Salmonella* Infantis (19 isolates, 6%). *S.* Typhimurium was the predominant serovar isolated from cattle and pigs (59/128, 46.1% and 58/123, 47.2%, respectively). *S.* Infantis was the predominant serovar isolated from chickens (17/66, 25.8%).

Antimicrobial resistance was found for most antimicrobials tested, except ciprofloxacin. Resistance was frequently found against tetracyclines, streptomycin (2013), and ampicillin in food-producing animals.

In general, the highest resistance rate was found in *Salmonella* isolates from cattle and pigs. Resistance in cattle and pigs was most commonly against streptomycin (67.9% and 70.0% respectively, 2013), tetracycline (34.5–66.1% and 53.0–66.7%, respectively), and ampicillin (34.5–60.7% and 25.3–45.0%, respectively).

Resistance to cefazolin and cefotaxime was found in *Salmonella* isolates from cattle and chickens, however, resistance frequencies were low (0–8.9%).

Resistance to colistin was found in isolates from pigs and chickens, however, resistance frequencies were low (0–8.9%).

Resistance rates against most antimicrobials studied in the fifth stage were stable compared to those of the third and fourth stages (Table 1.6). However, the frequency of nalidixic acid resistance in Salmonella from cattle in the fifth stage increased compared to that of the third stage ($p<0.05$).

By contrast, the frequencies of kanamycin, oxytetracycline–tetracycline, and chloramphenicol resistance in *Salmonella* from pigs in the fifth stage decreased compared to those of the third stage ($p<0.05$).

Table 1.2 Total number of bacterial isolates examined from 1999 to 2013

	year	*E.coli*	*Enterococcus*	*Campylobacter*	*Salmonella*		
					Healty animal	Disease animal	Total
Trial Stage	1999	1,018	1,024	166	124	194	318
1st stage	2000~2003	2,207	1,386	956	183	211	394
2nd stage	2004~2007	1,979	1,920	683	179	482	661
3rd stage	2008~2009	1,295	1,273	390	—	371	371
4th stage	2010~2011	1,567	1,432	540	—	325	325
5th stage	2012~2013	1,482	1,486	464	—	369	369
TOTAL		**10,327**	**9,341**	**3,439**	**486**	**2,124**	**2,610**

Table 1.3 Resistance rates of *E. coli* from third to fifth stage (%)

Antimicrobials	Cattle			Pig			Broiler			Layer		
	3rd stage	4th stage	5th stage	3rd stage	4th stage	5th stage	3rd stage	4th stage	5th stage	3rd stage	4th stage	5th stage
Ampicillin	8.5	6.5	6.7	29.8	27.4	29.5	46.5	42.4	45.8	19.7	13.6	14.2
Cefazolin	0	0.4	0.9	0	2.5	1.4	19.9	20.2	8.0[b]	1.3	1.9	3.0
Ceftiofur-Cefotaxime	0	0.4	1.1[a]	0	1.4	1.8	17.3	18.3	7.1[b]	1.7	0.6	3.3[b]
Dihydrostreptomycin-Streptomycin	18.1	-	17.3	50.7	-	41.8[a]	38.1	-	38.3	13.7	-	17.2
Gentamicin	0	0	0.2	2.1	2.1	2.2	4.0	3.7	2.4	0.4	0.3	0.6
Kanamycin	2.5	3.2	2.4	15.6	9.5	7.3[a]	20.4	13.2	26.4[a]	2.6	3.6	4.3
Oxytetracycline-Tetracycline	24.7	19.3	22.4	63.8	59.3	57.1	63.7	52.2	59.4	27.9	25.8	32.7
Nalidixic acid	3.1	1.9	2.6	8.5	8.4	9.8	34.1	32.6	32.0	6.4	11.4	13.6[a]
Enrofloxacin-Ciprofloxacin	0.2	0.4	0.6	1.8	2.1	0.7	9.7	5.1	7.7	2.1	0.8	0.6
Colistin	0.4	0	0	0.7	0	0	0	0	0	0	0	0
Chloramphenicol	3.8	3.2	3.9	24.8	21.8	24.4	13.7	10.1	18.7[b]	5.2	2.2	8.4
Trimethoprim-Trimethoprim/Sulfa-methoxazole	3.2	3.4	3.3	28.4	26.7	31.6	31.4	24.7	35.9	12.9	9.2	13.0[b]

a: Significantly different compared with the third stage
b: Significantly different compared with the forth stage
: Significantly increased
: Significantly decreased

Table 1.4 Resistance rates of *Campylobacter* (*C. jejuni* isolated from cattle, broilers, and layers; *C. coli* isolated from pigs) from third to fifth stage (%)

Antimicrobials	Cattle			Pig			Broiler			Layer		
	3rd stage	4th stage	5th stage	3rd stage	4th stage	5th stage	3rd stage	4th stage	5th stage	3rd stage	4th stage	5th stage
Ampicillin	5.1	1.0	3.4	8.7	0.9	4.1	17.4	25.2	19.3	18.3	22.5	26.7
Dihydrostreptomycin-Streptomycin	0	-	5.1	61.5	-	60.6	0	0	0	4.9	-	0[a]
Erythromycin	0	0	0	53.8	53.3	42.4	0	0	0	0	0	0
Oxytetracycline-Tetracycline	28.2	43.1	53.4[a]	88.5	76.6	74.7[a]	40.2	49.5	36.4	32.9	41.7	37.1
Nalidixic acid	33.3	34.3	44.1	48.1	56.1	37.4	22.8	34.2	22.7	13.4	14.6	14.7
Enrofloxacin-Ciprofloxacin	26.9	33.3	42.4	45.2	55.1	33.3[b]	22.8	32.4	18.2	13.4	11.9	13.0
Chloramphenicol	0	0	1.7	28.8	19.6	25.2	1.1	0	0	0	1.3	0.9

a: Significantly different compared with the third stage
b: Significantly different compared with the forth stage
: Significantly increased
: Significantly decreased

Table 1.5 Resistance rates of *Enterococci* from third to fifth stage (%)

Species	Antimicrobials	Cattle			Pig			Broiler			Layer		
		3rd stage	4th stage	5th stage	3rd stage	4th stage	5th stage	3rd stage	4th stage	5th stage	3rd stage	4th stage	5th stage
E. faecalis	Ampicillin	0	0	0	0	0	1.7	0	0	0	0	0	0
	Dihydrostreptomycin	50.0	35.7	47.0	84.6	76.7	57.4[a]	69.7	58.4	55.2	54.5	53.2	47.6
	Gentamicin	22.2	7.1	0	33.3	16.3	13.1[a]	16.9	9.6	16.6	15.9	14.9	9.8
	Kanamycin	11.1	7.1	5.9	51.3	44.2	32.8	33.7	39.3	42.8	16.7	28.2	27.3
	Oxytetracycline	27.8	35.7	5.9	89.7	76.7	67.2[a]	86.5	73.0	75.2	62.1	52.7	53.9
	Chloramphenicol	0	0	0	30.8	53.5	42.6	11.2	9.6	14.5	4.5	5.3	6.3
	Erythromycin	11.1	0	0	66.7	65.1	55.7	52.8	51.7	51.7	35.6	29.3	25.9
	Tylosin	-	0	0	-	62.8	52.5	-	51.7	53.1	-	29.3	25.2
	Lincomycin	11.1	0	0	76.9	62.8	59.0	55.1	52.2	53.1	35.6	29.8	25.2
	Enrofloxacin	5.6	7.1	0	2.6	11.6	0[b]	2.2	4.5	2.1	2.3	0.5	2.1
E. faecium	Ampicillin	0	0	0	0	0	0	5.3	2.2	2.3	0	0	0
	Dihydrostreptomycin	13.0	11.1	22.2	48.2	31.7	27.4	35.1	19.1	26.9	12.5	13.9	4.7
	Gentamicin	1.3	0.0	1.9	3.6	3.2	0.0	1.1	7.9	3.1	3.6	5.6	1.2
	Kanamycin	9.1	27.8	38.9[a]	26.8	41.3	41.2	18.1	34.8	48.4[a]	19.6	36.1	40.7[a]
	Oxytetracycline	14.3	18.5	7.4	62.5	54.0	45.1	71.3	60.7	64.6	37.5	19.4	11.6[a]
	Chloramphenicol	0	1.9	0	1.8	6.3	5.9	2.1	1.1	3.9	0	0	0
	Erythromycin	9.1	33.3	14.8[b]	25.0	34.9	27.5	30.9	28.1	29.2	12.5	30.6	7.0[b]
	Tylosin	-	5.6	7.4	-	25.4	19.6	-	14.6	22.3	-	4.2	1.2
	Lincomycin	5.2	9.3	7.4	41.1	33.3	39.2	33.0	21.3	30.0	10.7	4.2	0[a]
	Enrofloxacin	20.8	37.0	35.2	51.8	28.6	43.2	63.8	58.4	73.1	55.4	47.2	55.8

a: Significantly different compared with the third stage
b: Significantly different compared with the forth stage
: Significantly increased
: Significantly decreased

Table 1.6 Resistance rates of *Salmonella* from third to fifth stage (%)

Antimicrobials	Cattle			Pig			Chicken		
	3rd stage	4th stage	5th stage	3rd stage	4th stage	5th stage	3rd stage	4th stage	5th stage
Ampicillin	34.4	45.1	45.0	46.5	31.1	33.6	7.5	6.9	6.1
Cefazolin	1	4.2	4.3	0	0.8	0	4.3	1.7	3.6
Cefotaxime	-	3.5	4.3	-	0.8	0	-	1.7	2.4
Gentamicin	0	0	0	15.8	13.1	8.4	0	0.0	1.2
Kanamycin	20	19	12.2	21.9	15.6	9.8[a]	22.6	13.8	19.5
Oxytetracycline-Tetracycline	37.6	45.1	47.1	79.8	66.4	58.7[a]	40.9	22.4	31.7
Chloramphenicol	11.5	21.5	11.4	26.3	9.8	12.6[a]	1.1	0	6.1
Colistin	0	0	0	0	0	0.7	1.1	0	2.4
Nalidixic acid	0.6	5.5	5.0[a]	19.3	9.8	14.7	7.5	6.9	7.3
Enrofloxacin-Ciprofloxacin	0	0	0	0	0	0	0	0	0
Trimethoprim-Trimethoprim/Sulfa-methoxazole	1.9	3.5	1.4	31.6	29.5	28.0	18.3	10.3	14.6

a: Significantly different compared with the third stage
b: Significantly different compared with the forth stage
(red) : Significantly increased
(blue) : Significantly decreased

2. Monitoring System in Slaughterhouses

(1) *Escherichia coli*

In total, 1210 isolates of *E. coli* (589 from cattle, 322 from pigs, and 299 from broiler chickens) collected between 2012 and 2013 were available for antimicrobial susceptibility testing. The MIC distributions during 2012–2013 are shown in Tables 2.3–2.4. Antimicrobial resistance was found for all antimicrobials tested. Resistance was frequently found against tetracycline, streptomycin, and ampicillin.

In general, the highest resistance rate was found in *E. coli* from pigs or broilers. Resistance in pig and broiler isolates was most common against streptomycin (resistance rate in pigs and broilers, 44.1–44.9% and 39.1–38.6%, respectively), tetracycline (58.5–62.2% and 44.0–49.6%, respectively), ampicillin (26.0–32.3% and 30.8–35.5%, respectively), kanamycin (7.9–9.7% and 24.1%, respectively), chloramphenicol (23.6% and 11.3–11.4%, respectively), and sulfamethoxazol/trimethoprim (23.6–26.8% and 24.8–31.9%, respectively).

Incidence of nalidixic acid resistance was high in the *E. coli* isolates from broilers (36.1–39.8%), intermediate in those isolates from pigs (4.1–11.0%), and low in those isolates from cattle (1.8–2.4%). Frequency of ciprofloxacin resistance remained low (≤1.5%), except for isolates of *E. coli* from broilers (5.4–6.0%).

Resistance to cefazolin and cefotaxime remained low (≤1.0%) in *E. coli* isolates, except for isolates of *E. coli* from broilers (1.5–7.8%).

(2) *Enterococci*

A total of 221 *E. faecalis* and 38 *E. faecium* isolates collected in 2012 were subjected to antimicrobial susceptibility testing. The MIC distributions in 2012 are shown in Tables 3.3 and 4.3.

Antimicrobial resistance was found for 9 of the 13 tested antimicrobials in *E. faecalis* and *E. faecium* (Tables 3.3 and 4.3, respectively). Extent of resistance rates to each antimicrobial varied with the bacterial species and animal species. Resistance rates of isolates originating from pigs and broilers tended to be higher than those isolates originating from cattle.

Resistance in pig and broiler isolates was frequently found against oxytetracycline (resistance rates in *E. faecalis and E. faecium,* 64.7–75.0% and 35.0–83.3%, respectively), dihydrostreptomycin (76.9–88.2% and 50.0–75.0%, respectively), kanamycin (71.2–72.9% and 90.0–100%, respectively), erythromycin (51.8–58.7% and 25.0–60.0%, respectively), and lincomycin (57.7–76.5% and 30.0–50.0%, respectively).

The enrofloxacin resistance rate in *E. faecium* isolates (65.0–83.3%) was higher than in *E. faecalis* (2.9–5.9%).

(3) *Campylobacter*

A total of 377 *C. jejuni* and 368 *C. coli* isolates collected between 2012 and 2013 were subjected to antimicrobial susceptibility testing. *C. jejuni* was isolated mainly from cattle and broilers, whereas *C. coli* was isolated mainly from pigs. The MIC distributions from 2012 to 2013 are shown in Tables 5.3–5.4 and 6.3–6.4.

Antimicrobial resistance was found for all antimicrobials tested, except gentamicin. However, the extent of resistance rates to each antimicrobial varied by bacterial species and animal species. *C. 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 antimicrobials, resistance was more frequently found against tetracycline in *C. coli* (80.7–82.1%) and *C. jejuni* (41.8–49.6%). Resistance in *C. jejuni* and *C. coli* isolates was found against ampicillin (resistance rate in *C. jejuni* and *C. coli*, 9.2–12.9% and 15.9–18.6%, respectively), streptomycin (2.0–2.2% and 30.6–51.2%, respectively), erythromycin (0–0.4% and 27.1–31.4%, respectively), chloramphenicol (0–4.0% and 3.–7.2%, respectively), nalidixic acid (36.6–38.8% and 51.2–57.8%, respectively), and ciprofloxacin, (33.0–36.6% and 51.2–52.2%, respectively).

Incidence of ciprofloxacin resistance was high in *C. coli* isolates from cattle (60.3–70.3%) and intermediate in *C. coli* from pigs (46.2–46.5%), *C. jejuni* isolates from broilers (39.4–39.5%), and cattle (29.4–34.1%). Erythromycin resistance was frequently found in *C. coli* isolates from pigs (32.6–44.3%). However, frequency of erythromycin resistance in *C. jejuni* isolates was only detected in cattle (0.7%).

(4) *Salmonella*

In total, 212 *Salmonella* isolates from broilers collected between 2012 and 2013 were available for antimicrobial susceptibility testing. The MIC distributions during the years 2012–2013 are shown in Tables 7.3–7.4.

The predominant serovars isolated from chickens were *S.* Infantis (104 isolates, 51.2%), *Salmonella* Schwarzengrund (36 isolates, 17.7%), *S.* Typhimurium (33 isolates, 16.3%), and *Salmonella* Manhattan (24 isolates, 11.8%).

Antimicrobial resistance was found for most antimicrobials tested, except gentamicin, ciprofloxacin, and colistin. Resistance in chickens was most commonly against streptomycin (77.7–84.7%), tetracycline (74.5–82.2%), ampicillin (22.9–31.9%), kanamycin (31.9–42.4%), trimethoprim-sulfamethoxazole (31.9–48.3%), and nalidixic acid (29.8–19.5%)

Resistance to cefazolin, cefotaxime, and chloramphenicol was found in *Salmonella* isolates from chickens, however, resistance frequencies were low (5.9–7.4%, 5.1–7.4% and 0–0.8%, respectively).

IV. JVARM Topics

Decreased resistance to broad-spectrum cephalosporin in *Escherichia coli* isolated from healthy broilers by voluntary withdrawal of ceftiofur usage.

The emergence and prevalence of broad-spectrum cephalosporin (BSC)-resistant *Escherichia coli* in food-producing animals is a global public health concern. BSC antibiotics are designated as critically important antimicrobial agents in human medicine by the Food Safety Committee of Japan as well as in other countries.

The incidence of resistance against ceftiofur (CTF) was 4.0% in broiler chicken isolates from 2000 to 2003. However, since 2004, CTF resistance in *E. coli* isolates from broiler chickens has increased by about 10%(Figure 8).

In Japan, broad-spectrum cephalosporin antibiotics were approved for use in cattle and pigs in 1996, but not in poultry. However, the off-label use of CTF in conjunction with *in ovo* vaccination or vaccination of newly hatched chicks had been adopted at some hatcheries.

The MAFF announced the results of the increasing resistance to CTF to the broiler farmers association in JVARM. Consequently, CTF usage was voluntarily withdrawn by farmer's associations in March 2012. The percentage of BSC-resistant *E. coli* isolates significantly decreased after voluntary withdrawal of off-label use of CTF. These events indicate that the JVARM monitoring system is acting effectively as risk management tool.

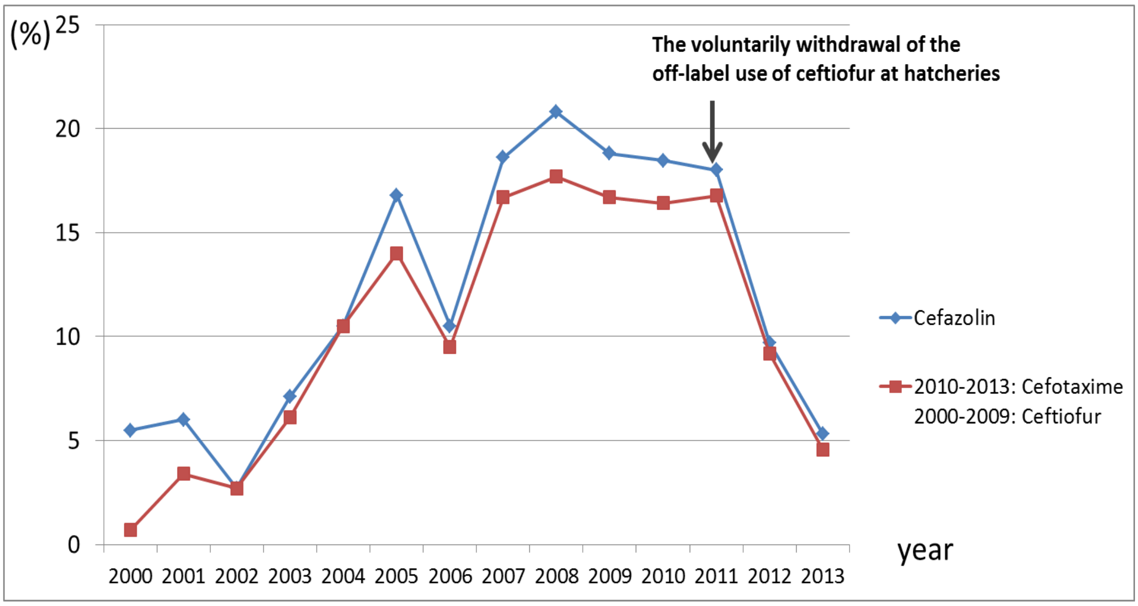


Fig. 8 The cephalosporin resistance rate in *E. coli* isolates from healthy broilers from 2000 to 2013

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 Act on Securing Quality, Efficacy, and Safety of Pharmaceuticals, Medical Devices, Regenerative and Cellular Therapy Products, Gene Therapy Products, and Cosmetics (Law No.145, Series of 1960)". The purpose of the law is to regulate matters pertaining to drugs, quasi-drugs, medical devices, and regenerative and cellular therapy products 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 economic consequences on the livestock industry. Feed additives, 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 to 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 zoonotic 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. In Japan, the post-marketing surveillance of VMPs occurs at two stages: during reexamination of new VMPs and during reevaluation of all VMPs. After the reexamination 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 are 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 from a veterinarian, these VMPs cannot be used without the diagnosis and instruction of 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 third generation cephalosporins), the description includes an explanation that the drug is not considered 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 was established in 2003. FSC is an organization responsible for risk assessment based on the Food Safety Basic Law (Law No. 48 of 2003) and is independent of risk management organizations such as MAFF and the 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 strategy developed based on the 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 guidelines cover the entire process, from development to implementation of risk management options in on-farm animal practices, referring to the standard guidelines for risk management adopted by the MAFF and MHLW (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 feasible risk management options are considered based on the results of risk assessment by FSC (‘high’, ‘medium’, ‘low’, or ‘negligible’), as shown in Table 9. Extended results of release assessments should especially be considered to determine risk management options; a high-risk estimation-of-release assessment should be carefully estimated. Secondly, to determine risk management options, the factors in Table 10 are fully considered based on target animals and approved administration routes. As necessary, risk communication, including public comment procedures, should be implemented.

