‘Research results, projects in past and at the moment’

Estonian Veterinary and Food Laboratory

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Monitoring of antimicrobial resistance in bacteria from food chain

Estonian University of Life Sciences

- Antimicrobial resistance in *Salmonella* Enteritidis from poultry
- Antimicrobial resistance in *Salmonella* Typhimurium from animal clinical cases
- Antimicrobial resistance in *Campylobacter* from poultry
- Antimicrobial resistance in *E.coli* from patological materjal of pigs
- Antimicrobial resistance in Indicator bacteria (*E.coli, Enterococcus faecalis, Enterococcus faecium)*
- Antimicrobial resistance in *Staphylococcus aureus* from dairy milk samples
- Antimicrobial resistance in *Staphylococcus (pseud)intermedius* from pets (dogs and cats)

Antimicrobial resistance in *Salmonella* Enteritidis from poultry 2006-2009

Distribution of MIC for *Salmonella* Enteritidis (n=24) from poultry 2006-2009

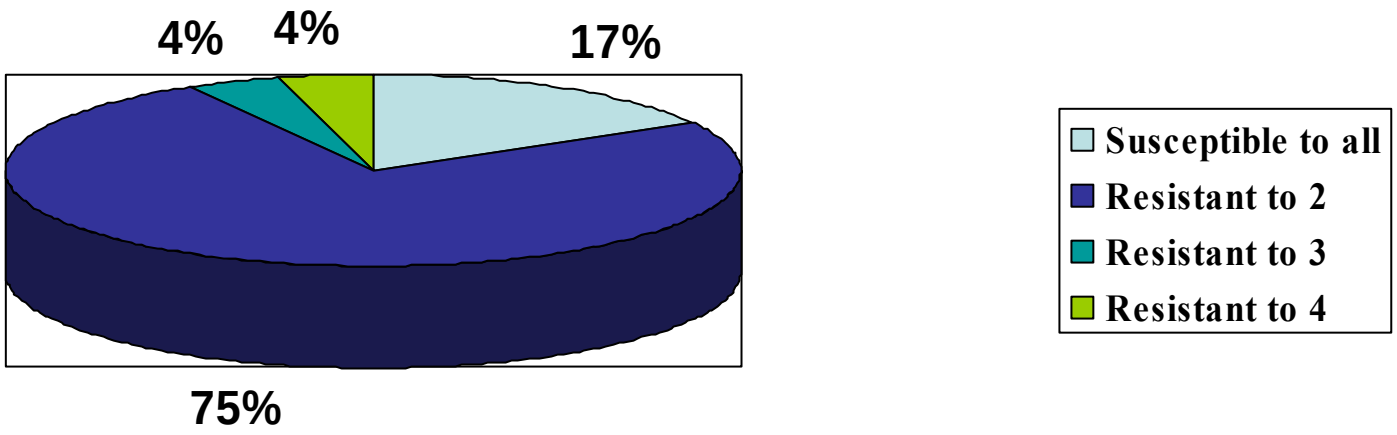
	Distribution (%) of MIC (mg/L)																		
Antimicrobial	**≤0,008**	**0,016**	**0,03**	**0,06**	**0,12**	**0,25**	**0,5**	**1**	**2**	**4**	**8**	**16**	**32**	**64**	**128**	**256**	**512**	**1024**	**□1024**
Ampicillin							20,8	58,3	8,3	4,2	4,2		4,2						
Cefotaxime				33,3	66,7														
Chloramphenicol									8,3	37,5	54,2								
Ciprofloxacin			8,3	8,3	16,7	58,3	8,3												
Florfenicol										75,0	25,0								
Gentamycin							70,8	29,2											
Kanamycin									75,0	20,8	4,2								
Nalidixic acid										16,7					79,1	4,2			
Streptomycin									25,0	58,3	12,5		4,2						
Sulphonamide														41,6	25,0		4,2		29,2
Tetracycline								29,2	66,6	4,2									
Trimethoprim						58,3	33,3	4,2	4,2										

Antimicrobial resistance in *Salmonella* Enteritidis from poultry 2006-2009

- *Salmonella* Enteritidis were isolated from poultry at slaughter and retail

- **24** *Salmonella* Enteritidis isolates in poultry were tested
- **83,3%i**solates resistant to quinolones (ciprofloxacin/enrofloxacin and nalidixic acid)
- All isolates susceptible to **cefotaxime**, chloramphenicol, gentmicin, kanamycin, florfenicol, streptomycin, tetracycline, trimethoprim.
- **75%** isolates resistant to two antimicrobial agents
- **8%** isolates were multiresistant
- **17%** isolates were fully susceptible

