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Antimicrobial resistance in *Salmonella enteritidis* strains isolated from broiler carcasses, food, human and poultry-related samples

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Abstract

Antimicrobial resistance was investigated in 91 *Salmonella enteritidis* isolates from broiler carcasses, food, human and poultry-related samples originated from South of Brazil. A great proportion of resistant strains was found, 90.1% showing resistance to at least one antimicrobial drug. There was a high resistance to sulfonamides (75.8%) and nitrofurantoin (52.8%). Lower levels of resistance were found for tetracycline (15.4%), streptomycin (7.7%), nalidixic acid (7.7%), gentamicin (5.5%), norfloxacin (3.3%), trimethoprim (3.3%), cefalotin (2.2%), ampicillin (1.1%), and chloramphenicol (1.1%). Resistance to ciprofloxacin was not detected. A total of 51.6% of *S. enteritidis* strains were multiresistant (resistance to two or more antimicrobial agents) and 18 resistance patterns were found. The highest resistance was found in strains isolated from poultry-related samples, where all strains were resistant to at least one antimicrobial agent. No predominant resistance pattern was related to phage type in our isolates. The high number of antimicrobial resistant *S. enteritidis* found in Southern Brazil indicates the need for the prudent drugs uses to diminish the development and spread of antimicrobial resistance.

Keywords: Antimicrobial resistance; Brazil; Poultry; Food pathogen; *Salmonella enteritidis*

1. Introduction

The development of antimicrobial resistance among pathogenic bacteria has emerged as a major public health concern, which has led to an intensification of discussion about the prudent use of antimicrobial agents, especially in veterinary medicine, nutrition and agriculture (Caprioli et al., 2000).

The utilisation of antimicrobial drugs has played an important role in animal husbandry, since they are used in prophylaxis, treatment and growth promotion. Overall, the largest quantities of antimicrobials are used as regular supplements for prophylaxis or growth promotion in the feed of animal herds and poultry flocks. This results in the exposure of a large number of animals, irrespective of their health, to frequently subtherapeutic concentrations of antimicrobials (Dupont and Steele,

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1987; Franco et al., 1990). Furthermore, antibiotics given to animals and closely related compounds used in human therapy have been exerting selective pressure on their target bacteria for decades (Witte, 1998), and can generate a reservoir of antimicrobial resistant bacteria (Endtz et al., 1991; Smith et al., 1999).

Antimicrobial-resistant bacteria in food animals threaten the efficacy of human drugs if antimicrobial-resistant bacteria or antimicrobial-resistance genes become incorporated into human bacterial populations (Smith et al., 2002). Agricultural antibiotic use increases the frequency of antibiotic resistant zoonotic pathogens such as *Salmonella* (Smith et al., 2002). Most antimicrobial-resistant *Salmonella* infections are acquired from eating contaminated foods of animal origin (Angulo et al., 2000). The husbandry practices used in the poultry industry and the widespread use of medicated feeds in broiler and layer operations made poultry a major reservoir of antimicrobial-resistant *Salmonella* (D'Aoust et al., 1992). Resistance in *Salmonella* limits the therapeutic options available to veterinarians and physicians in the treatment of certain human cases of salmonellosis (Witte, 1998). Furthermore, if there is a coinfection with HIV, it may result in rapid disease progression in the infected individual and has a potential multiplier effect on the dissemination of the resistant pathogen to the rest of the population (WHO, 2001).

Surveillance of antimicrobial resistance is essential for providing information on the magnitude and trends in resistance and for monitoring the effect of interventions, especially because the prevalence of resistance varies widely between and within countries, and over time (WHO, 2001). Therefore, it is of great value the study of antimicrobial resistance in *Salmonella*, especially *Salmonella enteritidis* that has represented an important public health problem in the last two decades. Since the 1980s, there has been a dramatic increase in the number of reported findings of this serovar in Europe and worldwide (Rodrigue et al., 1990; Fantasia and Filetici, 1994; Tassios et al., 1997; Ling et al., 1998). In Brazil, the remarkable increase in the incidence of *S. enteritidis* from foodborne outbreaks, human infections, nonhuman sources, broiler carcasses and other poultry materials has been reported since the 1990s (Tavechio et al., 1996, 2002; Hofer et al., 1997; Peresi et al., 1998; Fuzihara et al., 2000; Santos et al., 2000). The more prevalent phage type (PT) in this country has been PT4 (Irino et al., 1996; Nunes et al., 2003; Santos et al., 2003).

Few studies have been performed about antimicrobial resistance in *Salmonella* isolates from Brazil, although this country, mainly Southern Brazil, is the second world producer of poultry meat. The present study is an attempt to help the surveillance of the antimicrobial resistance status. The purpose of this investigation was to determine and to compare antimicrobial resistance in *S. enteritidis* strains isolated from broiler carcasses, food, human and poultry-related samples and to verify possible relation between phage type and its antimicrobial resistance.

2. Materials and methods

2.1. Bacterial strains

The study was carried out using 91 phage-typed *S. enteritidis* strains isolated in Southern Brazil (between 25°S and 35°S) over the period 1995–1997 from human, foods, broiler carcasses and poultry-related samples (Table 1). It is subtropical to humid area with average temperatures ranging from 10–18 °C in winter to 22–35 °C in summer. Seventeen isolates were from human; 31 from food involved in foodborne outbreaks, 22 from broiler carcasses, and 21 were from other poultry-related samples (viscera and environmental samples). Strains isolated from human and food not belonged to the same outbreak. All

Table 1
Source and phage types (PT) of the *S. enteritidis* strains

Samples	Number of strains				
	PT4	PT4a	PT6a	PT7	Total
Human					17
Patients	6	6	0	0	12
Food handlers	2	3	0	0	5
Foods					31
Meals with eggs or other poultry product	17	7	1	0	25
Meals without eggs or other poultry product	3	3	0	0	6
Broiler carcasses	20	2	0	0	22
Poultry					21
Viscera	3	8	0	1	12
Environmental swabs	2	6	1	0	9
Total	53	35	2	1	91