The present status of risk analysis of antimicrobial resistance in food-producing animals in Japan is shown in Table11.

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 predetermined guidelines in order to perform appropriate risk-management implementation on antimicrobial resistance, taking into consideration the benefits/risks of antimicrobial use in animal husbandry.

Table 9. Selected examples and expected effects of risk management options for antimicrobial drugs depending on their risk assessment result

Assessment result	Examples of risk management options	Expected effects
High	Withdrawal Temporary ban on use	Distribution of the drug in the country is discontinued. Distribution of the drug in the country is discontinued (temporarily).
High/ medium	Withdrawal of the antimicrobial: against specific animal species against target disease/bacteria Limitation of antimicrobial use near the time of slaughter Shortening duration of antimicrobial administration	 When the drug is approved for use in multiple animal species, it will be banned in some target animals. The use of the drug for the target animal should be considered for each administration route of the drug. When the drug is approved for multiple target diseases/bacteria species, it will be banned in some target diseases/bacteria. The use of the drug for the target animal should be considered for each target disease/bacteria. Use volume of the drug is decreased by setting limits on its use during the final stage of a rearing period; otherwise, a high amount of the drug would be administered per animal. This will prevent increases in resistant bacteria due to selective pressures during the final stage of a rearing period. A course dose per animal is decreased by shortening a dosage period of AVMPs based on veterinary diagnosis.
Medium	Strict use as secondary line of AVMPs Intensified monitoring of	The drug is strictly used only when treatment with the first-line drug is ineffective, as stated on the label of the specific AVMPs such as new quinolone drugs or third-generation cephalosporin antibiotics available in Japan. Changes in the resistance of bacteria are

	antimicrobial resistance	detected immediately by increasing the monitoring frequency and area.
Low/ negligible	Continued monitoring of antimicrobial resistance	-

AVMPs, antimicrobial veterinary medicinal products.

Table 10. Basic components required to set criteria for risk management options

Decision factors	Comments
Significance of antimicrobial veterinary medicinal products in veterinary medicine	Severity (e.g., organs affected, potential systemic involvement, and pathology) of the target disease Significance in the clinical settings (e.g., facility, efficacy, and economy)
The presence of alternates for the target disease	Availability of alternates including different classes of antimicrobials and vaccines used for the same purposes
Secondary risk	Possible harmful consequences entailed in implementing each risk-management option
Estimated efficacy of risk-management option	Extent of efficacy imposed by implementing each risk-management option
Feasibility of risk-management option	Feasibility in terms of technical, administrative, and financial issues involved in implementing each risk-management option
Other concerns	Decision factors depending on antimicrobial characteristics whenever necessary

Table 11. The present situation of risk analysis of antimicrobial resistance in food-producing animals in Japan (as of October 2, 2015)

	URL of Japanese documents*	
Antimicrobials	Risk assessment	Risk management
Fluoroquinolones used in cattle and swine (2nd edition)	http://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20071024051 (Risk estimation: Medium)	http://www.maff.go.jp/j/syouan/tikusui/yakuzi/pdf/fluoro.pdf
Tulathromycin used in swine	http://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20091124004 (Risk estimation: Medium)	http://www.maff.go.jp/j/syouan/tikusui/yakuzi/pdf/draxxin_kanrisochi.pdf
Pirlimycin used in dairy cows	http://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20080212002 (Risk estimation: Low)	http://www.maff.go.jp/j/syouan/tikusui/yakuzi/pdf/pirlimy.pdf
Fluoroquinolones used in poultry	https://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20071024051 **https://www.jstage.jst.go.jp/article/foodsafetyfscj/2/4/2_2014035s/_article (Risk estimation: Medium)	http://www.maff.go.jp/j/syouan/tikusui/yakuzi/pdf/risk_mana_torifq.pdf
Gamithromycin used in cattle	https://www.fsc.go.jp/fsciis/evaluationDocument/show/kya2013111337z **http://www.fsc.go.jp/english/evaluationreports/vetmedicine/July_22_2014_Gamithromycin.pdf (Risk estimation: Low)	Continue existing risk management
Ceftiofur used in cattle and swine	https://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20100201004 (Risk estimation: Medium)	Not released
Tulathromycin used in cattle	https://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20150310290 (Risk estimation: Low)	Continue existing risk management

* English version is not available.

** Summary in English.

VI. JVARM Publications

2012

Baba, K., Ishihara, K., Ozawa, M., Usui, M., Hiki, M., Tamura, Y., Asai, T. Prevalence and Mechanism of Antimicrobial Resistance in *Staphylococcus aureus* Isolates from Diseased Cattle, Swine and Chickens in Japan. J Vet Med Sci 74(5): 561–565, 2012.

Usui, M., Hiki, H., Murakami, K., Ozawa, M., Nagai, H., Asai, T. Evaluation of transferability of R-plasmid in bacteriocin-producing donors to bacteriocin-resistant recipients. Jpn. J. Infect. Dis. 65, 252-255, 2012

Ozawa, M., Makita, K., Tamura, Y., Asai, T. Associations of antimicrobial use with antimicrobial resistance in *Campylobacter coli* from grow-finish pigs in Japan. Prev Vet Med. 106(3-4):295-300, 2012.

Asai, T., Hiki, M., Baba, K., Usui, M., Ishihara, K., Tamura, Y. Presence of *Staphylococcus aureus* ST398 and ST9 in swine in Japan. Jpn. J. Infect. Dis. 65(6):551-2, 2012.

2013

Hiki, M., Usui, M., Kojima, A., Ozawa, M., Ishii, Y., Asai, T. Diversity of plasmid replicons encoding the blaCMY-2 gene in broad-spectrum cephalosporin-resistant *Escherichia coli* from livestock animals in Japan. Foodborne Pathog Dis.10(3):243-249, 2013.

Asai, T., Usui, M., Hiki, M., Kawanishi, M., Nagai, H., Sasaki, Y. *Clostridium difficile* isolated from the fecal contents of swine in Japan. J Vet Med Sci. 75(4): 539-541, 2013.

Ozawa, M., Asai, T. Relationships between mutant prevention concentrations and mutation frequencies against enrofloxacin for avian pathogenic *Escherichia coli* isolates. J Vet Med Sci. 75(6): 709-713, 2013.

Hosoi, Y., Asai, T., Koike, R., Tsuyuki, M., Sugiura, K. Use of veterinary antimicrobial agents from 2005 to 2010 in Japan. International Journal of Antimicrobial Agents. 41(5): 489-490, 2013.

Usui M, Nagai H, Hiki M, Tamura Y and Asai T (2013). Effect of antimicrobial exposure on AcrAB expression in *Salmonella enterica* subspecies *enterica* serovar Choleraesuis. Front. Microbiol. 4:53. doi: 10.3389/fmicb.2013.00053

Kawanishi M, Ozawa M, Hiki M, Abo H, Kojima A, Asai T. Detection of *aac(6')-Ib-cr* in avian pathogenic *Escherichia coli* isolates in Japan. J Vet Med Sci. 75(11):1539-1542. 2013.

VII. Acknowledgments

The JVARM members would like to thank the staff of the Livestock Hygiene Service Centres for collecting samples and isolates from animals. Gratitude is also extended to the farmers for providing faecal samples and valuable information concerning antimicrobial use.

The JVARM members are grateful to the following people for helpful support and encouragement:

Haruo Watanabe, Makoto Kuroda, Hidemasa Izumiya, Jun Terajima (National Institute of Infectious Disease)

Shizunobu Igimi (National Institute of Health Science)

Masato Akiba (National Institute of Animal Health)

Yasushi Kataoka (Nippon Veterinary and Life Science University)

Yutaka Tamura (Rakuno Gakuen University)

Yoshikazu Ishii (Toho University)

Akemi Kai (Tokyo Metropolitan Institute of Public Health)

Takayuki Kurazono (Saitama Institute of Public Health)

Masumi Taguchi (Osaka Prefectural Institute of Public Health)

Kanako Ishihara (Tokyo University of Agriculture and Technology)

VIII. Participants in the JVARM program

1. Data from the National Veterinary Assay Laboratory was provided thanks to the contributions of the following people:

2012
Shuichi Hamamoto (Head of Assay Division II)
Tetsuo Asai (Chief of JVARM)
Michiko Kawanishi, Mototaka Hiki**,**

2013
Shuichi Hamamoto (Head of Assay Division II)
Akemi Kojima
Michiko Kawanishi
Mototaka Hiki,

2. Data from the Food and Agricultural Materials Inspection Centre was provided thanks to the contributions of the following people:

2012
Norio Aita (Director, Feed Analysis II Division)
Sayaka Hashimoto, Susumu Yoshinaga, Toshiaki Yamata, Yoshiyasu Hashimoto, Masaru Kondo, Yasuharu Takashima, Chisa Shimamura, Naoko Tamaru

2013
Norio Aita (Director, Feed Analysis II Division)
Susumu Yoshinaga, Toshiaki Yamata, Yoshiyasu Hashimoto, Masaru Kondo, Masaki Kasahara, Chisa Shimamura, Mayu Enomoto, Naoko Tamaru

3. Data from the Livestock Hygiene Services Centre was provided thanks to the contributions of the following people:

2012
Minako Tomiyama (Aomori), Yasuo Sato (Iwate), Risa Yajima (Miyagi), Atsushi Tanaka (Akita), Toru Ojima (Yamagata), Hidetaka Oonishi (Fukushima), Hitomi Tanabe (Ibaraki), Hirofumi Yuzawa (Tochigi), Rie Arai (Saitama), Atsuko Matsumoto (Chiba), Hiroshi Yoshizaki (Tokyo), Chieko Kosuge (Kanagawa), Shizuka Fukudome (Niigata), Toshitaka Goto , Kana Sugibayashi (Toyama), Hisahiro Ide (Ishikawa), Kiyohito Katsuragi (Fukui), Kazutada Ushiyama (Yamanashi), Junichi Ando (Nagano), Keiko Otsu (Gifu), Kazuho Suzuki (Shizuoka), Toshinari Suzuki (Aichi), Tomoko Yamane (Mie), Taketoshi Morooka (Shiga), Isao Taneda (Kyoto), Hiromi Otsuka (Osaka), Atsuko Kojima (Hyogo), Minako Moriyama (Nara),

Kumi Toyoshi (Wakayama), Yuuji Watanabe (Tottori), Yoichi Sakamoto (Shimane), Reiko Tahara (Okayama), Kanako Kishimoto (Hiroshima), Daiki Ooishi (Yamaguchi), Kanichirou Suzuki (Tokushima), Shuichi Taji (Ehime), Yasumichi Hamada (Kochi), Dai Fukamizu (Fukuoka), Kengo Shimojo (Nagasaki), Yuka Uchiyama (Kumamoto), Fumiko Yamamoto (Oita), Hiroko Matsukawa (Miyazaki), Shunsuke Kamimura (Kagoshima), Satoko Nakao (Okinawa)

2013

Minako Tomiyama (Aomori), Yasuo Sato (Iwate), Risa Yajima (Miyagi), Atsushi Tanaka (Akita), Toru Ojima (Yamagata), Hidetaka Oonishi (Fukushima), Hitomi Tanabe (Ibaraki), Shunsuke Akama (Tochigi), Rie Arai (Saitama), Atsuko Matsumoto (Chiba), Hiroshi Yoshizaki (Tokyo), Chieko Kosuge (Kanagawa), Kensuke Tanaka (Niigata), Mie Maiko (Toyama), Hisahiro Ide (Ishikawa), Tomomi Tanaka (Fukui), Kazutada Ushiyama (Yamanashi), Junichi Ando (Nagano), Keiko Otsu (Gifu), Megumi Sadahiro (Shizuoka), Toshinari Suzuki (Aichi), Haru Uehara (Mie), Michiko Mitsumatsu (Shiga), Akane Kato, Isao Taneda (Kyoto), Eiichi Tsuyama (Osaka), Atsuko Kojima (Hyogo), Minako Moriyama (Nara), Kumi Toyoshi (Wakayama), Yuuji Watanabe (Tottori), Yoichi Sakamoto (Shimane), Reiko Tahara (Okayama), Megumi Kanehiro (Hiroshima), Daiki Ooishi (Yamaguchi), Shizu Kashioka (Tokushima), Naohito Okazaki (Ehime), Yuka Chikami (Kochi), Yuiko Morinaga (Fukuoka), Kengo Shimojo (Nagasaki), Yuka Uchiyama (Kumamoto), Fumiko Yoshida (Oita), Hiroko Matsukawa (Miyazaki), Eriko Uchimura (Kagoshima), Satoko Nakao (Okinawa)

IX. Appendix (Materials and Methods)

1. Sampling

(1) Monitoring System in Farms

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

Escherichia coli, *Enterococcus* and *Campylobacter* were isolated from these fecal samples while *Salmonella* was isolated from diagnostic submissions of clinical cases.

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

(2) Monitoring System in Slaughterhouses

Sampling was carried out by private research laboratories. Fresh cecal feces samples were collected from healthy broilers, and rectal feces from cattle and pigs at each slaughterhouse.

Freshly voided cecal or rectal feces samples from healthy cattle, pigs, broiler chickens, and layer chickens were collected from approximately 300 cattle, 200 pigs, and 272 broiler chickens at different slaughterhouses.

E. coli, *Enterococcus* and *Campylobacter* were isolated from these cecal or rectal fecal samples from healthy cattle, pigs, and broilers, while *Salmonella* was isolated from only cecal fecal samples of healthy broilers.

2. Isolation and Identification

(1) *Escherichia coli*

E. coli isolates from each sample were maintained 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 testing.

(2) *Enterococci*

Fecal samples were cultured 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-pyrrolidonyl-β-naphthylamide, 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 the 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 short, 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 Centers from farm monitoring. While monitoring in slaughterhouses, *Salmonella* is isolated from cecal fecal samples from healthy broilers. Fecal samples were cultured using the enrichment procedure with Buffered Peptone Water (Oxoid, Basingstoke, Hampshire, England). Tubes containing sample were incubated at 37°C for 18–24 h and subsequently passaged onto Rappaport-Vassiliadis broth and incubated at 42°C for 18–24 h. They were then passaged onto CHROM agar *Salmonella* plates and incubated at 37°C for 18–24 h. Isolates were presumptively identified as *Salmonella* by colony morphology.

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*, *Campylobacter*, and *Salmonella* 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.

4. Resistance Breakpoints

Resistance breakpoints were defined microbiologically in serial studies. The intermediate MIC of two peak distributions was defined as the breakpoint 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 determined microbiologically.

5. Statistical analysis

Resistance rates of the fifth stage were compared with the third and fourth stages using the chi-square test followed by multiple comparisons made by Ryan’s method. If the expected frequency was less than 5, fisher’s exact test was used. Difference with $p<0.05$ was considered significant.

Table2.1. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=299), pigs(n=143), broilers(n=205) and layers(n=195) in 2012_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	8.0	6.4	3.86-9.75						0.7	13.7	60.9	17.7	0.7	0.3			6.0	
	Pigs	4.0	>128	28.7	21.42-36.83							10.5	49.0	11.9			0.7		28.0	
	Broilers	8.0	>128	44.9	37.94-51.97							14.1	33.7	6.8	0.5	0.5		0.5	43.9	
	Layers	4.0	>128	12.3	8.04-17.76						1.0	16.9	53.8	14.9	1.0	0.5		0.5	11.3	
	Total	4.0	>128	20.9	18.20-23.81						0.5	14.0	50.6	13.4	0.6	0.4	0.1	0.2	20.2	
Cefazolin	Cattle	≦1	2.0	1.7	0.54-3.86						64.9	28.8	3.3	1.3		0.3	0.3		1.0	
	Pigs	≦1	4.0	1.4	0.16-4.97						51.7	31.5	12.6	2.8					1.4	
	Broilers	2.0	16.0	9.8	6.06-14.67						43.9	31.2	11.2	0.5	3.4		1.0		8.8	
	Layers	≦1	2.0	3.1	1.13-6.58						57.4	35.4	2.6	1.0	0.5				3.1	
	Total	≦1	4.0	3.9	2.71-5.47						55.8	31.4	6.7	1.3	1.0	0.1	0.4		3.4	
Cefotaxime	Cattle	≦0.5	≦0.5	2.0	0.73-4.32					96.7	1.0	0.3	0.7	0.3	0.7	0.3				
	Pigs	≦0.5	≦0.5	2.8	0.76-7.01					96.5	0.7		1.4	1.4						
	Broilers	≦0.5	2.0	8.8	5.28-13.53					87.3	2.4	1.5	2.4	1.5	2.4	1.0	1.5			
	Layers	≦0.5	≦0.5	3.6	1.45-7.26					94.9	1.5		1.0	1.0		0.5		1.0		
	Total	≦0.5	≦0.5	4.2	2.91-5.74					93.9	1.4	0.5	1.3	1.0	0.8	0.5	0.4	0.2		
Streptomycin	Cattle	4.0	64.0	15.1	11.19-19.62							1.7	49.2	29.8	4.3	3.7	5.4	3.0	3.0	
	Pigs	16.0	>128	39.9	31.77-48.38								22.4	26.6	11.2	6.3	12.6	5.6	15.4	
	Broilers	8.0	>128	38.0	31.37-45.08								25.4	27.3	9.3	4.4	3.9	5.4	24.4	
	Layers	8.0	128.0	18.5	13.27-24.64							0.5	41.0	30.3	9.7	3.6	1.5	4.6	8.7	
	Total	8.0	>128	25.7	22.73-28.75							0.7	36.9	28.7	8.0	4.3	5.3	4.4	11.6	
Gentamicin	Cattle	≦0.5	1.0	0.0	0-1.23					87.0	11.7	1.3								
	Pigs	≦0.5	1.0	2.8	0.76-7.01					79.7	14.0	3.5				0.7	1.4	0.7		
	Broilers	≦0.5	1.0	3.4	1.38-6.91					76.6	16.6	3.4				1.5	2.0			
	Layers	≦0.5	1.0	1.0	0.12-3.66					82.6	13.8	2.1	0.5		0.5	0.5				
	Total	≦0.5	1.0	1.5	0.82-2.63					82.2	13.8	2.4	0.1		0.1	0.6	0.7	0.1		
Kanamycin	Cattle	4.0	8.0	2.3	0.94-4.77						0.3	34.4	53.2	7.7	2.0				2.3	
	Pigs	4.0	8.0	7.0	3.40-12.49							20.3	53.1	17.5	2.1		1.4		5.6	
	Broilers	4.0	>128	27.8	21.78-34.48							17.6	43.4	10.2	1.0		0.5		27.3	
	Layers	4.0	8.0	3.1	1.13-6.58						1.0	21.5	59.5	12.8	1.5	0.5			3.1	
	Total	4.0	16.0	9.5	7.60-11.69						0.4	24.9	52.3	11.2	1.7	0.1	0.4		9.1	