Resistance (%) and multiresistance (%) in S.Enteritidis from poultry 2006-2009



Antimicrobial resistance in *Salmonella* Typhimurium from animals 2006-2009

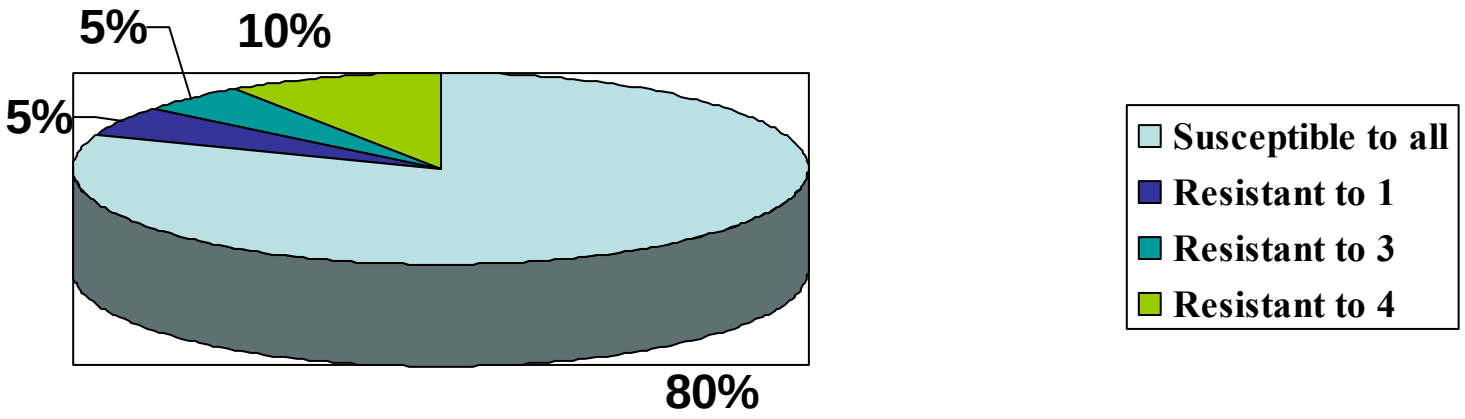
Distribution of MIC for *Salmonella* Typhimurium (n=21) from animals 2006-2009

	Distribution (%) of MIC (mg/L)																	
Antimicrobial	**≤0,008**	**0,016**	**0,03**	**0,06**	**0,12**	**0,25**	**0,5**	**1**	**2**	**4**	**8**	**16**	**32**	**64**	**128**	**256**	**512**	**1024**	**□1024**
Ampicillin								76,2	9,5	4,8			9,5						
Cefotaxime				9,5	90,5														
Chloramphenicol									4,8	14,3	80,9								
Ciprofloxacin			9,5	85,7	4,8														
Florfenicol										28,6	71,4								
Gentamycin							23,8	66,7	9,5										
Kanamycin									23,8	61,9	9,5	4,8							
Nalidixic acid									4,8	90,4		4,8							
Streptomycin											23,8	57,1	4,8			14,3			
Sulphonamide													19,0	33,3	19,0	14,3			14,3
Tetracycline								9,5	71,4	14,3				4,8					
Trimethoprim						47,6	42,9						9,5						

Antimicrobial resistance in *Salmonella* Typhimurium from animals 2006-2009

- *Salmonella* Typhimurium were isolated from clinical submissions of faecal samples or samples taken post mortem from the gastro-intestinal.tract.
- **21** *Salmonella* Typhimurium isolates were tested
- All isolates susceptible to **cefotaxime**, chloramphenicol, gentmicin, kanamycin, nalidixic acid, florfenicol
- **1** *Salmonella* Typhimurium isolate resistant to ciprofloxacin
- 80% isolates were fully susceptible
- 15% isolates were multiresistant (resistance to three and more antimicrobials)

Resistance (%) and multiresistance (%) in S.Typhimurium from animal 2006-2009



Antimicrobial resistance in *Campylobacter* spp. from poultry 2005-2009

- *Campylobacter* spp. were isolated from poultry at slaughter and retail
- **14** *Campylobacter* spp (13 *C.jejuni* and 1 *C.coli*) isolates in poultry were tested
- **3** isolates resistant to ciprofloxacin /enrofloxacin
- 5 isolates resistant to nalidixic acid
- **8** isolates were fully susceptible
- **2** isolates were resistant to one antimicrobial agent (ampicillin, tetracycline)

Distribution of MIC for *Campylobacter jejuni* (n=8) from poultry 2008-2009.

		Distribution (%) of MIC (mg/L)											
Antimicrobial		**0,06**	**0,12**	**0,25**	**0,5**	**1**	**2**	**4**	**8**	**16**	**32**	**64**	**>64**
Ciprofloxacin			37,5	37,5				25,0					
Erythromycin					85,7		12,5						
Gentamicin				12,5	50,0	37,5							
Nalidixic acid								62,5	12,5		12,5		12,5
Streptomycin					12,5	25,0	62,5						
Tetracycline			75,0	25,0									

