Paper # 0713

Antimicrobial Susceptibilities of *Salmonella* Strains Isolated from Food Animals.

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Abstract

Background: The widespread use of antibiotics in humans and animals has led to an increase in the number of resistant *Salmonella* strains. Therefore, continued concern about the development of antimicrobial resistance in these organisms is warranted.
Methods: 505 *Salmonella* strains were isolated from pigs, and broiler (< 7 weeks) and adult (> 20 weeks) chickens between June and December 1998. All strains were serotyped, phage typed, and their activity (µg/ml) to 11 antimicrobial agents was determined by the agar dilution method according to NCCLS standards.
Results: *S. Enteritidis* (25%), *S. Typhimurium* (16%), and *S. Derby* (8%) were the most common serotypes.
All isolates were susceptible to ceftriaxone and ciprofloxacin. Resistance to nalidixic acid was more prevalent in *Salmonella* from broiler chicken. 52 of the 178 isolates (29%) showed resistance, of which 35 of 52 were *S. Hadar.*
Conclusions: The high rate of resistance to nalidixic acid can be a first step towards the development of resistance to ciprofloxacin.

Introduction

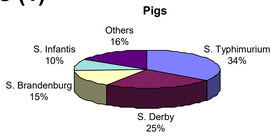
Nontyphoid *Salmonella* infections in humans are the primary cause of foodborne disease in developed countries, resulting in considerable morbidity and occasionally death, especially in immunocompromised patients. Strains of *Salmonella* that are resistant to antimicrobial agents have become a worldwide health problem. Fluoroquinolones are drugs of choice for treatment of human invasive salmonellosis. However, strains resistant to ciprofloxacin have been noted. Therefore, continued concern about the development of antimicrobial resistance in these organisms is warranted.

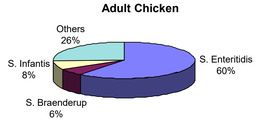
Methods

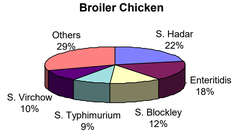
505 *Salmonella* strains were isolated from pigs, and broiler (< 7 weeks) and adult (> 20 weeks) chickens between June and December 1998. All strains were serotyped, phage typed, and their activity (µg/ml) to 11 antimicrobial agents was determined by the agar dilution method according to NCCLS standards.

Results (1)

Of the 505 strains, 25% were *S. Enteritidis*, 16% *S. Typhimurium*, and 8% *S. Derby*. However, the distribution differed substantially amongst the different animals.







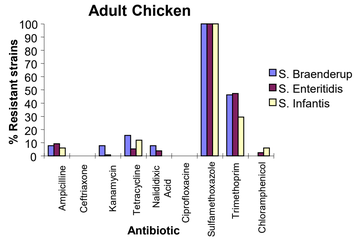
We tested the susceptibility of the strains to 11 antibiotics. Results are shown in the table below:

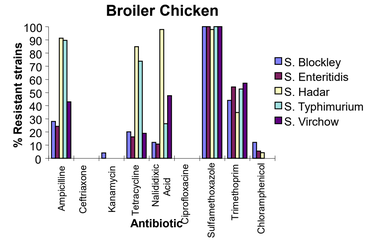
Antibiotics	Pig (164)			Adult chicken (163)			Broiler chicken (178)		
	MIC_{50}	MIC_{90}	% R	MIC_{50}	MIC_{90}	% R	MIC_{50}	MIC_{90}	% R
Ampicillin	2	>512	21	2	8	10	4	>512	44
Ceftriaxone	0.06	0.125	0	0.06	0.125	0	0.06	0.125	0
Kanamycin	2	2	1	2	2	1	2	4	2
Streptomycin	16	128		8	64		32	128	
Sulfamethoxazole	>512	>512	100	>512	>512	100	>512	>512	100
Trimethoprim	256	>256	63	8	>256	45	32	>256	48
Co-trimoxazole	>256	>256		32	>256		256	>256	
Tetracycline	4	256	38	2	32	12	4	128	36
Nalidixic acid	4	8	4	4	8	5	4	>512	29
Ciprofloxacin	0.03	0.03	0	0.03	0.03	0	0.03	0.25	0
Chloramphenicol	16	16	10	8	16	3	8	256	11

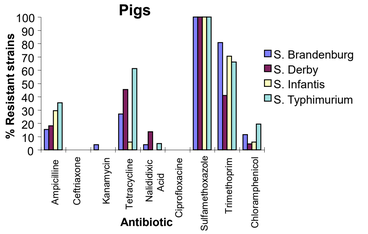
All isolates were susceptible to ceftriaxone. Resistance to nalidixic acid, a quinolone, was noticed in pigs and adult chicken, but the highest prevalence was encountered in *Salmonella* from broiler chicken (29%). Of the 52 isolates from broiler chicken that showed nalidixic acid resistance, 35 were *S.Hadar*. Most of the *S. Hadar* strains in our study were also resistant to ampicillin and tetracycline. No strains resistant to the fluorinated quinolone, ciprofloxacin, were encountered.

Results (2)

The resistance rates to the different antibiotics differed from animal species to animal species and from serotype to serotype.







Discussion and conclusions

In our study no ciprofloxacin resistant strains were found. However, the rate of resistance to nalidixic acid was high. This can be the first step towards the development of resistance to ciprofloxacin. Indeed, for resistance to nalidixic acid, a single genetic mutation is sufficient, but for resistance to ciprofloxacin, a second mutation is needed. This would explain why resistance occurs more rapidly in *Campylobacter* (see abstract 0723), where only one mutation is required for resistance to occur to ciprofloxacine, than *Salmonella*, where two mutations are needed.
It seems probably that the introduction of fluoroquinolones into veterinary medicine, i.e., in the treatment of poultry, contributed significantly to the appearance of nalidixic acid resistant *Salmonella* causing infections in man.