Table2.1. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=299), pigs(n=143), broilers(n=205) and layers(n=195) in 2012_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Tetracycline	Cattle	2.0	64.0	22.4	17.80-27.57						17.1	34.4	24.4	1.7	2.0	2.3	9.4	8.7		
	Pigs	64.0	>64	60.1	51.62-68.23						11.2	19.6	7.7	1.4	1.4	2.8	21.0	35.0		
	Broilers	64.0	>64	58.5	51.46-65.36					1.0	10.2	18.0	9.8	2.4		2.9	21.5	34.1		
	Layers	4.0	>64	37.9	31.11-45.16					0.5	20.0	24.1	16.9	0.5	1.0	1.5	16.9	18.5		
	Total	4.0	>64	41.2	37.86-44.63					0.4	15.1	25.5	16.3	1.5	1.2	2.4	16.0	21.6		
Nalidixic acid	Cattle	4.0	8.0	3.7	1.85-6.49						0.7	15.1	68.9	11.7					3.7	
	Pigs	4.0	16.0	9.8	5.45-15.89							7.0	69.9	9.8	3.5		0.7	1.4	7.7	
	Broilers	4.0	>128	30.2	24.04-37.03							10.2	46.8	8.8	3.9	2.0	2.9	2.9	22.4	
	Layers	4.0	>128	16.4	11.50-22.37							11.8	64.6	6.2	1.0		2.1	2.6	11.8	
	Total	4.0	>128	14.1	11.84-16.68						0.2	11.8	62.7	9.4	1.8	0.5	1.3	1.5	10.8	
Ciprofloxacin	Cattle	≦0.03	≦0.03	1.0	0.20-2.91	94.6	1.7		1.7	0.3	0.3	0.3		1.0						
	Pigs	≦0.03	0.1	0.7	0.01-3.84	84.6	1.4	4.9	6.3	2.1				0.7						
	Broilers	≦0.03	1.0	7.8	4.52-12.37	65.4		5.4	13.2	5.4	1.5	1.5	2.9	4.9						
	Layers	≦0.03	0.3	1.0	0.12-3.66	81.5	2.6	3.6	7.7	2.6	1.0		0.5	0.5						
	Total	≦0.03	0.3	2.6	1.64-3.93	82.8	1.4	3.0	6.7	2.4	0.7	0.5	0.8	1.8						
Colistin	Cattle	0.3	0.5	0.0	0-1.23			6.0	74.2	16.1	1.7	0.7	1.3							
	Pigs	0.3	0.5	0.0	0-2.55			6.3	67.8	19.6	1.4	2.8	2.1							
	Broilers	0.3	0.5	0.0	0-1.79			3.4	71.2	17.6	2.9	3.4	1.5							
	Layers	0.3	0.5	0.0	0-1.88			4.1	71.3	21.5	2.6		0.5							
	Total	0.3	0.5	0.0	0-0.44			5.0	71.7	18.3	2.1	1.5	1.3							
Chloramphenicol	Cattle	8.0	8.0	3.3	1.61-6.07							0.3	22.1	69.2	5.0	0.7	1.3	0.7	0.7	
	Pigs	8.0	128.0	26.6	19.54-34.61								18.2	54.5	0.7	4.2	9.1	6.3	7.0	
	Broilers	8.0	64.0	16.6	11.76-22.40							1.5	18.5	56.1	7.3	3.9	5.4	2.4	4.9	
	Layers	8.0	16.0	9.7	5.96-14.80								16.4	70.3	3.6	0.5	1.5	0.5	7.2	
	Total	8.0	32.0	12.0	9.87-14.39							0.5	19.2	63.8	4.5	2.0	3.7	2.0	4.3	
Trimethoprim	Cattle	0.5	1.0	2.3	0.94-4.77				21.7	39.5	29.8	5.4	1.0	0.3		2.3				
	Pigs	1.0	>16	35.0	27.18-43.38				15.4	30.1	16.8	2.8			0.7	34.3				
	Broilers	1.0	>16	33.2	26.76-40.08				15.6	31.7	15.6	2.4	1.5			33.2				
	Layers	0.5	>16	13.3	8.89-18.93				20.0	35.9	23.1	4.6	1.5	1.5		13.3				
	Total	0.5	>16	17.9	15.39-20.70				18.8	35.2	22.6	4.0	1.1	0.5	0.1	17.8				

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

Table2.2. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=240), pigs(n=132), broilers(n=131) and layers(n=136) in 2013_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	8.0	7.1	4.18-11.10						2.5	19.2	60.4	10.8					7.1	
	Pigs	4.0	>128	30.3	22.61-38.91						3.0	23.5	40.2	3.0				3.8	26.5	
	Broilers	8.0	>128	47.3	38.54-56.24							19.1	26.0	7.6			0.8	4.6	42.0	
	Layers	4.0	>128	16.9	11.03-24.30						0.7	21.3	45.6	14.7	0.7			1.5	15.4	
	Total	4.0	>128	22.2	19.05-25.65						1.7	20.5	46.0	9.4	0.2		0.2	2.0	20.0	
Cefazolin	Cattle	≦1	2.0	0.0	0-1.53						59.6	34.2	4.2	1.3	0.8					
	Pigs	≦1	4.0	1.5	0.18-5.37						50.0	38.6	7.6	2.3				0.8	0.8	
	Broilers	2.0	8.0	5.3	2.17-10.7						32.8	39.7	15.3	5.3	1.5		0.8	0.8	3.8	
	Layers	2.0	4.0	2.9	0.8-7.36						44.1	41.2	9.6	1.5	0.7			1.5	1.5	
	Total	2.0	4.0	2.0	1.08-3.46						48.8	37.7	8.3	2.3	0.8		0.2	0.6	1.3	
Cefotaxime	Cattle	≦0.5	≦0.5	0.0	0-1.53					98.3	1.7									
	Pigs	≦0.5	≦0.5	0.8	0.01-4.15					97.7	0.8	0.8		0.8						
	Broilers	≦0.5	≦0.5	4.6	1.69-9.71					94.7	0.8		1.5	2.3	0.8					
	Layers	≦0.5	≦0.5	2.9	0.80-7.36					95.6	1.5		1.5		1.5					
	Total	≦0.5	≦0.5	1.7	0.86-3.06					96.9	1.3	0.2	0.6	0.6	0.5					
Streptomycin	Cattle	8.0	64.0	20.0	15.13-25.63								36.3	40.4	3.3	4.6	5.4	4.6	5.4	
	Pigs	8.0	>128	43.9	35.31-52.84								22.7	28.0	5.3	6.1	6.8	9.1	22.0	
	Broilers	8.0	>128	38.9	30.53-47.84							0.8	19.8	32.1	8.4	6.9	2.3	5.3	24.4	
	Layers	8.0	128.0	14.7	9.22-21.80							1.5	30.1	47.8	5.9	3.7	0.7	2.9	7.4	
	Total	8.0	>128	27.7	24.26-31.35							0.5	28.8	37.7	5.3	5.2	4.1	5.3	13.1	
Gentamicin	Cattle	≦0.5	1.0	0.4	0.01-2.30					82.9	16.3	0.4					0.4			
	Pigs	≦0.5	1.0	1.5	0.18-5.37					75.0	19.7	2.3	1.5			1.5				
	Broilers	≦0.5	1.0	0.8	0.01-4.18					78.6	16.8	3.8			0.8					
	Layers	≦0.5	1.0	0.0	0-2.68					77.2	19.1	3.7								
	Total	≦0.5	1.0	0.6	0.17-1.60					79.2	17.7	2.2	0.3		0.2	0.3	0.2			
Kanamycin	Cattle	4.0	8.0	2.5	0.92-5.37						1.3	45.0	42.9	7.9	0.4				2.5	
	Pigs	4.0	8.0	7.6	3.69-13.50						0.8	37.1	46.2	6.8	1.5				7.6	
	Broilers	4.0	>128	24.4	17.34-32.70						1.5	35.9	35.1	1.5	1.5			0.8	23.7	
	Layers	4.0	8.0	5.9	2.57-11.27						0.7	33.8	47.1	12.5					5.9	
	Total	4.0	8.0	8.8	6.68-11.23						1.1	39.1	42.9	7.4	0.8			0.2	8.6	

Table2.2. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=240), pigs(n=132), broilers(n=131) and layers(n=136) in 2013_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Tetracycline	Cattle	2.0	64.0	22.5	17.37-28.32						16.3	41.7	18.3	1.3	1.7	2.5	9.2	9.2		
	Pigs	32.0	>64	53.8	44.90-62.50						15.9	21.2	9.1		1.5	2.3	22.0	28.0		
	Broilers	64.0	>64	61.1	52.16-69.47						6.1	23.7	8.4	0.8		5.3	29.8	26.0		
	Layers	2.0	>64	24.3	17.32-32.36						16.2	37.5	22.1			2.2	10.3	11.8		
	Total	4.0	>64	37.2	33.48-41.13						14.1	32.9	15.2	0.6	0.9	3.0	16.3	17.1		
Nalidixic acid	Cattle	4.0	4.0	1.3	0.25-3.61						0.4	19.2	72.1	7.1		0.4			0.8	
	Pigs	4.0	8.0	9.8	5.34-16.26							19.7	62.1	8.3				3.0	6.8	
	Broilers	4.0	>128	35.1	26.98-43.94							9.9	47.3	6.1	1.5	0.8	1.5	3.8	29.0	
	Layers	4.0	8.0	9.6	5.18-15.80						0.7	16.9	67.6	5.1			2.2	1.5	5.9	
	Total	4.0	128.0	11.7	9.34-14.49						0.3	16.9	64.0	6.7	0.3	0.3	0.8	1.7	8.9	
Ciprofloxacin	Cattle	≦0.03	≦0.03	0.0	0-1.53	96.3	2.1	0.4	0.8		0.4									
	Pigs	≦0.03	0.1	0.8	0.01-4.15	87.9	1.5	5.3	2.3	1.5	0.8			0.8						
	Broilers	≦0.03	1.0	7.6	3.72-13.60	59.5		8.4	15.3	5.3	3.1	0.8	1.5	6.1						
	Layers	≦0.03	0.1	0.0	0-2.68	88.2	2.2	2.2	6.6		0.7									
	Total	≦0.03	0.1	1.7	0.86-3.06	85.3	1.6	3.4	5.3	1.4	1.1	0.2	0.3	1.4						
Colistin	Cattle	0.3	0.5	0.0	0-1.53			25.8	52.9	12.5	4.6	4.2								
	Pigs	0.3	1.0	0.0	0-2.76			24.2	50.8	14.4	3.8	3.8	2.3	0.8						
	Broilers	0.3	0.5	0.0	0-2.78			23.7	44.3	25.2	0.8	4.6	1.5							
	Layers	0.3	0.5	0.0	0-2.68			19.1	45.6	25.7	8.1	1.5								
	Total	0.3	0.5	0.0	0-0.58			23.6	49.1	18.3	4.4	3.6	0.8	0.2						
Chloramphenicol	Cattle	8.0	8.0	4.6	2.30-8.06							1.7	25.0	67.5	1.3			2.1	2.5	
	Pigs	8.0	128.0	22.0	15.23-30.01							1.5	21.2	53.8	1.5	5.3	4.5	3.0	9.1	
	Broilers	8.0	128.0	22.1	15.35-30.23							1.5	17.6	53.4	5.3	2.3	6.1	5.3	8.4	
	Layers	8.0	8.0	6.6	3.07-12.20							2.2	23.5	64.7	2.9		4.4	0.7	1.5	
	Total	8.0	64.0	12.2	9.76-15.00							1.7	22.4	61.2	2.5	1.6	3.1	2.7	4.9	
Trimethoprim	Cattle	0.5	1.0	4.6	2.30-8.06				13.8	53.8	23.8	3.8	0.4			4.6				
	Pigs	0.5	>16	28.0	20.56-36.51				20.5	36.4	14.4	0.8				28.0				
	Broilers	1.0	>16	40.5	31.97-49.39				9.2	29.0	17.6	3.1	0.8			40.5				
	Layers	0.5	>16	12.5	7.45-19.26				14.7	47.8	19.9	5.1				12.5				
	Total	0.5	>16	18.5	15.53-21.70				14.4	43.8	19.7	3.3	0.3			18.5				

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

Table2.3. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=248), pigs(n=195) and broilers(n=133) in 2012_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	4.0	2.4	0.89-5.20						2.4	30.2	60.1	4.4	0.4				2.4	
	Pigs	4.0	>128	32.3	25.80-39.37						2.1	17.9	36.9	10.8			0.5	2.6	29.2	
	Broilers	4.0	>128	30.8	23.11-39.42							12.0	39.8	15.0	2.3				30.8	
	Layers				-															
	Total	4.0	>128	19.1	15.96-22.55						1.7	21.9	47.6	9.0	0.7		0.2	0.9	18.1	
Cefazolin	Cattle	≦1	2.0	0.4	0.01-2.23						50.8	44.8	2.8	1.2				0.4		
	Pigs	2.0	4.0	1.0	0.12-3.66						40.0	43.1	12.3	3.6		1.0				
	Broilers	2.0	8.0	3.0	0.82-7.53						31.6	39.1	16.5	7.5	2.3	0.8	0.8		1.5	
	Layers				-															
	Total	2.0	4.0	1.2	0.48-2.49						42.7	42.9	9.2	3.5	0.5	0.5	0.2	0.2	0.3	
Cefotaxime	Cattle	≦0.5	≦0.5	0.0	0-1.48					99.6		0.4								
	Pigs	≦0.5	≦0.5	0.0	0-1.88					100.0										
	Broilers	≦0.5	≦0.5	1.5	0.18-5.33					97.0	0.8	0.8	0.8					0.8		
	Layers				-															
	Total	≦0.5	≦0.5	0.3	0.04-1.25					99.1	0.2	0.3	0.2					0.2		
Streptomycin	Cattle	8.0	64.0	14.9	10.72-19.98								13.3	57.3	14.5	2.0	4.4	8.5		
	Pigs	16.0	>64	44.1	37.01-51.38							2.6	12.3	23.1	17.9	5.6	8.2	30.3		
	Broilers	16.0	>64	39.1	30.75-47.94								9.8	31.6	19.5	4.5	5.3	29.3		
	Layers				-															
	Total	8.0	>64	30.4	26.64-34.32							0.9	12.2	39.8	16.8	3.8	5.9	20.7		
Gentamicin	Cattle	1.0	2.0	0.0	0-1.48					38.7	44.4	16.5		0.4						
	Pigs	≦0.5	2.0	0.5	0.01-2.83					50.8	26.7	17.9	4.1			0.5				
	Broilers	1.0	2.0	1.5	0.18-5.33					26.3	33.1	34.6	4.5			1.5				
	Layers				-															
	Total	1.0	2.0	0.5	0.10-1.52					39.9	35.8	21.2	2.4	0.2		0.5				
Kanamycin	Cattle	4.0	8.0	1.2	0.25-3.50						0.4	16.9	49.2	29.8	2.4				1.2	
	Pigs	4.0	32.0	9.7	5.96-14.80						0.5	18.5	35.9	28.7	6.2	0.5	1.0		8.7	
	Broilers	8.0	>128	24.1	17.07-32.24							9.0	27.1	27.8	11.3	0.8	1.5		22.6	
	Layers				-															
	Total	4.0	16.0	9.4	7.12-12.06						0.3	15.6	39.6	29.0	5.7	0.3	0.7		8.7	

Table2.3. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=248), pigs(n=195) and broilers(n=133) in 2012_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Tetracycline	Cattle	2.0	64.0	19.0	14.26-24.40					2.0	41.5	20.2	8.9	8.5	3.6	2.0	6.5	6.9		
	Pigs	64.0	>64	58.5	51.20-65.46					0.5	14.4	15.4	9.2	2.1	0.5	2.1	20.5	35.4		
	Broilers	8.0	>64	49.6	40.84-58.43						2.3	20.3	24.1	3.8	2.3	6.0	18.8	22.6		
	Layers				-															
	Total	4.0	>64	39.4	35.39-43.54					1.0	23.3	18.6	12.5	5.2	2.3	3.0	14.1	20.1		
Nalidixic acid	Cattle	4.0	8.0	2.4	0.89-5.20							15.7	73.8	6.9	1.2	0.8	0.8		0.8	
	Pigs	4.0	8.0	4.1	1.78-7.93							14.4	60.5	17.4	3.6			0.5	3.6	
	Broilers	8.0	>128	39.8	31.46-48.70							9.0	33.8	14.3	3.0	0.8	1.5	3.8	33.8	
	Layers				-															
	Total	4.0	128.0	11.6	9.12-14.54							13.7	60.1	12.2	2.4	0.5	0.7	1.0	9.4	
Ciprofloxacin	Cattle	≦0.03	≦0.03	0.0	0-1.48	94.8	2.8	0.8	1.2	0.4										
	Pigs	≦0.03	≦0.03	1.5	0.31-4.43	91.3	1.0	1.0	3.6	1.5				1.5						
	Broilers	≦0.03	1.0	6.0	2.63-11.51	57.9		5.3	18.8	6.0	3.8	2.3	3.0	3.0						
	Layers				-															
	Total	≦0.03	0.3	1.9	0.95-3.40	85.1	1.6	1.9	6.1	2.1	0.9	0.5	0.7	1.2						
Colistin	Cattle	0.3	0.5	0.0	0-1.48			48.4	35.9	11.3	3.2	1.2								
	Pigs	0.3	0.5	0.0	0-1.88			31.8	42.1	17.9	4.6	2.1	1.5							
	Broilers	0.3	0.5	0.8	0.01-4.12			36.1	45.1	12.8	1.5	2.3	1.5			0.8				
	Layers				-															
	Total	0.3	0.5	0.2	0-0.97			39.9	40.1	13.9	3.3	1.7	0.9			0.2				
Chloramphenicol	Cattle	8.0	8.0	5.2	2.82-8.80							0.8	33.5	56.9	3.6	2.4	1.2	0.8	0.8	
	Pigs	8.0	>128	23.6	17.81-30.19								22.6	49.7	4.1	3.1	4.6	5.6	10.3	
	Broilers	8.0	32.0	11.3	6.45-17.92								6.8	63.2	18.8	7.5	0.8	0.8	2.3	
	Layers				-															
	Total	8.0	32.0	12.8	10.22-15.86							0.3	23.6	55.9	7.3	3.8	2.3	2.4	4.3	

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs							
						2.38/0.12	4.75/0.25	9.5/0.5	19/1	38/2	76/4	152/8	>152/8
Sulfamethoxazole /Trimethoprim	Cattle	≦2.38/0.12	9.5/0.5	2.0	0.65-4.65	74.2	9.3	7.3	3.2	4.0			2.0
	Pigs	≦2.38/0.12	>152/8	23.6	17.81-30.19	51.3	10.8	8.7	5.1	0.5		0.5	23.1
	Broilers	4.75/0.25	>152/8	24.8	17.73-33.05	47.4	9.0	11.3	5.3	2.3			24.8
	Layers				-								
	Total	≦2.38/0.12	>152/8	14.6	11.80-17.74	60.2	9.7	8.7	4.3	2.4		0.2	14.4

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

Table2.4. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=341), pigs(n=127) and broilers(n=166) in 2013_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	8.0	6.5	4.08-9.61						2.1	18.8	61.0	11.4	0.3	1.2	0.3		5.0	
	Pigs	4.0	>128	26.0	18.60-34.52						1.6	15.7	46.5	8.7	1.6				26.0	
	Broilers	8.0	>128	35.5	28.27-43.34						0.6	9.6	39.2	15.1			0.6	1.2	33.7	
	Layers				-															
	Total	4.0	>128	18.0	15.06-21.20						1.6	15.8	52.4	11.8	0.5	0.6	0.3	0.3	16.7	
Cefazolin	Cattle	≦1	2.0	0.3	0-1.63						73.6	23.8	2.3			0.3				
	Pigs	2.0	4.0	0.8	0.01-4.31						48.8	35.4	15.0						0.8	
	Broilers	2.0	8.0	7.8	4.23-13.02						42.2	30.1	12.7	7.2		1.2	0.6	0.6	5.4	
	Layers				-															
	Total	≦1	4.0	2.4	1.33-3.88						60.4	27.8	7.6	1.9		0.5	0.2	0.2	1.6	
Cefotaxime	Cattle	≦0.5	≦0.5	0.0	0-1.08					93.3	4.1	2.6								
	Pigs	≦0.5	1.0	0.0	0-2.87					88.2	6.3	5.5								
	Broilers	≦0.5	≦0.5	4.8	2.10-9.28					93.4	1.2	0.6	2.4	1.2		0.6	0.6			
	Layers				-															
	Total	≦0.5	≦0.5	1.3	0.54-2.48					92.3	3.8	2.7	0.6	0.3		0.2	0.2			
Streptomycin	Cattle	8.0	64.0	12.3	9.02-16.29							1.5	36.7	40.2	9.4	1.2	3.8	7.3		
	Pigs	16.0	>64	44.9	36.05-53.96							0.8	15.0	29.9	9.4	6.3	3.9	34.6		
	Broilers	16.0	>64	38.6	31.11-46.42							0.6	12.0	33.7	15.1	4.8	6.0	27.7		
	Layers				-															
	Total	8.0	>64	25.7	22.34-29.30							1.1	25.9	36.4	10.9	3.2	4.4	18.1		
Gentamicin	Cattle	≦0.5	1.0	0.3	0-1.63					77.4	20.5	1.8					0.3			
	Pigs	≦0.5	1.0	2.4	0.48-6.75					61.4	32.3	3.9				0.8	0.8	0.8		
	Broilers	1.0	2.0	1.8	0.37-5.20					37.3	29.5	27.1	4.2					1.8		
	Layers				-															
	Total	≦0.5	2.0	1.1	0.44-2.27					63.7	25.2	8.8	1.1			0.2	0.3	0.6		
Kanamycin	Cattle	4.0	8.0	1.5	0.47-3.39						1.8	40.5	44.3	11.4	0.6				1.5	
	Pigs	4.0	8.0	7.9	3.84-14.01						3.1	21.3	48.0	18.1	1.6				7.9	
	Broilers	8.0	>128	24.1	17.80-31.34							9.6	34.9	24.1	7.2				24.1	
	Layers				-															
	Total	4.0	16.0	8.7	6.60-11.15						1.6	28.5	42.6	16.1	2.5				8.7	