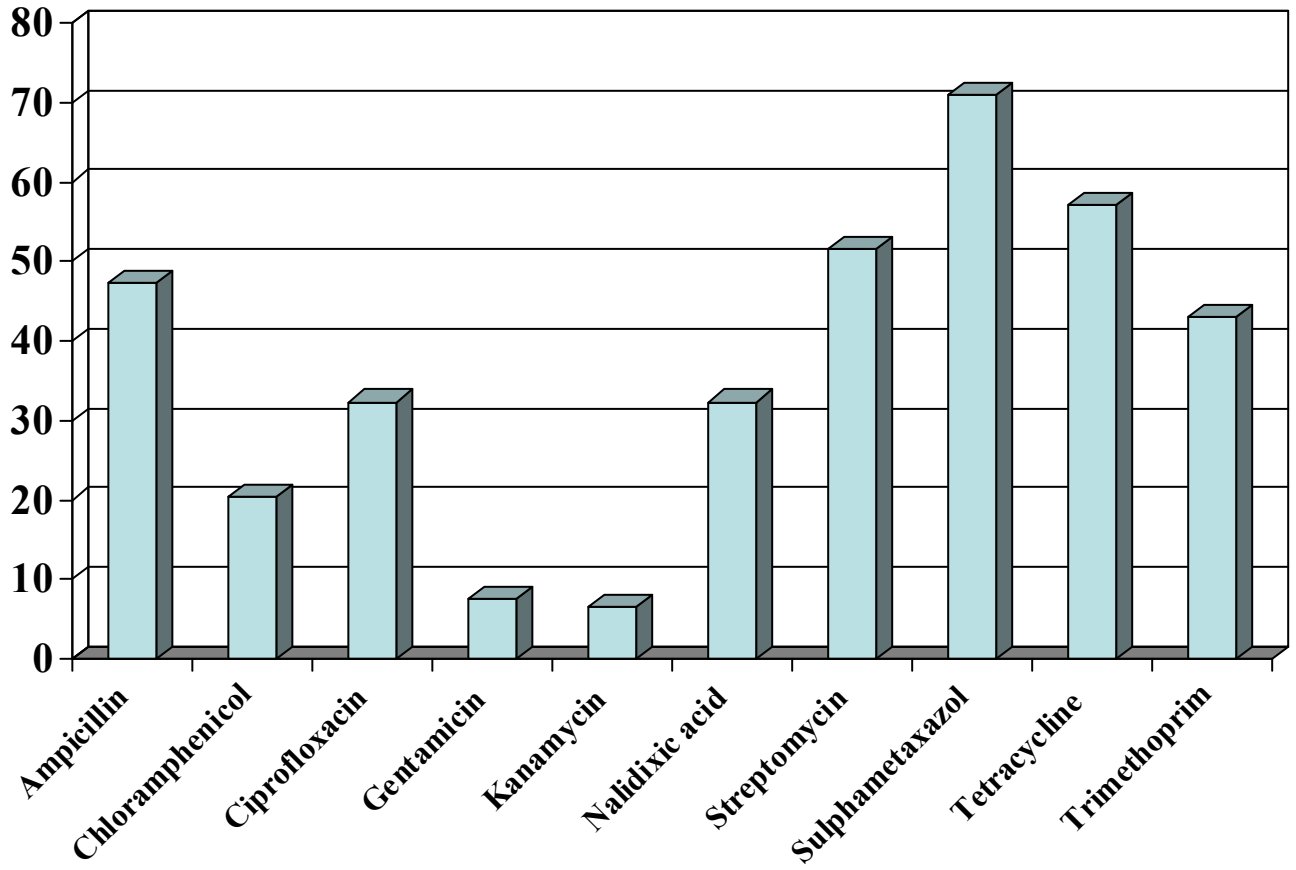
Antimicrobial resistance in *Campylobacter* spp. from poultry 2005-2009

Distribution of MIC for Campylobacter spp. (n=6) from poultry 2005, 2007

	Distribution (%) of MIC (mg/L)													
Antimicrobial	**≤0,03**	**0,06**	**0,12**	**0,25**	**0,5**	**1**	**2**	**4**	**8**	**16**	**32**	**64**	**128**	**□128**
Ampicillin					33,3			33,3	16,7			16,7		
Enrofloxacin			33,3	16,7	33,3				16,7					
Erythromycin				16,7		50,0	33,3							
Gentamicin					50,0	50,0								
Nalidixic acid						16,7			16,7	16,7	33,3	16,7		
Tetracycline				16,7	16,7	33,3		16,7	16,7					

Antimicrobial resistance (%) *E.coli* from pathological material of pigs 2006-2009