Table2.4. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=341), pigs(n=127) and broilers(n=166) in 2013_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Tetracycline	Cattle	2.0	>64	16.4	12.65-20.79					0.6	15.5	44.0	19.6	3.8	1.8	1.2	2.9	10.6		
	Pigs	64.0	>64	62.2	53.17-70.66						6.3	18.1	7.9	5.5	0.8	1.6	15.7	44.1		
	Broilers	4.0	>64	44.0	36.29-51.88					1.8	9.0	31.9	12.7	0.6	1.2	3.0	19.3	20.5		
	Layers				-															
	Total	4.0	>64	32.8	29.16-36.62					0.8	12.0	35.6	15.5	3.3	1.4	1.7	9.8	19.9		
Nalidixic acid	Cattle	4.0	8.0	1.8	0.64-3.80						0.6	10.6	75.7	10.3	1.2	0.6			1.2	
	Pigs	4.0	64.0	11.0	6.15-17.81							3.9	62.2	19.7	3.1		3.1	0.8	7.1	
	Broilers	4.0	>128	36.1	28.83-43.96							9.6	48.2	4.8	1.2	0.6	1.2	4.2	30.1	
	Layers				-															
	Total	4.0	128.0	12.6	10.13-15.46						0.3	9.0	65.8	10.7	1.6	0.5	0.9	1.3	9.9	
Ciprofloxacin	Cattle	≦0.03	≦0.03	0.6	0.07-2.11	96.5	1.2	0.6	1.2					0.6						
	Pigs	≦0.03	0.1	0.8	0.01-4.31	87.4	3.9	4.7	2.4			0.8		0.8						
	Broilers	≦0.03	0.5	5.4	2.50-10.05	60.8	1.2	9.6	17.5	1.2	3.0	1.2	1.2	4.2						
	Layers				-															
	Total	≦0.03	0.1	1.9	0.98-3.29	85.3	1.7	3.8	5.7	0.3	0.8	0.5	0.3	1.6						
Colistin	Cattle	0.3	1.0	0.0	0-1.08			25.5	37.8	25.8	9.7	0.9	0.3							
	Pigs	0.3	0.5	0.0	0-2.87			17.3	59.1	22.0		1.6								
	Broilers	0.5	1.0	0.6	0.01-3.32			10.2	29.5	39.8	15.7	2.4	1.2	0.6		0.6				
	Layers				-															
	Total	0.3	1.0	0.2	0-0.88			19.9	39.9	28.7	9.3	1.4	0.5	0.2		0.2				
Chloramphenicol	Cattle	8.0	8.0	2.3	1.01-4.58						0.3	0.3	18.8	72.1	6.2	0.6	0.3	0.3	1.2	
	Pigs	8.0	>128	23.6	16.54-31.98								12.6	53.5	10.2	2.4	3.9	5.5	11.8	
	Broilers	8.0	32.0	11.4	7.03-17.30						0.6		24.1	57.8	6.0	3.0	4.2	1.8	2.4	
	Layers				-															
	Total	8.0	16.0	9.0	6.88-11.50						0.3	0.2	18.9	64.7	6.9	1.6	2.1	1.7	3.6	

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs							
						2.38/0.12	4.75/0.25	9.5/0.5	19/1	38/2	76/4	152/8	>152/8
Sulfamethoxazole /Trimethoprim	Cattle	≦2.38/0.12	9.5/0.5	2.9	1.41-5.33	66.9	16.7	8.5	4.1	0.9	0.3		2.6
	Pigs	4.75/0.25	>152/8	26.8	19.30-35.36	44.1	8.7	7.1	8.7	4.7			26.8
	Broilers	4.75/0.25	152/8	31.9	24.91-39.60	48.2	8.4	7.2	3.6	0.6		31.9	
	Layers				-								
	Total	≦2.38/0.12	152/8	15.3	12.58-18.35	57.4	12.9	7.9	4.9	1.6	0.2	8.4	6.8

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

Table3.1. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=14), pigs(n=39), broilers(n=90) and layers(n=76) in 2012_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%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	1.0	1.0	0.0	0-23.17		14.3	7.1	7.1	71.4										
	Pigs	1.0	1.0	2.6	0.06-13.48				28.2	66.7	2.6							2.6		
	Broilers	1.0	1.0	0.0	0-4.02				10.0	87.8	2.2									
	Layers	1.0	1.0	0.0	0-4.74				23.7	76.3										
	Total	1.0	1.0	0.5	0.01-2.52		0.9	0.5	17.8	79.0	1.4							0.5		
Dihydrostreptomycin	Cattle	64.0	128.0	35.7	12.75-64.87									14.3	14.3	35.7	35.7			
	Pigs	128.0	512.0	51.3	34.78-67.59							2.6			7.7	38.5	5.1			46.2
	Broilers	64.0	512.0	40.0	29.81-50.87										5.6	54.4	14.4		2.2	23.3
	Layers	64.0	512.0	34.2	23.70-45.99										22.4	43.4	15.8	2.6		15.8
	Total	64.0	512.0	39.7	33.19-46.54							0.5		0.9	12.3	46.6	14.6	0.9	0.9	23.3
Gentamicin	Cattle	16.0	16.0	0.0	0-23.17							28.6		71.4						
	Pigs	16.0	>256	12.8	4.29-27.43						5.1	7.7	20.5	53.8					12.8	
	Broilers	16.0	32.0	16.7	9.63-26.00								40.0	43.3	7.8				8.9	
	Layers	16.0	16.0	6.6	2.17-14.69						1.3	5.3	38.2	48.7	6.6					
	Total	16.0	32.0	11.4	7.52-16.39						1.4	5.0	33.3	48.9	5.5				5.9	
Kanamycin	Cattle	64.0	64.0	0.0	0-23.17									7.1	21.4	71.4				
	Pigs	64.0	512.0	35.9	21.17-52.91									7.7	12.8	43.6				35.9
	Broilers	64.0	512.0	37.8	27.76-48.62										18.9	43.3	8.9	2.2		26.7
	Layers	64.0	512.0	31.6	21.38-43.26									5.3	26.3	36.8	13.2	2.6	2.6	13.2
	Total	64.0	512.0	32.9	26.69-39.53									3.7	20.5	42.9	8.2	1.8	0.9	21.9
Oxytetracycline	Cattle	0.5	1.0	0.0	0-23.17			7.1	64.3	28.6										
	Pigs	64.0	>64	61.5	44.51-76.81			7.7	10.3	12.8		2.6	5.1	2.6	7.7	5.1	46.2			
	Broilers	32.0	>64	68.9	58.26-78.24			2.2	4.4	12.2		2.2	10.0	15.6	12.2	8.9	32.2			
	Layers	32.0	>64	57.9	46.01-69.14			7.9	21.1	11.8	1.3			6.6	5.3	13.2	32.9			
	Total	32.0	>64	59.4	52.53-65.93			5.5	15.1	13.2	0.5	1.4	5.0	9.1	8.2	9.1	32.9			
Chloramphenicol	Cattle	8.0	8.0	0.0	0-23.17						14.3	28.6	57.1							
	Pigs	8.0	128.0	48.7	32.41-65.22						5.1	17.9	28.2		7.7	2.6	35.9			2.6
	Broilers	8.0	16.0	10.0	4.67-18.14							20.0	63.3	6.7		5.6	4.4			
	Layers	8.0	16.0	5.3	1.45-12.94						5.3	31.6	46.1	11.8	2.6	1.3	1.3			
	Total	8.0	64.0	14.6	10.21-20.00						3.7	24.2	50.7	6.8	2.3	3.2	8.7			0.5
Bacitracin	Cattle	256.0	512.0	-	-										14.3		14.3	57.1	14.3	
	Pigs	256.0	512.0	-	-										5.1		12.8	61.5	12.8	7.7
	Broilers	256.0	512.0	-	-										2.2	4.4	25.6	50.0	5.6	12.2
	Layers	256.0	512.0	-	-										3.9	2.6	25.0	55.3	9.2	3.9
	Total	256.0	512.0	-	-										4.1	2.7	22.4	54.3	8.7	7.8

Table3.1. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=14), pigs(n=39), broilers(n=90) and layers(n=76) in 2012_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%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	4.0	8.0	-	-					28.6		57.1	14.3							
	Pigs	4.0	8.0	-	-				5.1		28.2	56.4	5.1	5.1						
	Broilers	4.0	8.0	-	-					2.2	16.7	68.9	12.2							
	Layers	4.0	8.0	-	-					1.3	21.1	60.5	15.8					1.3		
	Total	4.0	8.0	-	-				0.9	3.2	19.2	63.0	12.3	0.9				0.5		
Erythromycin	Cattle	0.5	2.0	0.0	0-23.17		14.3	14.3	28.6	14.3	28.6									
	Pigs	16.0	>128	53.8	37.18-69.91			2.6	5.1	17.9	20.5		2.6	2.6				48.7		
	Broilers	16.0	>128	53.3	42.51-63.93				8.9	20.0	15.6	2.2	2.2	8.9	1.1	1.1	2.2	37.8		
	Layers	1.0	>128	27.6	17.98-39.11		6.6	5.3	7.9	30.3	22.4		1.3					26.3		
	Total	2.0	>128	41.1	34.51-47.93		3.2	3.2	9.1	22.8	19.6	0.9	1.8	4.1	0.5	0.5	0.9	33.3		
Tylosin	Cattle	2.0	2.0	0.0	0-23.17					14.3	78.6	7.1								
	Pigs	128.0	>256	51.3	34.78-67.59					15.4	17.9	10.3	2.6	2.6			2.6	2.6	46.2	
	Broilers	128.0	>256	55.6	44.69-66.04					5.6	26.7	12.2				1.1	5.6	7.8	41.1	
	Layers	2.0	>256	27.6	17.98-39.11					23.7	32.9	13.2	2.6				1.3		26.3	
	Total	4.0	>256	41.6	34.95-48.39					14.2	30.6	11.9	1.4	0.5		0.5	3.2	3.7	34.2	
Lincomycin	Cattle	32.0	32.0	0.0	0-23.17								21.4	21.4	57.1					
	Pigs	256.0	>256	56.4	39.62-72.19				5.1		2.6			15.4	20.5		2.6	7.7	46.2	
	Broilers	128.0	>256	54.4	43.60-64.99							1.1	2.2	17.8	22.2	2.2	5.6	10.0	38.9	
	Layers	32.0	>256	27.6	17.98-39.11								3.9	23.7	44.7		1.3		26.3	
	Total	32.0	>256	42.0	35.39-48.85				0.9		0.5	0.5	3.7	19.6	32.0	0.9	3.2	5.5	33.3	
Enrofloxacin	Cattle	1.0	1.0	0.0	0-23.17				21.4	78.6										
	Pigs	1.0	2.0	0.0	0-9.03			5.1	41.0	43.6	10.3									
	Broilers	1.0	1.0	0.0	0-4.02			2.2	30.0	61.1	6.7									
	Layers	1.0	1.0	2.6	0.32-9.19			3.9	44.7	46.1	2.6				2.6					
	Total	1.0	1.0	0.9	0.11-3.26			3.2	36.5	53.9	5.5				0.9					
Salinomycin	Cattle	2.0	2.0	-	-				7.1	28.6	64.3									
	Pigs	1.0	2.0	-	-				10.3	53.8	35.9									
	Broilers	2.0	8.0	-	-				2.2	32.2	27.8	16.7	13.3	7.8						
	Layers	1.0	2.0	-	-				10.5	46.1	36.8	1.3	3.9		1.3					
	Total	2.0	8.0	-	-				6.8	40.6	34.7	7.3	6.8	3.2	0.5					

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

Table3.2. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=3), pigs(n=22), broilers(n=55) and layers(n=67) in 2013_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%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	1.0	1.0	0.0	0-70.76					100										
	Pigs	1.0	1.0	0.0	0-15.44				13.6	81.8	4.5									
	Broilers	1.0	1.0	0.0	0-6.49			1.8	5.5	92.7										
	Layers	1.0	1.0	0.0	0-5.36			1.5	9.0	83.6	6.0									
	Total	1.0	1.0	0.0	0-2.48			1.4	8.2	87.1	3.4									
Dihydrostreptomycin	Cattle	128.0	512.0	100.0	29.24-100												66.7			33.3
	Pigs	128.0	512.0	68.2	45.12-86.14										4.5	27.3	22.7	4.5	9.1	31.8
	Broilers	512.0	512.0	80.0	66.85-89.74										1.8	18.2	27.3	1.8		50.9
	Layers	128.0	512.0	62.7	49.95-74.29										7.5	29.9	46.3	1.5		14.9
	Total	128.0	512.0	70.7	62.68-77.96										4.8	24.5	36.1	2.0	1.4	31.3
Gentamicin	Cattle	8.0	16.0	0.0	0-70.76								66.7	33.3						
	Pigs	16.0	32.0	13.6	2.90-34.92						13.6	4.5	18.2	50.0	4.5	4.5	4.5			
	Broilers	16.0	32.0	16.4	7.76-28.81								21.8	61.8	7.3				9.1	
	Layers	16.0	32.0	13.4	6.33-23.98						1.5	4.5	13.4	67.2	11.9				1.5	
	Total	16.0	32.0	14.3	9.06-21.01						2.7	2.7	18.4	61.9	8.8	0.7	0.7		4.1	
Kanamycin	Cattle	64.0	512.0	33.3	0.84-90.58											66.7				33.3
	Pigs	64.0	512.0	27.3	10.72-50.23									13.6		59.1	9.1			18.2
	Broilers	128.0	512.0	50.9	37.07-64.65										7.3	41.8	9.1			41.8
	Layers	64.0	512.0	22.4	13.10-34.23									7.5	3.0	67.2	10.4			11.9
	Total	64.0	512.0	34.0	26.41-42.28									5.4	4.1	56.5	9.5			24.5
Oxytetracycline	Cattle	1.0	32.0	33.3	0.84-90.58				33.3	33.3					33.3					
	Pigs	>64	>64	77.3	54.62-92.18					22.7					13.6		63.6			
	Broilers	>64	>64	85.5	73.33-93.51				1.8	7.3			5.5	10.9	9.1	5.5	60.0			
	Layers	8.0	>64	49.3	36.81-61.76			1.5	17.9	28.4			3.0	3.0	13.4	1.5	31.3			
	Total	32.0	>64	66.7	58.42-74.22			0.7	9.5	19.7			3.4	5.4	12.2	2.7	46.3			
Chloramphenicol	Cattle	8.0	8.0	0.0	0-70.76								100.0							
	Pigs	8.0	128.0	31.8	13.86-54.88							9.1	40.9	18.2	9.1	9.1	13.6			
	Broilers	8.0	128.0	21.8	11.81-35.02							7.3	65.5	5.5	1.8	5.5	14.5			
	Layers	8.0	8.0	7.5	2.46-16.57							13.4	79.1			1.5	6.0			
	Total	8.0	128.0	16.3	10.74-23.32							10.2	68.7	4.8	2.0	4.1	10.2			
Bacitracin	Cattle	256.0	256.0	-	-												33.3	66.7		
	Pigs	256.0	512.0	-	-											9.1	22.7	50.0	18.2	
	Broilers	256.0	512.0	-	-												29.1	50.9	7.3	12.7
	Layers	256.0	512.0	-	-												10.4	68.7	10.4	10.4
	Total	256.0	512.0	-	-											1.4	19.7	59.2	10.2	9.5

Table3.2. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=3), pigs(n=22), broilers(n=55) and layers(n=67) in 2013_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%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	4.0	8.0	-	-							66.7	33.3							
	Pigs	8.0	8.0	-	-					4.5	9.1	31.8	50.0	4.5						
	Broilers	4.0	8.0	-	-							67.3	29.1	3.6						
	Layers	4.0	8.0	-	-				1.5	1.5	7.5	55.2	34.3							
	Total	4.0	8.0	-	-				0.7	1.4	4.8	56.5	34.7	2.0						
Erythromycin	Cattle	2.0	2.0	0.0	0-70.76				33.3		66.7									
	Pigs	>128	>128	59.1	36.35-79.30				4.5	9.1	18.2	9.1						59.1		
	Broilers	4.0	>128	49.1	35.31-63.01			1.8	9.1	9.1	25.5	5.5	1.8	3.6	3.6			40.0		
	Layers	2.0	>128	23.9	14.30-35.87		1.5	10.4	11.9	16.4	23.9	11.9	1.5					22.4		
	Total	2.0	>128	38.1	30.21-46.47		0.7	5.4	10.2	12.2	24.5	8.8	1.4	1.4	1.4			34.0		
Tylosin	Cattle	2.0	2.0	0.0	0-70.76					33.3	66.7									
	Pigs	>256	>256	54.5	32.21-75.62						22.7	9.1	4.5	9.1					54.5	
	Broilers	4.0	>256	49.1	35.31-63.01						38.2	12.7						3.6	45.5	
	Layers	2.0	>256	22.4	13.10-34.23					3.0	67.2	7.5							22.4	
	Total	2.0	>256	36.7	28.94-45.08					2.0	49.7	9.5	0.7	1.4				1.4	35.4	
Lincomycin	Cattle	32.0	32.0	0.0	0-70.76										100.0					
	Pigs	>256	>256	63.6	40.65-82.81										27.3	9.1			63.6	
	Broilers	128.0	>256	50.9	37.07-64.65										45.5	3.6	1.8	7.3	41.8	
	Layers	32.0	>256	22.4	13.10-34.23					1.5		1.5		1.5	64.2	9.0	3.0		19.4	
	Total	32.0	>256	38.8	30.85-47.16					0.7		0.7		0.7	52.4	6.8	2.0	2.7	34.0	
Enrofloxacin	Cattle	0.5	1.0	0.0	0-70.76			33.3	33.3	33.3										
	Pigs	1.0	2.0	0.0	0-15.44				31.8	50.0	18.2									
	Broilers	1.0	1.0	5.5	1.13-15.13				32.7	60.0	1.8			1.8	3.6					
	Layers	1.0	2.0	1.5	0.03-8.04				20.9	68.7	9.0					1.5				
	Total	1.0	2.0	2.7	0.74-6.83			0.7	27.2	61.9	7.5			0.7	1.4	0.7				
Salinomycin	Cattle	2.0	2.0	-	-					33.3	66.7									
	Pigs	2.0	2.0	-	-					18.2	72.7	9.1								
	Broilers	2.0	8.0	-	-					20.0	47.3	9.1	23.6							
	Layers	2.0	4.0	-	-					35.8	49.3	9.0	6.0							
	Total	2.0	8.0	-	-					27.2	52.4	8.8	11.6							

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

Table3.3. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=32), pigs(n=85) and broilers(n=104) in 2012_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%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	1.0	1.0	0.0	0-10.89				34.4	65.6										
	Pigs	1.0	1.0	0.0	0-4.25			1.2	23.5	74.1	1.2									
	Broilers	1.0	1.0	0.0	0-3.49				1.9	95.2	1.9		1.0							
	Layers				-															
	Total	1.0	1.0	0.0	0-1.66			0.5	14.9	82.8	1.4		0.5							
Dihydrostreptomycin	Cattle	128.0	512.0	90.6	74.97-98.03										3.1	6.3	50.0	28.1	3.1	9.4
	Pigs	128.0	512.0	88.2	79.42-94.22										3.5	8.2	41.2	9.4		37.6
	Broilers	128.0	512.0	76.9	67.57-84.69											23.1	34.6	3.8		38.5
	Layers				-															
	Total	128.0	512.0	83.3	77.64-87.96										1.8	14.9	39.4	9.5	0.5	33.9
Gentamicin	Cattle	32.0	64.0	68.8	49.99-83.89							3.1		28.1	37.5	25.0			6.3	
	Pigs	32.0	>256	76.5	66.02-85.00							2.4	3.5	17.6	57.6	7.1			11.8	
	Broilers	16.0	>256	35.6	26.43-45.57								4.8	59.6	22.1	1.9			11.5	
	Layers				-															
	Total	32.0	>256	56.1	49.29-62.76							1.4	3.6	38.9	38.0	7.2			10.9	
Kanamycin	Cattle	128.0	256.0	71.9	53.25-86.26									3.1		25.0	59.4	6.3		6.3
	Pigs	128.0	512.0	72.9	62.21-82.02									1.2	3.5	22.4	37.6	7.1		28.2
	Broilers	128.0	512.0	71.2	61.40-79.67										1.0	27.9	26.0	1.0	1.9	42.3
	Layers				-															
	Total	128.0	512.0	71.9	65.52-77.77									0.9	1.8	25.3	35.3	4.1	0.9	31.7
Oxytetracycline	Cattle	1.0	64.0	31.3	16.11-50.01			12.5	25.0	31.3				12.5	6.3	6.3	6.3			
	Pigs	32.0	>64	64.7	53.53-74.83				8.2	25.9			1.2	2.4	17.6	2.4	42.4			
	Broilers	>64	>64	75.0	65.55-82.98			1.0	4.8	14.4			4.8	17.3	3.8	2.9	51.0			
	Layers				-															
	Total	32.0	>64	64.7	58.00-71.02			2.3	9.0	21.3			2.7	10.9	9.5	3.2	41.2			
Chloramphenicol	Cattle	8.0	16.0	9.4	1.97-25.03							6.3	68.8	15.6		9.4				
	Pigs	16.0	128.0	30.6	21.04-41.53							2.4	20.0	47.1		12.9	17.6			
	Broilers	16.0	64.0	17.3	10.59-25.97							1.0	27.9	53.8	1.0	10.6	5.8			
	Layers				-															
	Total	16.0	64.0	21.3	16.06-27.26							2.3	30.8	45.7	0.5	11.3	9.5			
Bacitracin	Cattle	256.0	512.0	-	-											3.1	3.1	53.1	40.6	
	Pigs	256.0	512.0	-	-											1.2	5.9	74.1	17.6	1.2
	Broilers	256.0	512.0	-	-									1.0		1.0	19.2	61.5	6.7	10.6
	Layers				-															
	Total	256.0	512.0	-	-									0.5		1.4	11.8	65.2	15.8	5.4

Table3.3. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=32), pigs(n=85) and broilers(n=104) in 2012_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%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	4.0	8.0	-	-					9.4	9.4	50.0	31.3							
	Pigs	4.0	16.0	-	-				1.2	3.5	2.4	48.2	32.9	11.8						
	Broilers	4.0	8.0	-	-					1.0	1.9	48.1	47.1	1.9						
	Layers				-															
	Total	4.0	8.0	-	-				0.5	3.2	3.2	48.4	39.4	5.4						
Erythromycin	Cattle	2.0	16.0	21.9	9.27-39.98			3.1	6.3	15.6	25.0	28.1	9.4	6.3				6.3		
	Pigs	>128	>128	51.8	40.63-62.79			2.4	20.0	5.9	8.2	11.8		1.2				50.6		
	Broilers	16.0	>128	58.7	48.57-68.23			2.9	5.8	13.5	18.3	1.0		10.6	6.7			41.3		
	Layers				-															
	Total	8.0	>128	50.7	43.89-57.45			2.7	11.3	10.9	15.4	9.0	1.4	6.3	3.2			39.8		
Tylosin	Cattle	4.0	8.0	6.3	0.76-20.81						12.5	71.9	9.4						6.3	
	Pigs	>256	>256	50.6	39.51-61.62						12.9	30.6	5.9						50.6	
	Broilers	256.0	>256	57.7	47.61-67.33						16.3	24.0	1.0	1.0			1.0	7.7	49.0	
	Layers				-															
	Total	8.0	>256	47.5	40.77-54.32						14.5	33.5	4.1	0.5			0.5	3.6	43.4	
Lincomycin	Cattle	64.0	256.0	34.4	18.57-53.20										18.8	46.9	18.8	9.4	6.3	
	Pigs	>256	>256	76.5	66.02-85.00									1.2	3.5	18.8	2.4	4.7	69.4	
	Broilers	>256	>256	57.7	47.61-67.33									1.0	25.0	16.3	1.9	3.8	51.9	
	Layers				-															
	Total	>256	>256	61.5	54.76-68.00									0.9	15.8	21.7	4.5	5.0	52.0	
Enrofloxacin	Cattle	1.0	2.0	3.1	0.07-16.22				3.1	53.1	40.6	3.1								
	Pigs	1.0	2.0	5.9	1.93-13.20				5.9	61.2	27.1	4.7			1.2					
	Broilers	1.0	1.0	2.9	0.59-8.20				9.6	80.8	6.7		1.9		1.0					
	Layers				-															
	Total	1.0	2.0	4.1	1.87-7.59				7.2	69.2	19.5	2.3	0.9		0.9					
Salinomycin	Cattle	1.0	2.0	-	-		3.1	25.0	9.4	18.8	43.8									
	Pigs	1.0	2.0	-	-			2.4	9.4	43.5	44.7									
	Broilers	2.0	8.0	-	-					35.6	33.7	1.9	26.0	2.9						
	Layers				-															
	Total	2.0	8.0	-	-		0.5	4.5	5.0	36.2	39.4	0.9	12.2	1.4						

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

Table4.1. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=44), pigs(n=33), broilers(n=84) and layers(n=64) in 2012_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%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	1.0	2.0	0.0	0-8.05				18.2	36.4	43.2	2.3								
	Pigs	1.0	4.0	0.0	0-10.58			6.1	27.3	18.2	24.2	15.2	9.1							
	Broilers	2.0	8.0	2.4	0.28-8.34		3.6	15.5	9.5	20.2	23.8	11.9	13.1		2.4					
	Layers	1.0	4.0	0.0	0-5.61			10.9	18.8	25.0	29.7	9.4	6.3							
	Total	1.0	4.0	0.9	0.10-3.18		1.3	9.8	16.4	24.4	29.3	9.8	8.0		0.9					
Dihydrostreptomycin	Cattle	32.0	128.0	22.7	11.47-37.85									9.1	45.5	22.7	13.6	2.3		6.8
	Pigs	64.0	512.0	30.3	15.59-48.72								3.0	6.1	36.4	24.2			9.1	21.2
	Broilers	64.0	512.0	28.6	19.23-39.47										23.8	47.6	2.4	1.2	9.5	15.5
	Layers	64.0	64.0	6.3	1.72-15.24										40.6	53.1				6.3
	Total	64.0	512.0	21.3	16.16-27.28								0.4	2.7	34.7	40.9	3.6	0.9	4.9	12.0
Gentamicin	Cattle	4.0	16.0	2.3	0.05-12.03						11.4	52.3	22.7	11.4	2.3					
	Pigs	4.0	8.0	0.0	0-10.58					3.0	6.1	54.5	33.3	3.0						
	Broilers	4.0	8.0	3.6	0.74-10.09						2.4	47.6	41.7	4.8		1.2			2.4	
	Layers	8.0	8.0	1.6	0.03-8.41						9.4	37.5	46.9	4.7	1.6					
	Total	4.0	8.0	2.2	0.72-5.11					0.4	6.7	46.7	38.2	5.8	0.9	0.4			0.9	
Kanamycin	Cattle	64.0	128.0	34.1	20.49-49.92									9.1	13.6	43.2	29.5	4.5		
	Pigs	64.0	128.0	30.3	15.59-48.72									9.1	30.3	30.3	24.2			6.1
	Broilers	64.0	512.0	34.5	24.48-45.70							1.2			15.5	48.8	17.9	6.0		10.7
	Layers	64.0	128.0	35.9	24.31-48.91										23.4	40.6	26.6	4.7	3.1	1.6
	Total	64.0	256.0	34.2	28.04-40.83							0.4		3.1	19.6	42.7	23.6	4.4	0.9	5.3
Oxytetracycline	Cattle	0.3	8.0	9.1	2.53-21.67			50.0	36.4				4.5		4.5		4.5			
	Pigs	0.5	>64	42.4	25.42-60.92		6.1	33.3	12.1	6.1					9.1		33.3			
	Broilers	32.0	>64	63.1	51.86-73.38		3.6	20.2	10.7	2.4					13.1	3.6	46.4			
	Layers	0.3	8.0	7.8	2.58-17.30		18.8	43.8	17.2	6.3			6.3				7.8			
	Total	0.5	>64	33.8	27.62-40.37		7.6	34.7	17.8	3.6			2.7		7.1	1.3	25.3			
Chloramphenicol	Cattle	4.0	4.0	0.0	0-8.05						4.5	93.2	2.3							
	Pigs	4.0	8.0	0.0	0-10.58						15.2	63.6	21.2							
	Broilers	4.0	8.0	4.8	1.31-11.75						25.0	59.5	8.3	2.4	4.8					
	Layers	4.0	8.0	0.0	0-5.61						26.6	62.5	9.4	1.6						
	Total	4.0	8.0	1.8	0.48-4.49						20.0	67.6	9.3	1.3	1.8					
Bacitracin	Cattle	256.0	512.0	-	-								2.3	2.3	11.4	4.5	9.1	36.4	25.0	9.1
	Pigs	256.0	512.0	-	-										12.1		12.1	54.5	18.2	3.0
	Broilers	256.0	512.0	-	-								6.0	19.0		1.2	7.1	21.4	11.9	33.3
	Layers	256.0	512.0	-	-								4.7	17.2	3.1	6.3	6.3	37.5	18.8	6.3
	Total	256.0	512.0	-	-								4.0	12.4	4.9	3.1	8.0	33.8	17.3	16.4

Table4.1. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=44), pigs(n=33), broilers(n=84) and layers(n=64) in 2012_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%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	2.0	2.0	-	-			2.3	22.7	18.2	56.8									
	Pigs	2.0	2.0	-	-			3.0	18.2	18.2	57.6	3.0								
	Broilers	1.0	2.0	-	-			2.4	26.2	39.3	23.8	6.0	2.4							
	Layers	1.0	2.0	-	-				48.4	25.0	23.4	3.1								
	Total	1.0	2.0	-	-			1.8	30.7	28.0	35.1	3.6	0.9							
Erythromycin	Cattle	1.0	8.0	11.4	3.79-24.56		18.2	13.6	2.3	20.5	15.9	18.2	2.3	2.3				6.8		
	Pigs	2.0	16.0	15.2	5.10-31.90		9.1	9.1		27.3	36.4	3.0	3.0	3.0				9.1		
	Broilers	1.0	>128	32.1	22.36-43.23		34.5	2.4	10.7	9.5	4.8	6.0	6.0	2.4	1.2			22.6		
	Layers	0.5	4.0	6.3	1.72-15.24		29.7	6.3	17.2	9.4	17.2	14.1	6.3							
	Total	1.0	>128	18.2	13.40-23.90		26.2	6.7	9.3	14.2	15.1	10.2	4.9	1.8	0.4			11.1		
Tylosin	Cattle	4.0	8.0	9.1	2.53-21.67					4.5	38.6	31.8	15.9					2.3	6.8	
	Pigs	4.0	256.0	12.1	3.40-28.21				3.0	6.1	36.4	39.4	3.0					3.0	9.1	
	Broilers	2.0	>256	26.2	17.19-36.93					11.9	38.1	15.5	4.8	1.2	2.4			2.4	23.8	
	Layers	2.0	8.0	1.6	0.03-8.41					21.9	37.5	20.3	14.1	4.7		1.6				
	Total	2.0	>256	13.8	9.55-18.99				0.4	12.4	37.8	23.6	9.3	1.8	0.9	0.4		1.8	11.6	
Lincomycin	Cattle	16.0	32.0	9.1	2.53-21.67			2.3	22.7				2.3	40.9	22.7				9.1	
	Pigs	16.0	>256	39.4	22.90-57.87			6.1	15.2		3.0		15.2	18.2	3.0		6.1	6.1	27.3	
	Broilers	16.0	>256	31.0	21.31-41.98			4.8	15.5	10.7			10.7	22.6	2.4	2.4	4.8	7.1	19.0	
	Layers	1.0	16.0	0.0	0-5.61			15.6	20.3	17.2	1.6		4.7	31.3	6.3	3.1				
	Total	16.0	>256	19.1	14.18-24.87			7.6	18.2	8.9	0.9		8.0	28.0	7.6	1.8	2.7	3.6	12.9	
Enrofloxacin	Cattle	1.0	16.0	36.4	22.40-52.23				13.6	36.4	13.6	20.5	4.5	11.4						
	Pigs	2.0	16.0	45.5	28.10-63.65				6.1	21.2	27.3	9.1	24.2	9.1	3.0					
	Broilers	4.0	8.0	65.5	54.30-75.52				2.4	16.7	15.5	32.1	27.4		3.6	2.4				
	Layers	4.0	16.0	56.3	43.27-68.63				7.8	14.1	21.9	20.3	23.4	6.3	6.3					
	Total	4.0	8.0	54.2	47.46-60.87				6.7	20.4	18.7	23.1	21.3	5.3	3.6	0.9				
Salinomycin	Cattle	2.0	2.0	-	-				4.5	31.8	59.1	4.5								
	Pigs	2.0	2.0	-	-				3.0	39.4	57.6									
	Broilers	2.0	8.0	-	-					26.2	34.5	21.4	11.9	6.0						
	Layers	2.0	2.0	-	-					48.4	42.2	7.8				1.6				
	Total	2.0	4.0	-	-				1.3	35.6	44.9	11.1	4.4	2.2		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

Table4.2. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=10), pigs(n=18), broilers(n=46) and layers(n=22) in 2013_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%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	1.0	2.0	0.0	0-30.85				20.0	30.0	50.0									
	Pigs	2.0	2.0	0.0	0-18.54			5.6	5.6	22.2	61.1	5.6								
	Broilers	4.0	8.0	2.2	0.05-11.53		2.2	6.5	15.2	4.3	6.5	26.1	37.0		2.2					
	Layers	0.5	1.0	0.0	0-15.44		9.1	31.8	36.4	18.2		4.5								
	Total	2.0	8.0	1.0	0.02-5.67		3.1	11.5	18.8	13.5	19.8	14.6	17.7		1.0					
Dihydrostreptomycin	Cattle	64.0	128.0	20.0	2.52-55.61										30.0	50.0	20.0			
	Pigs	64.0	512.0	22.2	6.40-47.64										33.3	44.4	5.6			16.7
	Broilers	64.0	512.0	23.9	12.58-38.77										19.6	56.5	2.2	2.2	2.2	17.4
	Layers	64.0	64.0	0.0	0-15.44										18.2	81.8				
	Total	64.0	512.0	17.7	10.66-26.84										22.9	59.4	4.2	1.0	1.0	11.5
Gentamicin	Cattle	8.0	16.0	0.0	0-30.85							10.0	70.0	20.0						
	Pigs	8.0	16.0	0.0	0-18.54							33.3	44.4	22.2						
	Broilers	8.0	16.0	2.2	0.05-11.53							15.2	60.9	21.7	2.2					
	Layers	8.0	8.0	0.0	0-15.44							22.7	68.2	9.1						
	Total	8.0	16.0	1.0	0.02-5.67							19.8	60.4	18.8	1.0					
Kanamycin	Cattle	128.0	256.0	60.0	26.23-87.85										20.0	20.0	30.0	30.0		
	Pigs	128.0	512.0	61.1	35.49-83.23										5.6	33.3	22.2	27.8		11.1
	Broilers	128.0	512.0	73.9	58.86-85.74										2.2	23.9	37.0	17.4		19.6
	Layers	128.0	256.0	54.5	32.21-75.62									9.1	4.5	31.8	40.9	9.1	4.5	
	Total	128.0	512.0	65.6	55.23-75.03									2.1	5.2	27.1	34.4	18.8	1.0	11.5
Oxytetracycline	Cattle	0.3	0.5	0.0	0-30.85			60.0	30.0	10.0										
	Pigs	1.0	>64	50.0	26.01-73.99			22.2	22.2	5.6				11.1	11.1		27.8			
	Broilers	>64	>64	67.4	51.98-80.47			21.7	4.3	2.2		2.2	2.2	2.2	4.3	4.3	56.5			
	Layers	0.3	64.0	22.7	7.82-45.38		9.1	45.5	22.7						9.1	4.5	9.1			
	Total	1.0	>64	46.9	36.61-57.34		2.1	31.3	14.6	3.1		1.0	1.0	3.1	6.3	3.1	34.4			
Chloramphenicol	Cattle	4.0	8.0	0.0	0-30.85							70.0	30.0							
	Pigs	8.0	32.0	16.7	3.57-41.42							33.3	50.0		16.7					
	Broilers	4.0	8.0	2.2	0.05-11.53						4.3	78.3	8.7	6.5	2.2					
	Layers	4.0	4.0	0.0	0-15.44						9.1	90.9								
	Total	4.0	8.0	4.2	1.14-10.33						4.2	71.9	16.7	3.1	4.2					
Bacitracin	Cattle	128.0	512.0	-	-												50.0	30.0	20.0	
	Pigs	512.0	512.0	-	-												16.7	22.2	33.3	27.8
	Broilers	256.0	512.0	-	-						2.2	2.2	10.9	10.9			4.3	19.6	8.7	41.3
	Layers	128.0	256.0	-	-							4.5	13.6	18.2		4.5	9.1	45.5	4.5	
	Total	256.0	512.0	-	-						1.0	2.1	8.3	9.4		1.0	12.5	27.1	13.5	25.0

Table4.2. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=10), pigs(n=18), broilers(n=46) and layers(n=22) in 2013_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%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	1.0	2.0	-	-				30.0	50.0	20.0									
	Pigs	2.0	2.0	-	-				5.6	27.8	61.1	5.6								
	Broilers	1.0	2.0	-	-				28.3	47.8	21.7		2.2							
	Layers	0.5	1.0	-	-			13.6	50.0	27.3	9.1									
	Total	1.0	2.0	-	-			3.1	29.2	39.6	26.0	1.0	1.0							
Erythromycin	Cattle	4.0	8.0	30.0	6.67-65.25					20.0	20.0	30.0	30.0							
	Pigs	4.0	>128	50.0	26.01-73.99		5.6	16.7			11.1	16.7	5.6	11.1				33.3		
	Broilers	0.5	>128	23.9	12.58-38.77		47.8		10.9	10.9	2.2	4.3	8.7		2.2		2.2	10.9		
	Layers	0.5	4.0	9.1	1.12-29.17		40.9	4.5	18.2	13.6		13.6	9.1							
	Total	1.0	>128	26.0	17.61-36.00		33.3	4.2	9.4	10.4	5.2	11.5	10.4	2.1	1.0		1.0	11.5		
Tylosin	Cattle	2.0	4.0	0.0	0-30.85						50.0	40.0	10.0							
	Pigs	4.0	>256	33.3	13.34-59.01						11.1	44.4	11.1						33.3	
	Broilers	2.0	>256	15.2	6.34-28.87					10.9	50.0	23.9					2.2		13.0	
	Layers	1.0	2.0	0.0	0-15.44					54.5	36.4	4.5	4.5							
	Total	2.0	>256	13.5	7.41-22.05					17.7	39.6	25.0	4.2				1.0		12.5	
Lincomycin	Cattle	4.0	16.0	0.0	0-30.85				10.0	20.0	10.0	10.0		50.0						
	Pigs	16.0	>256	38.9	17.29-64.26					5.6			16.7	38.9					38.9	
	Broilers	16.0	>256	28.3	15.98-43.47				17.4	6.5		2.2	6.5	39.1			8.7	2.2	17.4	
	Layers	0.5	16.0	0.0	0-15.44			13.6	45.5	4.5				36.4						
	Total	16.0	>256	20.8	13.21-30.33			3.1	19.8	7.3	1.0	2.1	6.3	39.6			4.2	1.0	15.6	
Enrofloxacin	Cattle	1.0	4.0	30.0	6.67-65.25				30.0	20.0	20.0	20.0	10.0							
	Pigs	2.0	16.0	38.9	17.29-64.26					22.2	38.9	11.1	11.1	11.1	5.6					
	Broilers	4.0	8.0	87.0	73.74-95.06					4.3	8.7	56.5	30.4							
	Layers	4.0	8.0	54.5	32.21-75.62				4.5	9.1	31.8	22.7	31.8							
	Total	4.0	8.0	64.6	54.16-74.08				4.2	10.4	20.8	36.5	25.0	2.1	1.0					
Salinomycin	Cattle	1.0	2.0	-	-					50.0	50.0									
	Pigs	2.0	2.0	-	-					11.1	83.3	5.6								
	Broilers	4.0	8.0	-	-					6.5	19.6	37.0	34.8	2.2						
	Layers	1.0	2.0	-	-					50.0	50.0									
	Total	2.0	8.0	-	-					21.9	41.7	18.8	16.7	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=6), pigs(n=20) and broilers(n=12) in 2012_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%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	1.0	2.0	0.0	0-45.93				33.3	16.7	50.0									
	Pigs	1.0	4.0	0.0	0-16.85		5.0		5.0	45.0	30.0	15.0								
	Broilers	2.0	4.0	0.0	0-26.47				16.7	16.7	41.7	16.7	8.3							
	Layers				-															
	Total	2.0	4.0	0.0	0-9.26		2.6		13.2	31.6	36.8	13.2	2.6							
Dihydrostreptomycin	Cattle	64.0	128.0	33.3	4.32-77.73											66.7	33.3			
	Pigs	128.0	512.0	75.0	50.89-91.35								5.0			20.0	25.0	15.0		35.0
	Broilers	64.0	512.0	50.0	21.09-78.91										8.3	41.7	33.3			16.7
	Layers				-															
	Total	128.0	512.0	60.5	43.38-75.97								2.6		2.6	34.2	28.9	7.9		23.7
Gentamicin	Cattle	16.0	32.0	33.3	4.32-77.73								16.7	50.0	33.3					
	Pigs	16.0	32.0	40.0	19.11-63.95						5.0		25.0	30.0	30.0	10.0				
	Broilers	8.0	16.0	8.3	0.21-38.48								66.7	25.0	8.3					
	Layers				-															
	Total	16.0	32.0	28.9	15.42-45.91						2.6		36.8	31.6	23.7	5.3				
Kanamycin	Cattle	128.0	512.0	83.3	34.12-99.99											16.7	33.3	33.3	16.7	
	Pigs	256.0	512.0	90.0	67.08-99.26											10.0	15.0	25.0	10.0	40.0
	Broilers	256.0	512.0	100.0	73.53-100												25.0	41.7	16.7	16.7
	Layers				-															
	Total	256.0	512.0	92.1	78.62-98.35											7.9	21.1	31.6	13.2	26.3
Oxytetracycline	Cattle	0.5	1.0	0.0	0-45.93			16.7	50.0	33.3										
	Pigs	0.5	>64	35.0	15.39-59.22			20.0	40.0				5.0		5.0	5.0	25.0			
	Broilers	64.0	>64	83.3	50.33-98.74				8.3	8.3				8.3	8.3	25.0	41.7			
	Layers				-															
	Total	1.0	>64	44.7	28.57-61.82			13.2	31.6	7.9			2.6	2.6	5.3	10.5	26.3			
Chloramphenicol	Cattle	8.0	16.0	0.0	0-45.93								83.3	16.7						
	Pigs	8.0	32.0	15.0	3.20-37.90							5.0	65.0	15.0	15.0					
	Broilers	4.0	8.0	0.0	0-26.47							50.0	41.7	8.3						
	Layers				-															
	Total	8.0	16.0	7.9	1.65-21.38							18.4	60.5	13.2	7.9					
Bacitracin	Cattle	512.0	512.0	-	-													33.3	66.7	
	Pigs	512.0	512.0	-	-							5.0					10.0	15.0	40.0	30.0
	Broilers	256.0	512.0	-	-									16.7			16.7	25.0	16.7	25.0
	Layers				-															
	Total	512.0	512.0	-	-							2.6		5.3			10.5	21.1	36.8	23.7