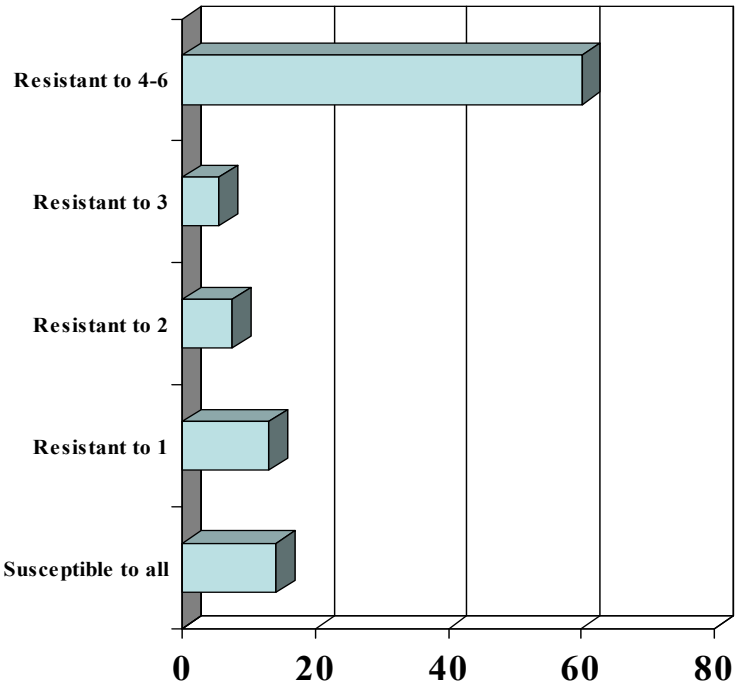
E.coli **n=93**



Antimicrobial resistance *E.coli* from pathological material of pigs 2006-2009

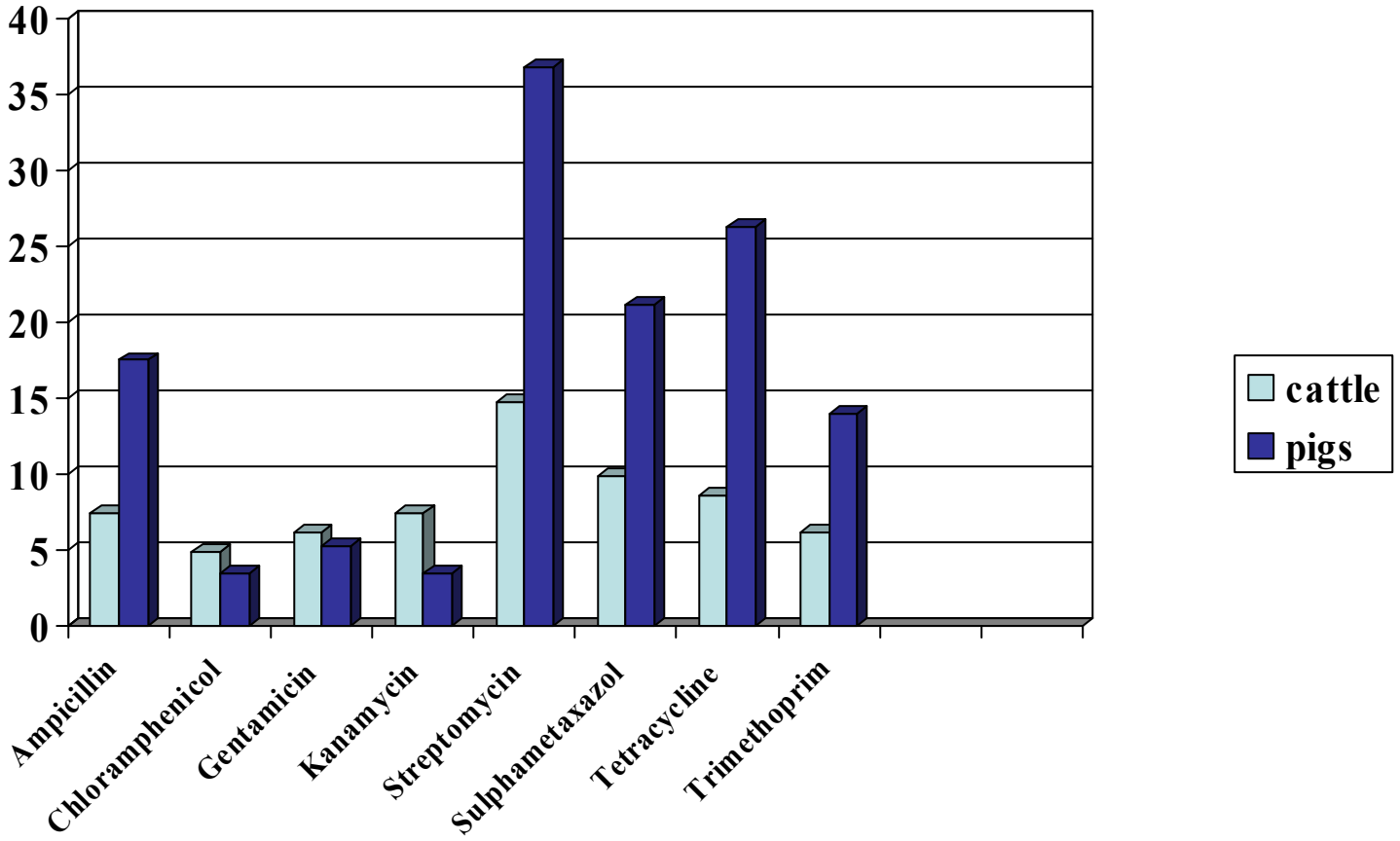
- **93** *E.coli* strains were isolated from suckling and weaned pigs samples taken post mortem from the gastro-intestinal.tract.
- High level of resistance to sulphonamide, tetracycline, streptomycin, ampicillin, trimethoprim (43% - 70,9%)
- **32,3**% *E.coli* isolates resistant to quinolones (ciprofloxacin /enrofloxacin and nalidixic acid)
- **1** *E.coli* isolates was resistant to cefotaxime not confirm ESBL but confirm AmpC
- **65,5**% *E.coli* isolates were multiresistant (resistant to three and more antimicrobials)

Resistance (%) and multiresistance in *E.coli* from pathological materjal of pigs 2006-2009



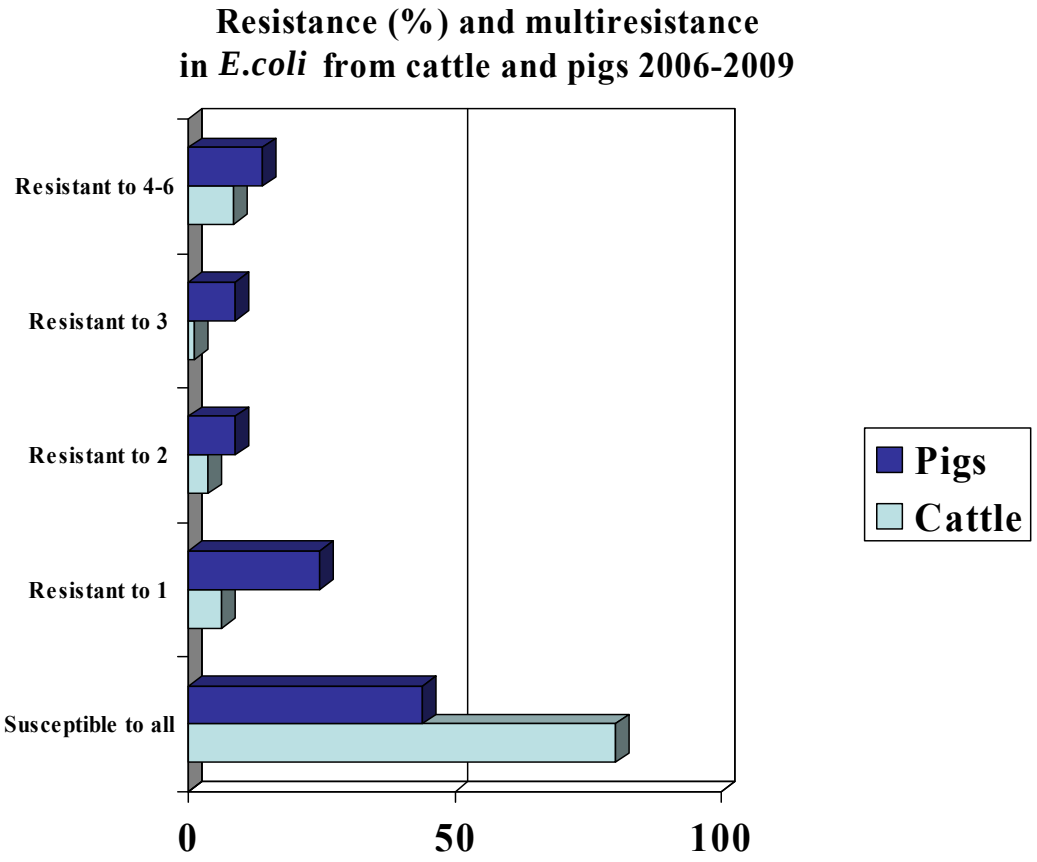
Antimicrobial (%) resistance in *E.coli* indicator isolates from cattle and pigs 2006-2009