Table4.3. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=6), pigs(n=20) and broilers(n=12) in 2012_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%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	0.5	2.0	-	-				50.0	33.3	16.7									
	Pigs	2.0	2.0	-	-			5.0	30.0	10.0	45.0	10.0								
	Broilers	0.5	2.0	-	-				58.3	16.7	25.0									
	Layers				-															
	Total	1.0	2.0	-	-			2.6	42.1	15.8	34.2	5.3								
Erythromycin	Cattle	4.0	8.0	16.7	0.42-64.13				33.3			50.0	16.7							
	Pigs	8.0	>128	60.0	36.05-80.89			5.0	5.0	10.0	10.0	10.0	25.0	10.0	5.0			20.0		
	Broilers	1.0	>128	25.0	5.48-57.19		25.0	16.7		16.7	8.3	8.3						25.0		
	Layers				-															
	Total	4.0	>128	42.1	26.30-59.18		7.9	7.9	7.9	10.5	7.9	15.8	15.8	5.3	2.6			18.4		
Tylosin	Cattle	8.0	16.0	0.0	0-45.93							33.3	33.3	33.3						
	Pigs	16.0	>256	20.0	5.73-43.67								40.0	40.0					20.0	
	Broilers	4.0	>256	25.0	5.48-57.19						25.0	25.0	16.7	8.3					25.0	
	Layers				-															
	Total	8.0	>256	18.4	7.74-34.33						7.9	13.2	31.6	28.9					18.4	
Lincomycin	Cattle	4.0	64.0	0.0	0-45.93					33.3		16.7			33.3	16.7				
	Pigs	32.0	>256	30.0	11.89-54.28					5.0	15.0	15.0			20.0	15.0			30.0	
	Broilers	32.0	>256	50.0	21.09-78.91				8.3	8.3	16.7				16.7		16.7		33.3	
	Layers				-															
	Total	32.0	>256	31.6	17.50-48.66				2.6	10.5	13.2	10.5			21.1	10.5	5.3		26.3	
Enrofloxacin	Cattle	8.0	32.0	83.3	34.12-99.99						16.7	16.7	16.7	16.7	33.3					
	Pigs	4.0	16.0	65.0	40.78-84.61			5.0	5.0	5.0	20.0	25.0	20.0	10.0	5.0	5.0				
	Broilers	4.0	32.0	66.7	34.88-90.08						33.3	25.0	8.3	8.3	25.0					
	Layers				-															
	Total	4.0	32.0	68.4	51.34-82.50			2.6	2.6	2.6	23.7	23.7	15.8	10.5	15.8	2.6				
Salinomycin	Cattle	2.0	4.0	-	-				16.7		66.7	16.7								
	Pigs	1.0	2.0	-	-			5.0	30.0	15.0	50.0									
	Broilers	2.0	4.0	-	-					8.3	50.0	33.3	8.3							
	Layers				-															
	Total	2.0	4.0	-	-			2.6	18.4	10.5	52.6	13.2	2.6							

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=47), pigs(n=2), broilers(n=32) and layers(n=37) in 2012_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs 0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	8.0	6.4	1.33-17.54				4.3	6.4	17.0	19.1	19.1	27.7		4.3				2.1
	Pigs	256.0	256.0	100.0	15.81-100														100.0	
	Broilers	8.0	16.0	6.3	0.76-20.81						3.1	3.1	25.0	40.6	21.9		3.1	3.1		
	Layers	8.0	128.0	29.7	15.85-47.06				2.7	10.8	5.4	10.8	16.2	10.8	13.5	8.1	10.8	5.4		5.4
	Total	8.0	64.0	15.3	9.29-23.04				2.5	5.9	9.3	11.9	19.5	25.4	10.2	4.2	4.2	2.5	1.7	2.5
Gentamicin	Cattle	0.3	1.0	-	-			10.6	42.6	31.9	14.9									
	Pigs	0.3	0.5	-	-				50.0	50.0										
	Broilers	0.5	1.0	-	-			6.3	34.4	43.8	15.6									
	Layers	0.5	0.5	-	-			8.1	27.0	56.8	5.4	2.7								
	Total	0.5	1.0	-	-			8.5	35.6	43.2	11.9	0.8								
Streptomycin	Cattle	1.0	2.0	4.3	0.51-14.55				10.6	23.4	46.8	10.6	4.3					2.1	2.1	
	Pigs	1.0	1.0	0.0	0-84.19						100									
	Broilers	1.0	2.0	0.0	0-10.89					28.1	50.0	21.9								
	Layers	1.0	2.0	0.0	0-9.49				10.8	16.2	56.8	13.5	2.7							
	Total	1.0	2.0	1.7	0.20-5.99				7.6	22.0	51.7	14.4	2.5					0.8	0.8	
Erythromycin	Cattle	0.5	1.0	0.0	-			4.3	36.2	42.6	8.5	4.3	4.3							
	Pigs	0.5	1.0	0.0	-					50.0	50.0									
	Broilers	0.5	2.0	0.0	-			3.1	12.5	53.1	15.6	15.6								
	Layers	0.5	2.0	0.0	-			5.4	35.1	21.6	27.0	8.1	2.7							
	Total	0.5	2.0	0.0	-			4.2	28.8	39.0	16.9	8.5	2.5							
Tetracycline	Cattle	16.0	128.0	55.3	40.11-69.83			27.7	10.6	2.1	4.3				10.6	10.6	10.6	19.1	4.3	
	Pigs	0.3	0.5	0.0	0-84.19				50.0	50.0										
	Broilers	0.3	128.0	28.1	13.74-46.75			31.3	21.9	12.5	6.3					9.4	6.3	9.4	3.1	
	Layers	≦0.12	128.0	21.6	9.82-38.22			51.4		8.1	5.4	5.4	5.4	2.7		8.1		5.4	8.1	
	Total	0.5	128.0	36.4	27.77-45.81			35.6	11.0	7.6	5.1	1.7	1.7	0.8	4.2	9.3	5.9	11.9	5.1	
Nalidixic acid	Cattle	64.0	>128	61.7	46.37-75.50							17.0	12.8	8.5		2.1	12.8	12.8	34.0	
	Pigs	128.0	128.0	100.0	15.81-100													100.0		
	Broilers	8.0	128.0	28.1	13.74-46.75							3.1	37.5	28.1	3.1	3.1	6.3	12.5	6.3	
	Layers	8.0	32.0	10.8	3.02-25.42							2.7	37.8	37.8	10.8	2.7	2.7	5.4		
	Total	8.0	>128	37.3	28.56-46.67							8.5	27.1	22.9	4.2	2.5	7.6	11.9	15.3	
Ciprofloxacin	Cattle	8.0	16.0	57.4	42.10-71.86	2.1	12.8	14.9	6.4	2.1	2.1	2.1	4.3	21.3	27.7	4.3				
	Pigs	8.0	8.0	100.0	15.81-100									100.0						
	Broilers	0.3	16.0	18.8	7.20-36.44			28.1	28.1	21.9	3.1		3.1	3.1	6.3	6.3				
	Layers	0.3	0.5	5.4	0.66-18.20			45.9	32.4	13.5	2.7		2.7		2.7					
	Total	0.3	16.0	31.4	23.13-40.55	0.8	5.1	28.0	20.3	11.0	2.5	0.8	3.4	11.0	13.6	3.4				
Chloramphenicol	Cattle	1.0	4.0	0.0	0-7.55					10.6	46.8	31.9	10.6							
	Pigs	2.0	2.0	0.0	0-84.19							100.0								
	Broilers	2.0	4.0	0.0	0-10.89					6.3	9.4	71.9	9.4	3.1						
	Layers	2.0	4.0	2.7	0.06-14.17				2.7	5.4	27.0	45.9	10.8	5.4	2.7					
	Total	2.0	4.0	0.8	0.02-4.64				0.8	7.6	29.7	48.3	10.2	2.5	0.8					

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

Table5.2. Distribution of MICs and resistance(%) in *Campylobacter jejuni* from cattle(n=71), pigs(n=2), broilers(n=56) and layers(n=79) in 2013_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	8.0	1.4	0.03-7.60				1.4	16.9	4.2	19.7	40.8	15.5		1.4				
	Pigs	1.0	1.0	0.0	0-84.19						100.0									
	Broilers	4.0	64.0	26.8	15.83-40.31					3.6	8.9	12.5	25.0	16.1	7.1	12.5	14.3			
	Layers	4.0	64.0	25.3	16.20-36.36				2.5	3.8	7.6	17.7	22.8	16.5	3.8	15.2	6.3	3.8		
	Total	4.0	32.0	17.3	12.42-23.15				1.4	8.2	7.7	16.8	29.3	15.9	3.4	9.6	6.3	1.4		
Gentamicin	Cattle	0.5	1.0	-	-			2.8	14.1	66.2	15.5	1.4								
	Pigs	1.0	1.0	-	-						100.0									
	Broilers	0.5	1.0	-	-			1.8	44.6	39.3	12.5	1.8								
	Layers	0.5	1.0	-	-			5.1	30.4	53.2	11.4									
	Total	0.5	1.0	-	-			3.4	28.4	53.4	13.9	1.0								
Streptomycin	Cattle	1.0	2.0	5.6	1.55-13.81				2.8	11.3	53.5	23.9	2.8			1.4	4.2			
	Pigs	2.0	2.0	0.0	0-84.19							100.0								
	Broilers	1.0	2.0	0.0	0-6.38				3.6	42.9	39.3	14.3								
	Layers	1.0	2.0	0.0	0-4.57				8.9	32.9	40.5	16.5	1.3							
	Total	1.0	2.0	1.9	0.52-4.86				5.3	27.9	44.2	19.2	1.4			0.5	1.4			
Erythromycin	Cattle	0.5	1.0	0.0	-				25.4	45.1	23.9	5.6								
	Pigs	0.5	0.5	0.0	-					####										
	Broilers	0.5	2.0	0.0	-				41.1	33.9	10.7	14.3								
	Layers	0.5	2.0	0.0	-			5.1	26.6	49.4	8.9	7.6	2.5							
	Total	0.5	1.0	0.0	-			1.9	29.8	44.2	14.4	8.7	1.0							
Tetracycline	Cattle	32.0	>128	52.1	39.92-64.13			36.6	7.0		1.4			2.8		19.7	14.1	7.0	11.3	
	Pigs	≦0.12	≦0.12	0.0	0-84.19			100.0												
	Broilers	0.5	64.0	41.1	28.09-55.03			37.5	7.1	7.1	7.1				5.4	12.5	17.9		5.4	
	Layers	0.5	128.0	44.3	33.12-55.93			36.7	10.1	3.8	2.5	2.5			2.5	7.6	22.8	3.8	7.6	
	Total	1.0	128.0	45.7	38.76-52.71			37.5	8.2	3.4	3.4	1.0		1.0	2.4	13.0	18.3	3.8	8.2	
Nalidixic acid	Cattle	4.0	>128	32.4	21.76-44.55							23.9	38.0	5.6			5.6	12.7	14.1	
	Pigs	4.0	4.0	0.0	0-84.19								100.0							
	Broilers	4.0	128.0	19.6	10.23-32.44							25.0	35.7	14.3	5.4	1.8	3.6	10.7	3.6	
	Layers	4.0	128.0	16.5	9.06-26.50							12.7	53.2	16.5	1.3		2.5	6.3	7.6	
	Total	4.0	128.0	22.6	17.10-28.90							19.7	43.8	12.0	1.9	0.5	3.8	9.6	8.7	
Ciprofloxacin	Cattle	0.1	16.0	32.4	21.76-44.55		19.7	35.2	12.7					11.3	16.9	4.2				
	Pigs	0.1	0.1	0.0	0-84.19			100.0												
	Broilers	0.1	16.0	17.9	8.91-30.40		19.6	32.1	14.3	14.3	1.8			3.6	5.4	8.9				
	Layers	0.3	16.0	16.5	9.06-26.50		11.4	36.7	22.8	10.1		2.5		1.3	10.1	1.3	3.8			
	Total	0.1	16.0	22.1	16.66-28.38		16.3	35.6	16.8	7.7	0.5	1.0		5.3	11.1	4.3	1.4			
Chloramphenicol	Cattle	1.0	2.0	2.8	0.34-9.81					1.4	54.9	38.0	2.8			2.8				
	Pigs	1.0	1.0	0.0	0-84.19						100.0									
	Broilers	1.0	2.0	0.0	0-6.38					8.9	48.2	33.9	7.1	1.8						
	Layers	1.0	4.0	0.0	0-4.57				2.5	1.3	50.6	34.2	10.1	1.3						
	Total	1.0	2.0	1.0	0.11-3.44				1.0	3.4	51.9	35.1	6.7	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

Table5.3. Distribution of MICs and resistance(%) in *Campylobacter jejuni* from cattle(n=82) and broilers(n=71) in 2012_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	8.0	0.0	0-4.40				1.2	3.7	4.9	20.7	45.1	23.2	1.2					
	Pigs				-															
	Broilers	4.0	32.0	19.7	11.22-30.87					2.8	9.9	7.0	42.3	15.5	2.8	14.1	5.6			
	Layers				-															
	Total	4.0	16.0	9.2	5.09-14.88				0.7	3.3	7.2	14.4	43.8	19.6	2.0	6.5	2.6			
Gentamicin	Cattle	0.5	1.0	-	-			1.2	12.2	63.4	22.0	1.2								
	Pigs				-															
	Broilers	0.5	0.5	-	-			15.5	31.0	47.9	4.2		1.4							
	Layers				-															
	Total	0.5	1.0	-	-			7.8	20.9	56.2	13.7	0.7	0.7							
Streptomycin	Cattle	1.0	4.0	2.4	0.29-8.54				1.2	8.5	48.8	30.5	6.1	2.4					2.4	
	Pigs				-															
	Broilers	1.0	1.0	1.4	0.03-7.60			1.4	9.9	31.0	47.9	8.5							1.4	
	Layers				-															
	Total	1.0	2.0	2.0	0.40-5.63			0.7	5.2	19.0	48.4	20.3	3.3	1.3					2.0	
Erythromycin	Cattle	0.5	2.0	0.0	-			2.4	13.4	40.2	28.0	13.4	2.4							
	Pigs				-															
	Broilers	0.5	1.0	0.0	-			2.8	16.9	46.5	26.8	7.0								
	Layers				-															
	Total	0.5	2.0	0.0	-			2.6	15.0	43.1	27.5	10.5	1.3							
Tetracycline	Cattle	0.3	>64	45.1	34.10-56.51	2.4	18.3	18.3	11.0	1.2		1.2		2.4	7.3	7.3	15.9	14.6		
	Pigs				-															
	Broilers	0.3	64.0	38.0	26.76-50.33	2.8	29.6	11.3	15.5	2.8					5.6	7.0	15.5	9.9		
	Layers				-															
	Total	0.3	>64	41.8	33.90-50.08	2.6	23.5	15.0	13.1	2.0		0.7		1.3	6.5	7.2	15.7	12.4		
Nalidixic acid	Cattle	4.0	128.0	34.1	24.01-45.48							8.5	45.1	8.5	3.7	2.4	13.4	15.9	2.4	
	Pigs				-															
	Broilers	8.0	64.0	39.4	28.03-51.75						1.4	12.7	32.4	12.7	1.4	8.5	21.1	4.2	5.6	
	Layers				-															
	Total	4.0	128.0	36.6	28.97-44.77						0.7	10.5	39.2	10.5	2.6	5.2	17.0	10.5	3.9	
Ciprofloxacin	Cattle	0.3	16.0	34.1	24.01-45.48		4.9	31.7	24.4	4.9				12.2	17.1	3.7	1.2			
	Pigs				-															
	Broilers	0.3	32.0	39.4	28.03-51.75		1.4	36.6	14.1	7.0	1.4			8.5	19.7	11.3				
	Layers				-															
	Total	0.3	16.0	36.6	28.97-44.77		3.3	34.0	19.6	5.9	0.7			10.5	18.3	7.2	0.7			
Chloramphenicol	Cattle	1.0	2.0	0.0	0-4.40					6.1	50.0	39.0	3.7	1.2						
	Pigs				-															
	Broilers	1.0	2.0	0.0	0-5.07				2.8	11.3	47.9	28.2	9.9							
	Layers				-															
	Total	1.0	2.0	0.0	0-2.39				1.3	8.5	49.0	34.0	6.5	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

Table5.4. Distribution of MICs and resistance(%) in *Campylobacter jejuni* from cattle(n=143) and broilers(n=81) in 2013_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	2.0	16.0	9.1	4.92-15.05					0.7	12.6	41.3	29.4	4.9	2.1	3.5	4.2	0.7	0.7	
	Pigs				-															
	Broilers	8.0	32.0	19.8	11.73-30.09					1.2	9.9	18.5	18.5	17.3	14.8	9.9	6.2	3.7		
	Layers				-															
	Total	4.0	32.0	12.9	8.84-18.07					0.9	11.6	33.0	25.4	9.4	6.7	5.8	4.9	1.8	0.4	
Gentamicin	Cattle	0.5	1.0	-	-			7.0	27.3	48.3	16.8	0.7								
	Pigs				-															
	Broilers	0.5	1.0	-	-				19.8	53.1	24.7	2.5								
	Layers				-															
	Total	0.5	1.0	-	-			4.5	24.6	50.0	19.6	1.3								
Streptomycin	Cattle	1.0	2.0	3.5	1.14-7.98			1.4	2.8	39.9	39.9	11.9		0.7		1.4	1.4		0.7	
	Pigs				-															
	Broilers	0.5	1.0	0.0	0-4.46				12.3	50.6	30.9	6.2								
	Layers				-															
	Total	0.5	2.0	2.2	0.72-5.14			0.9	6.3	43.8	36.6	9.8		0.4		0.9	0.9		0.4	
Erythromycin	Cattle	0.5	1.0	0.7	-			0.7	14.0	55.9	19.6	4.9	2.8	1.4				0.7		
	Pigs				-															
	Broilers	0.3	1.0	0.0	-			3.7	51.9	29.6	13.6			1.2						
	Layers				-															
	Total	0.5	1.0	0.4	-			1.8	27.7	46.4	17.4	3.1	1.8	1.3				0.4		
Tetracycline	Cattle	16.0	>64	52.4	43.93-60.86		9.1	27.3	7.7	2.1	0.7	0.7			3.5	14.0	10.5	24.5		
	Pigs				-															
	Broilers	2.0	>64	44.4	33.39-55.92		7.4	19.8	11.1	7.4	3.7	2.5		3.7	6.2	8.6	6.2	23.5		
	Layers				-															
	Total	8.0	>64	49.6	42.82-56.30		8.5	24.6	8.9	4.0	1.8	1.3		1.3	4.5	12.1	8.9	24.1		
Nalidixic acid	Cattle	8.0	128.0	33.6	25.89-41.94							7.7	32.2	23.1	3.5	4.2	9.8	12.6	7.0	
	Pigs				-															
	Broilers	16.0	>128	48.1	36.90-59.54							6.2	22.2	19.8	3.7	4.9	11.1	13.6	18.5	
	Layers				-															
	Total	8.0	>128	38.8	32.41-45.56							7.1	28.6	21.9	3.6	4.5	10.3	12.9	11.2	
Ciprofloxacin	Cattle	0.3	16.0	29.4	22.05-37.57	0.7	7.7	34.3	21.0	4.9	1.4	0.7	2.8	7.0	14.0	2.1	2.1	1.4		
	Pigs				-															
	Broilers	1.0	16.0	39.5	28.81-50.99			27.2	12.3	7.4	6.2	7.4	7.4	8.6	16.0	6.2	1.2			
	Layers				-															
	Total	0.3	16.0	33.0	26.91-39.62	0.4	4.9	31.7	17.9	5.8	3.1	3.1	4.5	7.6	14.7	3.6	1.8	0.9		
Chloramphenicol	Cattle	2.0	4.0	6.3	2.91-11.62				1.4	5.6	42.7	37.1	7.0		0.7	2.8	1.4	1.4		
	Pigs				-															
	Broilers	2.0	4.0	0.0	0-4.46					7.4	40.7	37.0	13.6	1.2						
	Layers				-															
	Total	2.0	4.0	4.0	1.85-7.49				0.9	6.3	42.0	37.1	9.4	0.4	0.4	1.8	0.9	0.9		

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

Table6.1. Distribution of MICs and resistance(%) in *Campylobacter coli* from cattle(n=6), pigs(n=57), broilers(n=3) and layers(n=11) in 2012_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	8.0	16.0	0.0	0-45.93						16.7		16.7	50.0	16.7					
	Pigs	4.0	16.0	3.5	0.42-12.11				1.8		15.8	24.6	24.6	12.3	17.5		1.8			1.8
	Broilers	2.0	8.0	0.0	0-70.76						33.3	33.3		33.3						
	Layers	16.0	32.0	27.3	6.02-60.98									36.4	36.4	18.2		9.1		
	Total	4.0	16.0	6.5	2.14-14.51				1.3		14.3	19.5	19.5	19.5	19.5	2.6	1.3	1.3		1.3
Gentamicin	Cattle	0.5	1.0	-	-					66.7	33.3									
	Pigs	1.0	1.0	-	-			3.5	1.8	19.3	66.7	8.8								
	Broilers	0.3	1.0	-	-				66.7		33.3									
	Layers	0.5	1.0	-	-					81.8	18.2									
	Total	1.0	1.0	-	-			2.6	3.9	31.2	55.8	6.5								
Streptomycin	Cattle	2.0	128.0	16.7	0.42-64.13							50.0	33.3					16.7		
	Pigs	128.0	>128	63.2	49.34-75.56				1.8		1.8	10.5	21.1	1.8			8.8	17.5	36.8	
	Broilers	1.0	>128	33.3	0.84-90.58						66.7								33.3	
	Layers	1.0	128.0	18.2	2.28-51.78						54.5	27.3						18.2		
	Total	64.0	>128	51.9	40.25-63.49				1.3		11.7	15.6	18.2	1.3			6.5	16.9	28.6	
Erythromycin	Cattle	1.0	>128	16.7	-					33.3	16.7	33.3							16.7	
	Pigs	4.0	>128	42.1	-				1.8	8.8	22.8	10.5	14.0					5.3	36.8	
	Broilers	0.5	>128	33.3	-					66.7									33.3	
	Layers	0.3	2.0	0.0	-			9.1	54.5		9.1	27.3								
	Total	2.0	>128	33.8	-			1.3	9.1	11.7	19.5	14.3	10.4					3.9	29.9	
Tetracycline	Cattle	0.5	>128	50.0	11.81-88.19				33.3	16.7						16.7			33.3	
	Pigs	64.0	>128	71.9	58.45-83.03			5.3	7.0	3.5	5.3			7.0		7.0	19.3	28.1	17.5	
	Broilers	≦0.12	32.0	33.3	0.84-90.58			66.7								33.3				
	Layers	0.3	128.0	27.3	6.02-60.98			18.2	45.5		9.1						9.1	18.2		
	Total	64.0	>128	62.3	50.56-73.14			9.1	14.3	3.9	5.2			5.2		7.8	15.6	23.4	15.6	
Nalidixic acid	Cattle	8.0	>128	33.3	4.32-77.73									66.7		16.7			16.7	
	Pigs	8.0	128.0	29.8	18.42-43.41							1.8	12.3	45.6	10.5	3.5	7.0	12.3	7.0	
	Broilers	32.0	64.0	100.0	29.24-100											66.7	33.3			
	Layers	8.0	128.0	27.3	6.02-60.98								9.1	54.5	9.1			27.3		
	Total	8.0	128.0	32.5	22.23-44.10							1.3	10.4	46.8	9.1	6.5	6.5	13.0	6.5	
Ciprofloxacin	Cattle	0.3	32.0	33.3	4.32-77.73				66.7						16.7	16.7				
	Pigs	0.3	32.0	26.3	15.53-39.67		3.5	38.6	24.6		1.8	5.3		5.3	5.3	12.3	3.5			
	Broilers	4.0	8.0	66.7	9.42-99.16					33.3			33.3	33.3						
	Layers	0.3	8.0	27.3	6.02-60.98		9.1	9.1	45.5	9.1				18.2	9.1					
	Total	0.3	32.0	28.6	18.84-40.01		3.9	29.9	29.9	2.6	1.3	3.9	1.3	7.8	6.5	10.4	2.6			
Chloramphenicol	Cattle	2.0	4.0	0.0	0-45.93						16.7	33.3	50.0							
	Pigs	4.0	32.0	29.8	18.42-43.41				1.8	1.8	10.5	29.8	21.1	5.3	1.8	21.1	3.5	1.8	1.8	
	Broilers	1.0	4.0	0.0	0-70.76						66.7		33.3							
	Layers	2.0	2.0	0.0	0-28.50						27.3	63.6	9.1							
	Total	2.0	32.0	22.1	13.41-32.98				1.3	1.3	15.6	33.8	22.1	3.9	1.3	15.6	2.6	1.3	1.3	

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

Table6.2. Distribution of MICs and resistance(%) in *Campylobacter coli* from cattle(n=4), pigs(n=42), broilers(n=5) and layers(n=10) in 2013_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs 0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	8.0	0.0	0-60.24								75.0	25.0						
	Pigs	4.0	16.0	4.8	0.58-16.17						7.1	21.4	21.4	28.6	16.7	2.4		2.4		
	Broilers	8.0	16.0	0.0	0-52.19							40.0		20.0	40.0					
	Layers	2.0	16.0	10.0	0.25-44.51						10.0	40.0	20.0	10.0	10.0	10.0				
	Total	4.0	16.0	4.9	1.02-13.71						6.6	24.6	23.0	24.6	16.4	3.3		1.6		
Gentamicin	Cattle	0.5	2.0	-	-					50.0	25.0	25.0								
	Pigs	1.0	2.0	-	-					4.8	76.2	19.0								
	Broilers	1.0	1.0	-	-					20.0	80.0									
	Layers	0.5	1.0	-	-					60.0	40.0									
	Total	1.0	2.0	-	-					18.0	67.2	14.8								
Streptomycin	Cattle	1.0	8.0	0.0	0-60.24						50.0		25.0	25.0						
	Pigs	64.0	>128	57.1	40.96-72.28							2.4	31.0	9.5			7.1	28.6	21.4	
	Broilers	2.0	4.0	0.0	0-52.19						40.0	20.0	40.0							
	Layers	1.0	2.0	0.0	0-30.85					10.0	60.0	20.0	10.0							
	Total	4.0	>128	39.3	27.07-52.69					1.6	16.4	6.6	27.9	8.2			4.9	19.7	14.8	
Erythromycin	Cattle	1.0	4.0	0.0	-					25.0	25.0	25.0	25.0							
	Pigs	2.0	>128	42.9	-				2.4	4.8	19.0	23.8	7.1						42.9	
	Broilers	1.0	2.0	0.0	-				20.0	20.0	20.0	40.0								
	Layers	0.3	1.0	0.0	-			30.0	30.0	20.0	20.0									
	Total	2.0	>128	29.5	-			4.9	8.2	9.8	19.7	21.3	6.6						29.5	
Tetracycline	Cattle	64.0	>128	75.0	19.41-99.37				25.0								50.0		25.0	
	Pigs	64.0	>128	78.6	63.18-89.71			2.4	7.1	7.1	4.8				2.4	11.9	23.8	16.7	23.8	
	Broilers	32.0	>128	60.0	14.66-94.73			40.0								20.0		20.0	20.0	
	Layers	0.5	64.0	40.0	12.15-73.77			20.0	20.0	20.0						20.0	20.0			
	Total	64.0	>128	70.5	57.43-81.49			8.2	9.8	8.2	3.3				1.6	13.1	23.0	13.1	19.7	
Nalidixic acid	Cattle	64.0	128.0	100.0	39.76-100												75.0	25.0		
	Pigs	16.0	128.0	47.6	32.00-63.59							2.4	16.7	26.2	7.1	4.8	16.7	16.7	9.5	
	Broilers	4.0	128.0	40.0	5.27-85.34								60.0				20.0	20.0		
	Layers	4.0	32.0	30.0	6.67-65.25							10.0	50.0	10.0		30.0				
	Total	16.0	128.0	47.5	34.59-60.74							3.3	24.6	19.7	4.9	8.2	18.0	14.8	6.6	
Ciprofloxacin	Cattle	16.0	16.0	100.0	39.76-100										100.0					
	Pigs	0.3	32.0	42.9	27.72-59.04			23.8	28.6	2.4	2.4			11.9	19.0	4.8	2.4	4.8		
	Broilers	0.5	8.0	40.0	5.27-85.34					60.0				40.0						
	Layers	0.3	4.0	20.0	2.52-55.61		10.0	20.0	30.0	10.0	10.0		10.0	10.0						
	Total	0.5	16.0	42.6	30.04-55.95		1.6	19.7	24.6	8.2	3.3		1.6	13.1	19.7	3.3	1.6	3.3		
Chloramphenicol	Cattle	2.0	2.0	0.0	0-60.24							100.0								
	Pigs	2.0	32.0	19.0	8.60-34.12						9.5	50.0	21.4		4.8	11.9	2.4			
	Broilers	2.0	2.0	0.0	0-52.19						20.0	80.0								
	Layers	2.0	2.0	0.0	0-30.85						40.0	50.0	10.0							
	Total	2.0	16.0	13.1	5.83-24.22						14.8	55.7	16.4		3.3	8.2	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

Table6.3. Distribution of MICs and resistance(%) in *Campylobacter coli* from cattle(n=68), pigs(n=129) and broilers(n=10) in 2012_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	8.0	16.0	1.5	0.03-7.93							2.9	16.2	64.7	14.7		1.5			
	Pigs	8.0	128.0	23.3	16.27-31.51					3.1	1.6	7.0	17.1	32.6	15.5	2.3	7.0	12.4		1.6
	Broilers	4.0	32.0	20.0	2.52-55.61					10.0	10.0	10.0	30.0	20.0		10.0		10.0		
	Layers				-															
	Total	8.0	64.0	15.9	11.23-21.66					2.4	1.4	5.8	17.4	42.5	14.5	1.9	4.8	8.2		1.0
Gentamicin	Cattle	1.0	2.0	-	-					23.5	27.9	48.5								
	Pigs	2.0	2.0	-	-					11.6	38.0	48.1	1.6	0.8						
	Broilers	0.5	1.0	-	-				10.0	60.0	20.0	10.0								
	Layers				-															
	Total	1.0	2.0	-	-				0.5	17.9	33.8	46.4	1.0	0.5						
Streptomycin	Cattle	8.0	>128	26.5	16.50-38.58						4.4	29.4	5.9	27.9	5.9		1.5	5.9	19.1	
	Pigs	>128	>128	67.4	58.63-75.43						0.8	3.1	12.4	15.5	0.8		4.7	7.8	55.0	
	Broilers	1.0	16.0	10.0	0.25-44.51					10.0	50.0	20.0			10.0				10.0	
	Layers				-															
	Total	64.0	>128	51.2	44.17-58.21					0.5	4.3	12.6	9.7	18.8	2.9		3.4	6.8	41.1	
Erythromycin	Cattle	2.0	>64	19.1	-					2.9	20.6	39.7	14.7	2.9				19.1		
	Pigs	4.0	>64	32.6	-					1.6	15.5	23.3	13.2	11.6	2.3		0.8	31.8		
	Broilers	1.0	2.0	10.0	-				40.0		40.0	10.0						10.0		
	Layers				-															
	Total	2.0	>64	27.1	-				1.9	1.9	18.4	28.0	13.0	8.2	1.4		0.5	26.6		
Tetracycline	Cattle	64.0	>64	85.3	74.61-92.72		1.5	4.4	1.5	5.9			1.5			19.1	33.8	32.4		
	Pigs	64.0	>64	84.5	77.07-90.27		0.8	2.3	4.7	2.3	2.3	1.6	0.8	0.8	6.2	14.0	30.2	34.1		
	Broilers	0.1	32.0	30.0	6.67-65.25		10.0	50.0	10.0						10.0	10.0	10.0			
	Layers				-															
	Total	64.0	>64	82.1	76.21-87.10		1.4	5.3	3.9	3.4	1.4	1.0	1.0	0.5	4.3	15.5	30.4	31.9		
Nalidixic acid	Cattle	64.0	128.0	60.3	47.69-71.97								4.4	27.9	7.4	7.4	25.0	22.1	5.9	
	Pigs	16.0	128.0	46.5	37.68-55.50							0.8	7.0	34.1	11.6	3.1	14.0	24.8	4.7	
	Broilers	16.0	64.0	50.0	18.70-81.30								30.0	10.0	10.0		50.0			
	Layers				-															
	Total	32.0	128.0	51.2	44.17-58.21							0.5	7.2	30.9	10.1	4.3	19.3	22.7	4.8	
Ciprofloxacin	Cattle	16.0	32.0	60.3	47.69-71.97			1.5	17.6	20.6				4.4	32.4	22.1	1.5			
	Pigs	0.5	32.0	46.5	37.68-55.50		1.6	5.4	24.0	19.4	2.3	0.8	1.6	2.3	14.7	19.4	7.8	0.8		
	Broilers	0.5	16.0	50.0	18.70-81.30			30.0	10.0	10.0				10.0	40.0					
	Layers				-															
	Total	8.0	32.0	51.2	44.17-58.21		1.0	5.3	21.3	19.3	1.4	0.5	1.0	3.4	21.7	19.3	5.3	0.5		
Chloramphenicol	Cattle	2.0	4.0	1.5	0.03-7.93						23.5	47.1	20.6	7.4			1.5			
	Pigs	4.0	16.0	10.9	6.06-17.54						9.3	33.3	34.1	12.4	3.1	6.2	1.6			
	Broilers	2.0	2.0	0.0	0-30.85						20.0	80.0								
	Layers				-															
	Total	2.0	8.0	7.2	4.11-11.68						14.5	40.1	28.0	10.1	1.9	3.9	1.4			

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

Table6.4. Distribution of MICs and resistance(%) in *Campylobacter coli* from cattle(n=37), pigs(n=106) and broilers(n=18) in 2013_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	8.0	16.0	5.4	0.66-18.20								8.1	70.3	16.2		5.4			
	Pigs	8.0	128.0	25.5	17.50-34.86						1.9	6.6	23.6	20.8	21.7	1.9	8.5	14.2		0.9
	Broilers	8.0	16.0	5.6	0.14-27.30							16.7	22.2	27.8	27.8		5.6			
	Layers				-															
	Total	8.0	64.0	18.6	12.93-25.52						1.2	6.2	19.9	32.9	21.1	1.2	7.5	9.3		0.6
Gentamicin	Cattle	1.0	2.0	-	-					8.1	67.6	24.3								
	Pigs	1.0	2.0	-	-					4.7	51.9	35.8	7.5							
	Broilers	1.0	2.0	-	-				5.6	27.8	55.6	5.6	5.6							
	Layers				-															
	Total	1.0	2.0	-	-				0.6	8.1	55.9	29.8	5.6							
Streptomycin	Cattle	1.0	4.0	2.9	0.07-14.92					14.3	51.4	22.9	8.6					2.9		
	Pigs	64.0	128.0	58.2	44.10-71.35							9.1	30.9		1.8	1.8	25.5	30.9		
	Broilers	1.0	2.0	0.0	0-18.54					16.7	72.2	5.6	5.6							
	Layers				-															
	Total	4.0	128.0	30.6	22.05-40.16					7.4	28.7	13.0	19.4		0.9	0.9	13.0	16.7		
Erythromycin	Cattle	2.0	4.0	5.4	-						24.3	40.5	27.0	2.7				5.4		
	Pigs	4.0	>64	44.3	-					4.7	16.0	24.5	9.4		0.9	0.9	0.9	42.5		
	Broilers	1.0	2.0	0.0	-			11.1	16.7	16.7	33.3	16.7	5.6							
	Layers				-															
	Total	2.0	>64	30.4	-			1.2	1.9	5.0	19.9	27.3	13.0	0.6	0.6	0.6	0.6	29.2		
Tetracycline	Cattle	>64	>64	56.8	39.48-72.91			10.8	27.0	5.4							2.7	54.1		
	Pigs	>64	>64	93.4	86.68-97.42		0.9	0.9	1.9	1.9				0.9	1.9	13.2	16.0	62.3		
	Broilers	16.0	>64	55.6	30.75-78.47		5.6	11.1	11.1	5.6	11.1				5.6	5.6	16.7	27.8		
	Layers				-															
	Total	>64	>64	80.7	73.79-86.53		1.2	4.3	8.7	3.1	1.2			0.6	1.9	9.3	13.0	56.5		
Nalidixic acid	Cattle	128.0	128.0	70.3	52.84-84.36								5.4	16.2	8.1	5.4	10.8	45.9	8.1	
	Pigs	32.0	>128	53.8	43.82-63.51								4.7	28.3	13.2	3.8	5.7	14.2	30.2	
	Broilers	32.0	128.0	55.6	30.75-78.47								16.7	27.8		11.1	16.7	22.2	5.6	
	Layers				-															
	Total	64.0	>128	57.8	49.74-65.50								6.2	25.5	10.6	5.0	8.1	22.4	22.4	
Ciprofloxacin	Cattle	16.0	32.0	70.3	52.84-84.36			5.4	21.6	2.7			2.7		45.9	18.9	2.7			
	Pigs	1.0	32.0	46.2	36.49-56.18			12.3	17.9	15.1	7.5	0.9	0.9	5.7	16.0	19.8	3.8			
	Broilers	2.0	32.0	50.0	26.01-73.99			16.7		27.8		5.6	11.1	22.2	5.6	11.1				
	Layers				-															
	Total	4.0	32.0	52.2	44.16-60.10			11.2	16.8	13.7	5.0	1.2	2.5	6.2	21.7	18.6	3.1			
Chloramphenicol	Cattle	4.0	4.0	2.7	0.06-14.17						2.7	32.4	56.8	5.4	2.7					
	Pigs	2.0	4.0	3.8	1.03-9.39					0.9	3.8	50.9	38.7	1.9	1.9	0.9	0.9			
	Broilers	2.0	8.0	0.0	0-18.54						5.6	55.6	27.8	11.1						
	Layers				-															
	Total	2.0	4.0	3.1	1.01-7.10					0.6	3.7	47.2	41.6	3.7	1.9	0.6	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

Table7.1. Distribution of MICs and resistance(%) in *Salmonella* from cattle(n=84), pigs(n=83) and chickens(n=32) in 2012_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	2.0	>128	34.5	24.48-45.70						32.1	31.0	2.4						34.5	
	Pigs	≦1	>128	25.3	16.39-36.04						51.8	20.5	2.4						25.3	
	Chickens	≦1	2.0	9.4	1.97-25.03						68.8	21.9							9.4	
					-															
	Total	2.0	>128	26.6	20.63-33.35						46.2	25.1	2.0						26.6	
Cefazolin	Cattle	≦1	4.0	1.2	0.03-6.46						54.8	19.0	21.4	3.6					1.2	
	Pigs	≦1	4.0	0.0	0-4.35						62.7	24.1	8.4	3.6	1.2					
	Chickens	≦1	2.0	3.1	0.07-16.22						71.9	25.0							3.1	
					-															
	Total	≦1	4.0	1.0	0.12-3.59						60.8	22.1	12.6	3.0	0.5				1.0	
Cefotaxime	Cattle	≦0.5	≦0.5	1.2	0.03-6.46					98.8							1.2			
	Pigs	≦0.5	≦0.5	0.0	0-4.35					100.0										
	Chickens	≦0.5	≦0.5	0.0	0-10.89					96.9	3.1									
					-															
	Total	≦0.5	≦0.5	0.5	0.01-2.77					99.0	0.5						0.5			
Streptomycin	Cattle				-															
	Pigs				-															
	Chickens				-															
					-															
	Total				-															
Gentamicin	Cattle	≦0.5	≦0.5	0.0	0-4.30					91.7	8.3									
	Pigs	≦0.5	≦0.5	3.6	0.75-10.21					92.8	3.6				2.4	1.2				
	Chickens	≦0.5	≦0.5	0.0	0-10.89					96.9	3.1									
					-															
	Total	≦0.5	≦0.5	1.5	0.31-4.35					93.0	5.5				1.0	0.5				
Kanamycin	Cattle	4.0	4.0	3.6	0.74-10.09						1.2	44.0	46.4	4.8					3.6	
	Pigs	4.0	>128	12.0	5.93-21.05							36.1	47.0	3.6	1.2				12.0	
	Chickens	4.0	>128	15.6	5.27-32.79						3.1	34.4	43.8	3.1					15.6	
					-															
	Total	4.0	8.0	9.0	5.44-13.92						1.0	39.2	46.2	4.0	0.5				9.0	