***E.coli* from cattle (n=81) and pigs (n=54).**



Antimicrobial resistance in *E.coli* indicator isolates from cattle and pigs 2006-2009

	Cattle	Pig
No. of samples cultured	106	107
Percent positive *E.coli*	76,4%	50.4%
No. of *E.coli* tested	**81**	**54**
Resistance (%) to streptomycin	13,4	36,8
Resistance (%) to tetracycline	8,5	26,3
Resistance (%) to sulfametaxazol	9,8	21,1
No. of *E.coli* resistant to cefotaxime	1*	0
* Not confirm ESBL and AmpC		
No. of *E.coli* resistant to ceftiofur	3	0
No. of *E.coli* resistant to quinolones**	0	1
**resistant to ciprofloxacin (1 µg/L)		
**resistant to nalidixic acid (>128 µg/L)		



Antimicrobial resistance in *Enterococcus* indicator isolates from cattle and pigs 2006-2009

Distribution of *Enterococcus faecium* from pigs (n=22) and from cattle (n=12) years 2006-2009

Distribution (%) of MIC (mg/L)

		0,12	0,25	0,5	1	2	4	8	16	32	64	128	256	512	1024	2048	□2048
Ampicillin	Pig		4,5	13,6	45,5	13,6	22,7										
	Cattle			25	16,7	50	8,3										
Bacitracin	Pig				9,1		4,5	9,1	40,9	27,3		9,1					
	Cattle							16,7	50	16,7	16,7						
Cloramphenicol	Pig						33,3	63,6	25		4,5						
	Cattle						25	66,7	8,3								
Erythromycin	Pig			13,6		13,6	27,3	18,2			13,6	13,6					
	Cattle			33,4		8,3	25	16,7	8,3	8,3							
Gentamycin	Pig						13,6	63,6	22,7								
	Cattle						8,3	58,3	33,4								
Kanamycin	Pig									9,1		31,8	22,7		4,5	13,6	18,2
	Cattle									8,3	8,3	25	50	8,3			
Linezolid	Pig			4,5		36,4	54,5			4,5							
	Cattle					58,3	41,7										
Narazin	Pig	4,5	4,5	36,4	45,5		9,1										
	Cattle		25	25	33,3		16,7										
Streptomycin	Pig									13,6	36,4	9,1		4,5	18,2	18,2	
	Cattle									8,3	66,7	16,7			8,3		
Tetracyclin	Pig			22,7	36,4					9,1	31,8						
	Cattle			33,3	50	8,3					8,3						
Vancomycin	Pig				81,8	13,6	4,5										
	Cattle				83,3			16,7									
Virginiamycin	Pig			4,5	13,6	27,3	50	4,5		4,5							
	Cattle			16,7		16,7	58,3	8,3									

Distribution of MIC for *Enterococcus faecalis* from pigs (n=16) and from cattle (n= 12) years 2006-2009.

Distribution (%) of MIC (mg/L)

		0,12	0,25	0,5	1	2	4	8	16	32	64	128	256	512	1024	2048	□2048
Ampicillin	Pig			18,8	75	6,2											
	Cattle		8,3	8,3	75,1	8,3											
Bacitracin	Pig							43,7	37,4	18,8							
	Cattle						16,7	16,7	41,7	25							
Cloramphenicol	Pig						25	50	6,3	6,3		12,5					
	Cattle						33,3	58,4			8,3						
Erythromycin	Pig			18,8	18,8	12,5	18,8			6,3		25					
	Cattle			16,7	16,7	33,2	16,7					16,7					
Gentamycin	Pig				6,3		6,3	25	50				6,3	6,3			
	Cattle						16,7	33,3	41,7				8,3				
Kanamycin	Pig									12,4	43,8	6,3	6,3			6,3	25
	Cattle										50	8,3	25				16,7
Linezolid	Pig			6,3	18,8	68,8	6,3										
	Cattle			8,3	16,7	66,7	8,3										
Narazin	Pig	6,3	62,4	18,8	6,3	6,3											
	Cattle	8,3	25	58,4	8,3												
Streptomycin	Pig								6,3	6,3	31,2	18,8			6,3	31,2	
	Cattle									8,3	8,3	50,1				33,3	
Tetracyclin	Pig			12,5	25	6,3			6,3	12,5	31,5	6,3					
	Cattle				41,7					25	33,3						
Vancomycin	Pig				12,5	56,3	18,8	12,5									
	Cattle					66,7	25	8,3									
Virginiamycin	Pig					6,3	12,5	43,8	31,3	6,3							
	Cattle					16,7	8,3	25	41,7	8,3							