Table7.1. Distribution of MICs and resistance(%) in *Salmonella* from cattle(n=84), pigs(n=83) and chickens(n=32) in 2012_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Tetracycline	Cattle	2.0	>64	34.5	24.48-45.70						4.8	54.8	4.8	1.2		2.4	8.3	23.8		
	Pigs	>64	>64	53.0	41.73-64.07					2.4	2.4	37.3	4.8				2.4	50.6		
	Chickens	2.0	64.0	34.4	18.57-53.20					3.1	15.6	43.8	3.1			3.1	21.9	9.4		
					-															
	Total	2.0	>64	42.2	35.25-49.41					1.5	5.5	45.7	4.5	0.5		1.5	8.0	32.7		
Nalidixic acid	Cattle	8.0	16.0	7.1	2.66-14.91								36.9	51.2	4.8			1.2	6.0	
	Pigs	8.0	>128	21.7	13.38-32.10							1.2	32.5	42.2	2.4	3.6	1.2		16.9	
	Chickens	4.0	8.0	6.3	0.76-20.81								50.0	43.8			3.1		3.1	
					-															
	Total	8.0	>128	13.1	8.71-18.56							0.5	37.2	46.2	3.0	1.5	1.0	0.5	10.1	
Ciprofloxacin	Cattle	≦0.03	≦0.03	0.0	0-4.30	91.7	1.2		3.6	2.4	1.2									
	Pigs	≦0.03	0.3	0.0	0-4.35	74.7	2.4	1.2	15.7	1.2	4.8									
	Chickens	≦0.03	≦0.03	0.0	0-10.89	93.8		3.1	3.1											
					-															
	Total	≦0.03	0.3	0.0	0-1.84	84.9	1.5	1.0	8.5	1.5	2.5									
Colistin	Cattle	0.5	1.0	0.0	0-4.30				35.7	42.9	21.4									
	Pigs	0.5	1.0	0.0	0-4.35				31.3	50.6	15.7		2.4							
	Chickens	0.5	1.0	3.1	0.07-16.22				21.9	37.5	37.5					3.1				
					-															
	Total	0.5	1.0	0.5	0.01-2.77				31.7	45.2	21.6		1.0			0.5				
Chloramphenicol	Cattle	16.0	>128	11.9	5.85-20.81								1.2	46.4	40.5	1.2			10.7	
	Pigs	8.0	>128	13.3	6.80-22.48								27.7	43.4	15.7			2.4	10.8	
	Chickens	8.0	16.0	6.3	0.76-20.81							3.1	9.4	62.5	18.8				6.3	
					-															
	Total	8.0	>128	11.6	7.46-16.84							0.5	13.6	47.7	26.6	0.5		1.0	10.1	
Trimethoprim	Cattle	0.5	0.5	1.2	0.03-6.46				33.3	60.7	4.8					1.2				
	Pigs	≦0.25	>16	21.7	13.38-32.10				53.0	24.1	1.2					21.7				
	Chickens	0.5	>16	15.6	5.27-32.79				18.8	56.3	6.3	3.1				15.6				
					-															
	Total	0.5	>16	12.1	7.88-17.42				39.2	44.7	3.5	0.5				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

Table7.2. Distribution of MICs and resistance(%) in *Salmonella* from cattle(n=56), pigs(n=60) and chickens(n=50) in 2013_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs 0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	>128	>128	60.7	46.75-73.51						23.2	16.1						1.8	58.9	
	Pigs	4.0	>128	45.0	32.12-58.39						20.0	26.7	6.7	1.7		1.7			43.3	
	Chickens	2.0	2.0	4.0	0.48-13.72						46.0	46.0	4.0						4.0	
					-															
	Total	2.0	>128	38.0	30.53-45.81						28.9	28.9	3.6	0.6		0.6		0.6	36.7	
Cefazolin	Cattle	4.0	8.0	8.9	2.96-19.62						32.1	16.1	39.3	3.6					8.9	
	Pigs	2.0	4.0	0.0	0-5.97						26.7	48.3	18.3	6.7						
	Chickens	≦1	2.0	4.0	0.48-13.72						50.0	42.0	4.0			2.0			2.0	
					-															
	Total	2.0	4.0	4.2	1.71-8.50						35.5	35.5	21.1	3.6		0.6			3.6	
Cefotaxime	Cattle	≦0.5	≦0.5	8.9	2.96-19.62					91.1					3.6	3.6	1.8			
	Pigs	≦0.5	≦0.5	0.0	0-5.97					98.3	1.7									
	Chickens	≦0.5	≦0.5	4.0	0.48-13.72					96.0			2.0				2.0			
					-															
	Total	≦0.5	≦0.5	4.2	1.71-8.50					95.2	0.6		0.6		1.2	1.2	1.2			
Streptomycin	Cattle	>128	>128	-	-									8.9	23.2	3.6		1.8	62.5	
	Pigs	>128	>128	-	-									13.3	16.7	3.3		5.0	61.7	
	Chickens	16.0	64.0	-	-								4.0	12.0	40.0	28.0	12.0	2.0	2.0	
					-															
	Total	64.0	>128	-	-								1.2	11.4	25.9	10.8	3.6	3.0	44.0	
Gentamicin	Cattle	≦0.5	≦0.5	0.0	0-6.38					94.6	5.4									
	Pigs	≦0.5	16.0	15.0	7.09-26.58					73.3	11.7				6.7	6.7	1.7			
	Chickens	≦0.5	≦0.5	2.0	0.05-10.65					90.0	8.0				2.0					
					-															
	Total	≦0.5	1.0	6.0	2.92-10.80					85.5	8.4				3.0	2.4	0.6			
Kanamycin	Cattle	4.0	>128	25.0	14.39-38.38							48.2	25.0			1.8			25.0	
	Pigs	2.0	4.0	6.7	1.84-16.20							56.7	35.0	1.7					6.7	
	Chickens	2.0	>128	22.0	11.52-35.97						6.0	48.0	18.0	6.0					22.0	
					-															
	Total	2.0	>128	17.5	12.02-24.12						1.8	51.2	26.5	2.4		0.6			17.5	

Table7.2. Distribution of MICs and resistance(%) in *Salmonella* from cattle(n=56), pigs(n=60) and chickens(n=50) in 2013_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Tetracycline	Cattle	>64	>64	66.1	52.18-78.19						5.4	26.8	1.8				3.6	62.5		
	Pigs	64.0	>64	66.7	53.31-78.32							30.0	3.3				18.3	48.3		
	Chickens	2.0	64.0	30.0	17.86-44.61						22.0	48.0					26.0	4.0		
					-															
	Total	64.0	>64	55.4	47.52-63.13						8.4	34.3	1.8				15.7	39.8		
Nalidixic acid	Cattle	4.0	8.0	1.8	0.04-9.56								53.6	44.6					1.8	
	Pigs	4.0	16.0	5.0	1.04-13.93								50.0	36.7	8.3	1.7			3.3	
	Chickens	4.0	8.0	8.0	2.22-19.24							6.0	62.0	22.0	2.0			4.0	4.0	
					-															
	Total	4.0	8.0	4.8	2.10-9.28							1.8	54.8	34.9	3.6	0.6		1.2	3.0	
Ciprofloxacin	Cattle	≦0.03	≦0.03	0.0	0-6.38	98.2				1.8										
	Pigs	≦0.03	≦0.03	0.0	0-5.97	90.0	6.7		3.3											
	Chickens	≦0.03	≦0.03	0.0	0-7.12	90.0	6.0	2.0		2.0										
					-															
	Total	≦0.03	≦0.03	0.0	0-2.20	92.8	4.2	0.6	1.2	1.2										
Colistin	Cattle	0.5	1.0	0.0	0-6.38				30.4	53.6	10.7	3.6	1.8							
	Pigs	0.5	1.0	1.7	0.04-8.94				43.3	41.7	11.7		1.7			1.7				
	Chickens	0.5	1.0	2.0	0.05-10.65				28.0	60.0	8.0		2.0			2.0				
					-															
	Total	0.5	1.0	1.2	0.14-4.29				34.3	51.2	10.2	1.2	1.8			1.2				
Chloramphenicol	Cattle	8.0	128.0	10.7	4.03-21.88								8.9	76.8	3.6			1.8	8.9	
	Pigs	8.0	64.0	11.7	4.82-22.58								33.3	48.3	6.7		1.7	1.7	8.3	
	Chickens	8.0	8.0	6.0	1.25-16.55							4.0	16.0	70.0	4.0				6.0	
					-															
	Total	8.0	16.0	9.6	5.61-15.19							1.2	19.9	64.5	4.8		0.6	1.2	7.8	
Trimethoprim	Cattle	≦0.25	0.5	1.8	0.04-9.56				75.0	21.4	1.8					1.8				
	Pigs	0.5	>16	36.7	24.59-50.11				43.3	18.3	1.7					36.7				
	Chickens	0.5	>16	14.0	5.81-26.74				26.0	54.0	4.0		2.0			14.0				
					-															
	Total	0.5	>16	18.1	12.53-24.79				48.8	30.1	2.4		0.6			18.1				

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

Table7.3. Distribution of MICs and resistance(%) in *Salmonella* from broilers(n=94) in 2012_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle				-															
	Pigs				-															
	Broilers	≦1	>128	31.9	22.67-42.34						64.9	3.2						6.4	25.5	
	Layers				-															
	Total	≦1	>128	31.9	22.67-42.34						64.9	3.2						6.4	25.5	
Cefazolin	Cattle				-															
	Pigs				-															
	Broilers	≦1	8.0	7.4	3.04-14.75						57.4	10.6	14.9	9.6			1.1		6.4	
	Layers				-															
	Total	≦1	8.0	7.4	3.04-14.75						57.4	10.6	14.9	9.6			1.1		6.4	
Cefotaxime	Cattle				-															
	Pigs				-															
	Broilers	≦0.5	≦0.5	7.4	3.04-14.75					92.6				6.4	1.1					
	Layers				-															
	Total	≦0.5	≦0.5	7.4	3.04-14.75					92.6				6.4	1.1					
Streptomycin	Cattle				-															
	Pigs				-															
	Broilers	64.0	64.0	77.7	67.90-85.61									4.3	18.1	16.0	53.2	8.5		
	Layers				-															
	Total	64.0	64.0	77.7	67.90-85.61									4.3	18.1	16.0	53.2	8.5		
Gentamicin	Cattle				-															
	Pigs				-															
	Broilers	≦0.5	1.0	0.0	0-3.85					80.9	19.1									
	Layers				-															
	Total	≦0.5	1.0	0.0	0-3.85					80.9	19.1									
Kanamycin	Cattle				-															
	Pigs				-															
	Broilers	4.0	>128	31.9	22.67-42.34							37.2	21.3		7.4	2.1			31.9	
	Layers				-															
	Total	4.0	>128	31.9	22.67-42.34							37.2	21.3		7.4	2.1			31.9	

Table7.3. Distribution of MICs and resistance(%) in *Salmonella* from broilers(n=94) in 2012_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Tetracycline	Cattle				-															
	Pigs				-															
	Broilers	32.0	64.0	74.5	64.43-82.91					6.4	18.1			1.1		37.2	34.0	3.2		
	Layers				-															
	Total	32.0	64.0	74.5	64.43-82.91					6.4	18.1			1.1		37.2	34.0	3.2		
Nalidixic acid	Cattle				-															
	Pigs				-															
	Broilers	4.0	>128	29.8	20.79-40.1							38.3	29.8	2.1		1.1			28.7	
	Layers				-															
	Total	4.0	>128	29.8	20.79-40.1							38.3	29.8	2.1		1.1			28.7	
Ciprofloxacin	Cattle				-															
	Pigs				-															
	Broilers	≦0.03	0.3	0.0	0-3.85	69.1	1.1	14.9	10.6	4.3										
	Layers				-															
	Total	≦0.03	0.3	0.0	0-3.85	69.1	1.1	14.9	10.6	4.3										
Colistin	Cattle				-															
	Pigs				-															
	Broilers	0.5	1.0	0.0	0-3.85			3.2	17.0	41.5	35.1	3.2								
	Layers				-															
	Total	0.5	1.0	0.0	0-3.85			3.2	17.0	41.5	35.1	3.2								
Chloramphenicol	Cattle				-															
	Pigs				-															
	Broilers	4.0	8.0	0.0	0-3.85							7.4	79.8	12.8						
	Layers				-															
	Total	4.0	8.0	0.0	0-3.85							7.4	79.8	12.8						

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs									
								2.38/0.12	4.75/0.25	9.5/0.5	19/1	38/2	76/4	152/8	>152/8
Sulfamethoxazole /Trimethoprim	Cattle				-										
	Pigs				-										
	Broilers	≦0.12	>8	31.9	22.67-42.34			51.1	9.6	3.2	3.2	1.1	1.1		30.9
	Layers				-										
	Total	≦0.12	>8	31.9	22.67-42.34			51.1	9.6	3.2	3.2	1.1	1.1		30.9

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

Table7.4. Distribution of MICs and resistance(%) in *Salmonella* from broilers(n=118) in 2013_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle				-															
	Pigs				-															
	Broilers	≦1	>128	22.9	15.65-31.52						59.3	12.7	3.4	0.8	0.8	0.8	0.8		21.2	
	Layers				-															
	Total	≦1	>128	22.9	15.65-31.52						59.3	12.7	3.4	0.8	0.8	0.8	0.8		21.2	
Cefazolin	Cattle				-															
	Pigs				-															
	Broilers	≦1	8.0	5.9	2.41-11.85						50.0	29.7	5.9	8.5		0.8		0.8	4.2	
	Layers				-															
	Total	≦1	8.0	5.9	2.41-11.85						50.0	29.7	5.9	8.5		0.8		0.8	4.2	
Cefotaxime	Cattle				-															
	Pigs				-															
	Broilers	≦0.5	≦0.5	5.1	1.88-10.74					94.9				2.5	0.8	0.8		0.8		
	Layers				-															
	Total	≦0.5	≦0.5	5.1	1.88-10.74					94.9				2.5	0.8	0.8		0.8		
Streptomycin	Cattle				-															
	Pigs				-															
	Broilers	64.0	>64	84.7	76.96-90.71						0.8		0.8	7.6	5.9	28.8	44.1	11.9		
	Layers				-															
	Total	64.0	>64	84.7	76.96-90.71						0.8		0.8	7.6	5.9	28.8	44.1	11.9		
Gentamicin	Cattle				-															
	Pigs				-															
	Broilers	≦0.5	2.0	0.0	0-3.08					61.0	28.0	11.0								
	Layers				-															
	Total	≦0.5	2.0	0.0	0-3.08					61.0	28.0	11.0								
Kanamycin	Cattle				-															
	Pigs				-															
	Broilers	8.0	>128	42.4	33.32-51.81						5.9	26.3	14.4	5.1	3.4	2.5	0.8		41.5	
	Layers				-															
	Total	8.0	>128	42.4	33.32-51.81						5.9	26.3	14.4	5.1	3.4	2.5	0.8		41.5	

Table7.4. Distribution of MICs and resistance(%) in *Salmonella* from broilers(n=118) in 2013_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Tetracycline	Cattle				-															
	Pigs				-															
	Broilers	64.0	64.0	82.2	74.02-88.70						5.9	11.9				10.2	66.9	5.1		
	Layers				-															
	Total	64.0	64.0	82.2	74.02-88.70						5.9	11.9				10.2	66.9	5.1		
Nalidixic acid	Cattle				-															
	Pigs				-															
	Broilers	4.0	>128	19.5	12.77-27.80							15.3	55.1	9.3	0.8	1.7		2.5	15.3	
	Layers				-															
	Total	4.0	>128	19.5	12.77-27.80							15.3	55.1	9.3	0.8	1.7		2.5	15.3	
Ciprofloxacin	Cattle				-															
	Pigs				-															
	Broilers	≦0.03	0.1	0.0	0-3.08	78.8	2.5	9.3	6.8	2.5										
	Layers				-															
	Total	≦0.03	0.1	0.0	0-3.08	78.8	2.5	9.3	6.8	2.5										
Colistin	Cattle				-															
	Pigs				-															
	Broilers	1.0	2.0	0.0	0-3.08				6.8	20.3	34.7	33.1	5.1							
	Layers				-															
	Total	1.0	2.0	0.0	0-3.08				6.8	20.3	34.7	33.1	5.1							
Chloramphenicol	Cattle				-															
	Pigs				-															
	Broilers	4.0	8.0	0.8	0.02-4.64						2.5	17.8	50.8	26.3	1.7			0.8		
	Layers				-															
	Total	4.0	8.0	0.8	0.02-4.64						2.5	17.8	50.8	26.3	1.7			0.8		

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs							
						2.38/0.12	4.75/0.25	9.5/0.5	19/1	38/2	76/4	152/8	>152/8
Sulfamethoxazole /Trimethoprim	Cattle				-								
	Pigs				-								
	Broilers	1.0	>8	48.3	38.99-57.71	18.6	21.2	8.5	3.4		0.8	1.7	45.8
	Layers				-								
	Total	1.0	>8	48.3	38.99-57.71	18.6	21.2	8.5	3.4		0.8	1.7	45.8

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

Table8 *Salmonella* serovars isolated from food-producing animals 2012 and 2013

Serovar	Farm											Slaughterhouse			
	Cattle			Pigs			Chickens			**Total**	**Rate(%)**	Chickens		**Total**	**Rate(%)**
	2012	2013	subtotal	2012	2013	subtotal	2012	2013	subtotal			2012	2013		
Typhimurium	34	25	59	35	23	58	1	1	2	119	37.5	18	15	33	16.3
O4:i:-	16	15	31	3	8	11				42	13.2			0	0.0
Choleraesuis		3	3	19	18	37				40	12.6			0	0.0
Infantis				2		2	10	7	17	19	6.0	47	57	104	51.2
Schwarzengrund							2	6	8	8	2.5	12	24	36	17.7
Manhattan										0	0.0	12	12	24	11.8
Derby				7	2	9				9	2.8			0	0.0
Give	9		9							9	2.8			0	0.0
Mbandaka	2		2					6	6	8	2.5			0	0.0
Rissen	6		6	1	1	2				8	2.5			0	0.0
Newport	1	2	3	1		1	1	2	3	7	2.2			0	0.0
Bareilly	3		3					3	3	6	1.9			0	0.0
Braenderup	1	1	2				2	2	4	6	1.9			0	0.0
Livingstone							2	2	4	4	1.3	1	1	2	1.0
Tennessee							4	2	6	6	1.9			0	0.0
Thompson		1	1				1	3	4	5	1.6		1	1	0.5
Stanley	1	1	2		2	2				4	1.3			0	0.0
II (Sofia)										0	0.0	3		3	1.5
Enteritidis	1		1					2	2	3	0.9			0	0.0
Blockley								2	2	2	0.6			0	0.0
Cerro								2	2	2	0.6			0	0.0
Dublin		2	2							2	0.6			0	0.0
Montevideo	2		2							2	0.6			0	0.0
Oranienburg		2	2							2	0.6			0	0.0
Othmarschen							2		2	2	0.6			0	0.0
Senftenberg					1	1		1	1	2	0.6			0	0.0

Editors:

Ryoji Koike
Section Leader of AMR
Assay Division Ⅱ
National Veterinary Assay Laboratory
Ministry of Agriculture, Forestry and Fisheries
1-15-1 Tokura Kokubunji, Tokyo 185-8511 Japan
E-mail; ryoji_koike860@maff.go.jp

Michiko Kawanishi（DVM.PhD)
Chief Researcher of AMR
E-mail; michiko_kawanishi700@maff.go.jp

Authors:

・**Ryoji Koike**
・**Manao Ozawa** (Chief Researcher of AMR)
・**Michiko Kawanishi**
・**Mariko Uchiyama** (Chief Inspector)

Contributors:

・**Mototaka Hiki**
・**Mai Tsuyuki**
・**Yuriko Sugawara**
・**Hitoshi Abo**

This report includes data gathered between 2012 and 2013, in part to data from 1999. This report is published by JVARM-Japanese Veterinary Antimicrobial Resistance Monitoring System