Antimicrobial resistance in *Enterococcus* indicator isolates from cattle and pigs 2006-2009

Enterococcus faecalis and *Enterococcus faecium* from cattle and pigs (2006 – 2009)

Cattle

- Enterococci were isolated from 21,2% of the 113 sample kultured
- 50% isolates susceptible to all antimicrobials
- Only 3 isolates were resistant to three or more antimicrobials

Enterococcus faecalis

- No isolates was resistant to ampicillin, linezolid and virginiamycin.
- Resistance to tetracycline was 58,3%
- Resistance to erythromycin, kanamycin and streptomycin was also common (16,7-33,3%)
- **One** strain was resistant **to vancomycin** (8 µg/L)

Enterococcus faecium

- No isolates was resistant to ampicillin, chloramphenicol, gentamicin, kanamycin, linezolid and virginiamycin.
- Erythromycin was the most common trait (33,3%)
- 16,7 % isolates were resistant to bacitracin and to narazin
- **Two** strains resitance to **vancomycin** (8 µg/L)

Pigs

- Enterococci were isolated from 40,8% of the 93 sample kultured
- 39,8% isolates susceptible to all antimicrobials
- 12 isolates (31,%) were resistant to three or more antimicrobials

Enterococcus faecalis

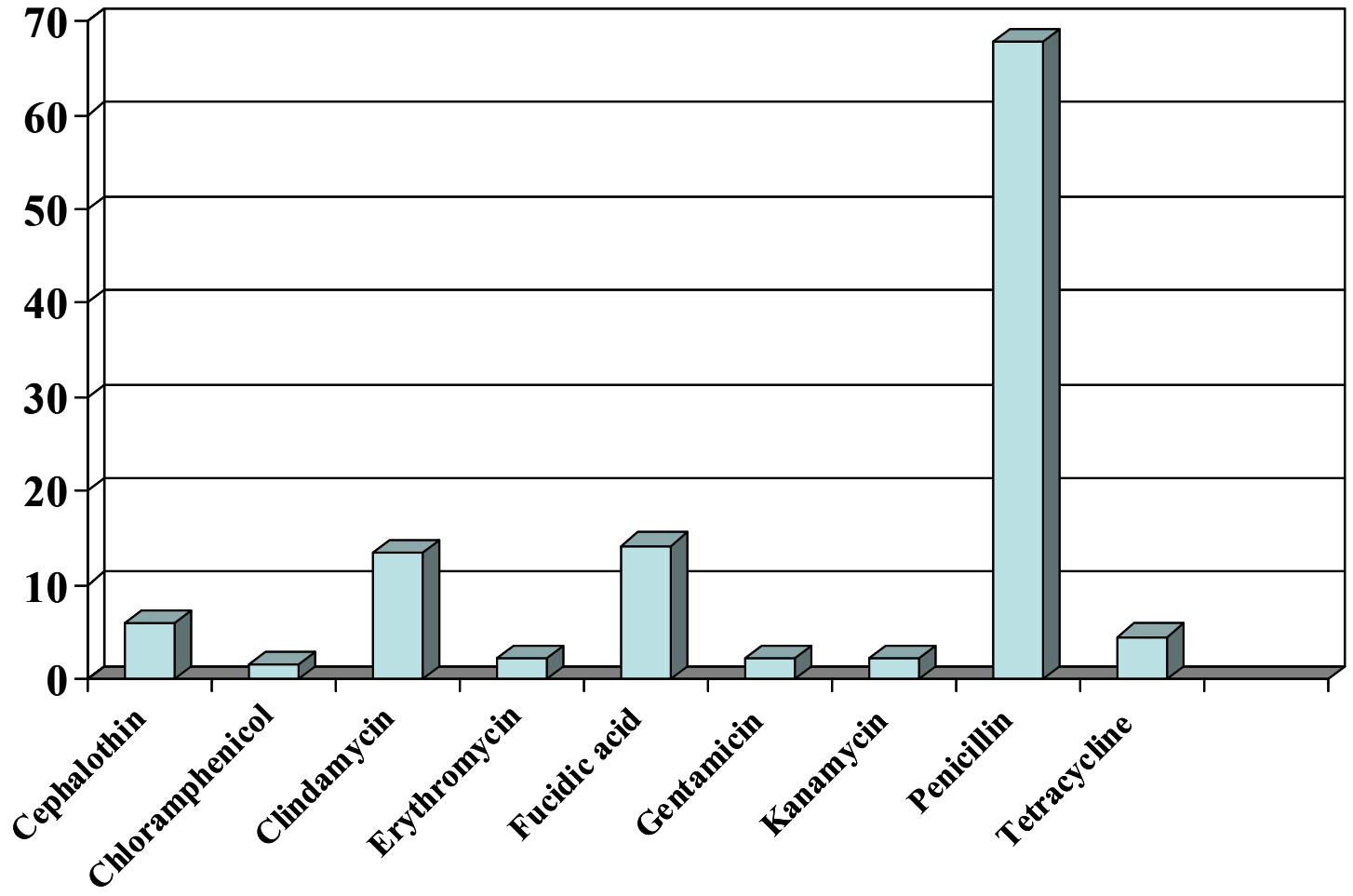
- No isolates was resistant to ampicillin, linezolid and virginiamycin.
- Resistance to erythromycin, kanamycin and streptomycin was also common (33,3-37,5%)
- **Two** strains resitance **to vancomycin** (8 µg/L)

Enterococcus faecium

- No isolates was resistant to ampicillin, gentamicin, vancomycin
- Resistance to erythromycin was 45,5%
- Resistance to tetracycline was 40,9%
- 36,4% strains resistant to streptomycin and 31,8% resistant to kanamycin
- One strain was resistant to virginiamycin

Antimicrobial resistance (%) in *Staphylococcus aureus* isolates from dairy milk samples 2006-2009

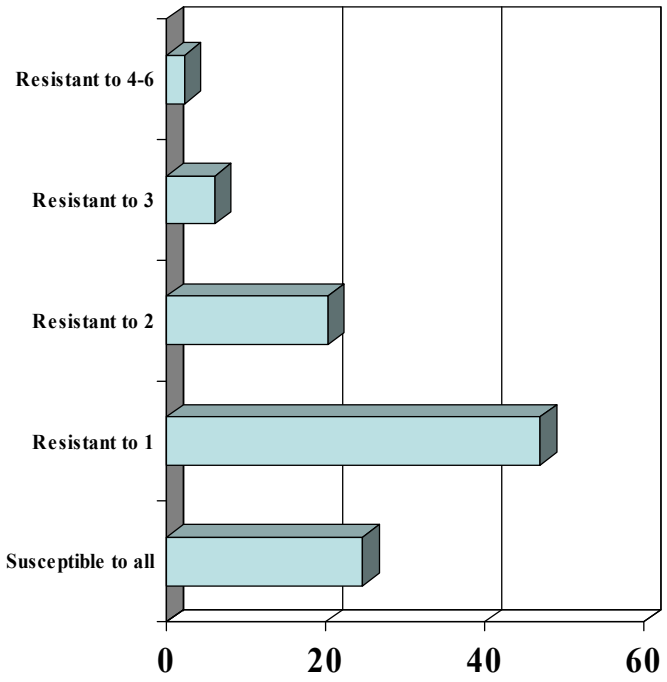
***Staphylococcus aureus* n=134**



Antimicrobial resistance in *Staphylococcus aureus* isolates from dairy milk samples 2006-2009

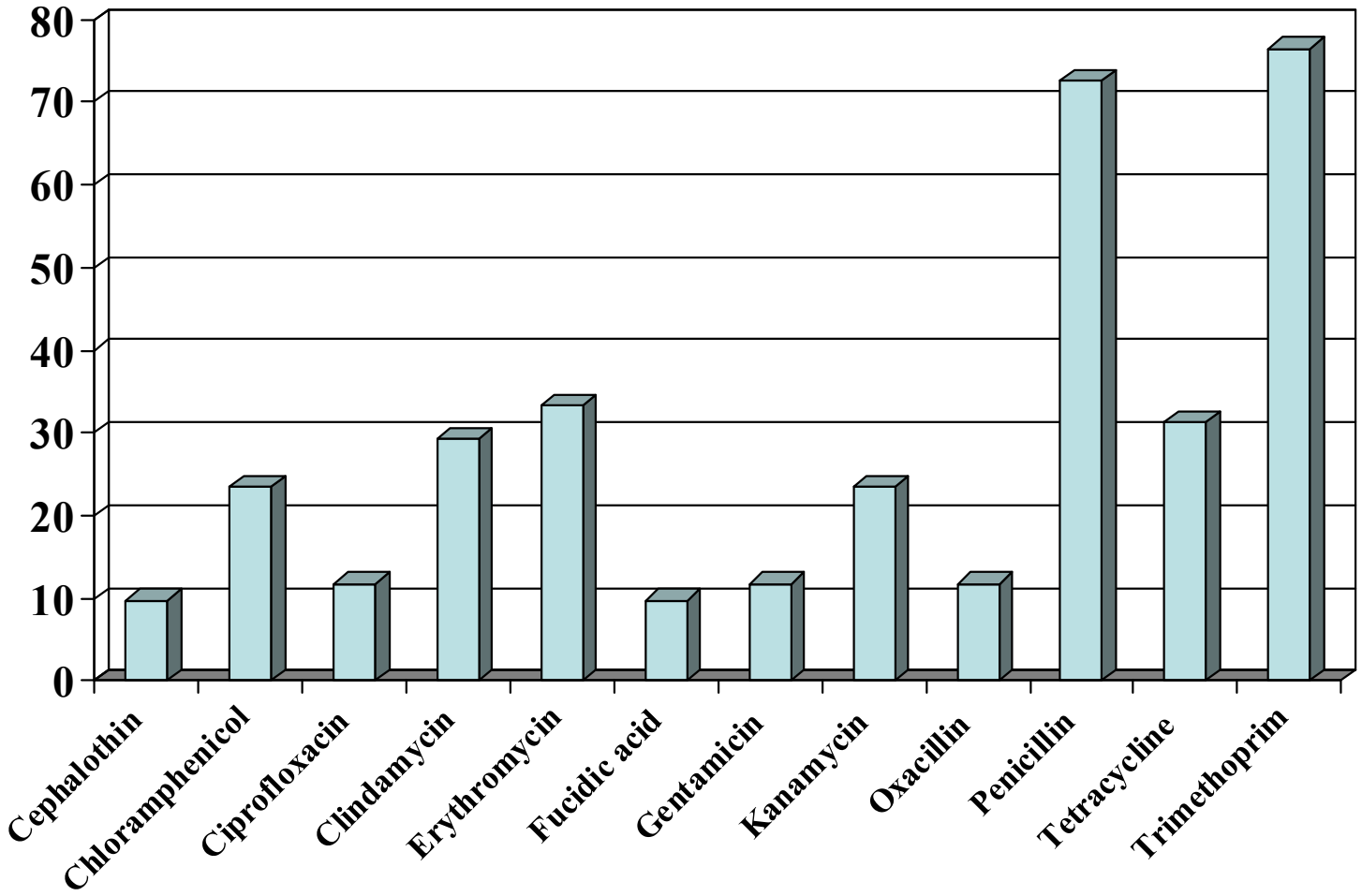
- *S.aureus* strains were isolated from milk samples from dairy cow with clinical mastitis
- **134** *S.aureus* isolates were tested to 12 antimicrobial agents
- None of the isolates were resistant to ciprofloxacin
- No meticillin resistant *S.aureus* from dairy milk samples was suspected
- Resistance to clindamycin was 13,4% and fucidic acid 14,2%
- Resistance to beta-lactam antibiotic (penicillin) was **67,9**%
- multiresistant strains were isolated only 2,2%

Resistance (%) and multiresistance in *S.aureus* from milk samples 2006-2009



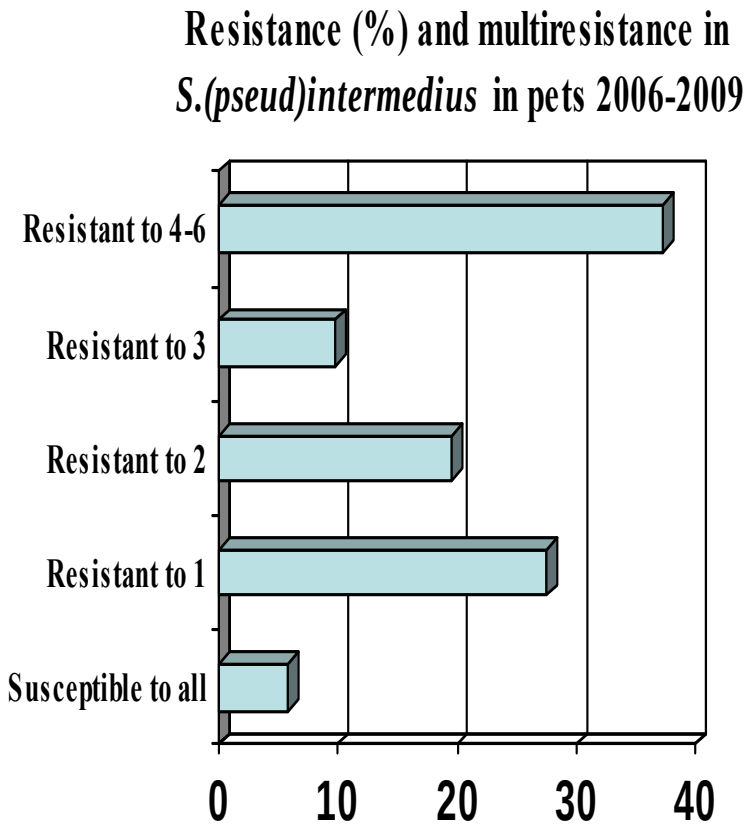
Antimocrobial resistance in *Staphylococcus (pseud)intermedius* from pets (dogs and cats) 2006-2009

Antimocrobial resistance (%) in *Staphylococcus (pseud)intermedius* from pets (n=51) 2006-2009



Antimocrobial resistance in *Staphylococcus (pseud)intermedius* from pets (dogs and cats) 2006-2009

- **51** *S.(pseud)intermedius* isolates from sick pets (dogs and cats) were tested to 12 antimicrobial agents
- Resistance to all 12 antimicrobial agents observed
- High resistance to trimethoprim was **76,5**%
- Resistance to beta-lactam antibiotic (penicillin) was **72,5**%
- MRSP strans from pets were **11,8**%
- Only **5,8**% isolates susceptible to all antimicrobial agents
- Resistance to three or more antimicrobials were **47,3**%



CONCLUSION

- High level of resistance to :

  quinolone (ciprofloxacin/enrofloxacin and nalidixic acid)

  in *Salmonella* Enteritidis from poultry

  in *E.coli* from patological material from pigs

  beta-lactam antibiotic (penicillin)

  in *Staphylococcus aureus* from milk samples

  in *Staphylococcus (pseud)intermedius* from pets
- In last years resistance to quinolone were observed in *Campylobacter* from poultry, in *Salmonella* Typhimurium from animals, in *E.coli* indicator from pigs and in *Staphylococcus (pseud)intermedius*
- Methicillin-resistant strains in *Staphylococcus (pseud)intermedius* from pets
- In 2009 year resistance to cefotaxime were observed in *E.coli* indicator from cattle (not confirm ESBL and AmpC) and in *E.coli* from patological material from pigs (not confirm ESBL and confirm AmpC)
- Vancomycin resistant strains were observed in *Enterococcus faecalis* from cattle and pigs, in *Enterococcus faecium* from cattle.
- High level multiresistance (resistance to three and more antimicrobials) in :

  E.coli from patological material from pigs

  Staphylococcus (pseud)intermedius from pets
- Multiresistance in *Salmonella* Typhimurium from animals and in *Enterococcus* spp. from pigs.