Fluoroquinolone Susceptibility of *Campylobacter* Strains, Senegal

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To assess fluoroquinolone susceptibility of *Campylobacter* strains in Senegal, skin samples were collected from 250 chicken carcasses from January 2001 to October 2002. Among 205 isolated *Campylobacter* strains, 59% and 41% were identified as *Campylobacter jejuni* and *C. coli*, respectively; the overall ciprofloxacin-resistance rate was 34%.

Campylobacter species are one of the most common causes of human bacterial diarrhea in industrialized and developing countries (1–3). *Campylobacter jejuni* and *C. coli* are the two main species involved in human infections (1,2). Because of genotyping and serotyping analysis, several studies have confirmed that poultry can be a source of *Campylobacter* infection in humans (1,4). The contamination may be due to direct ingestion of undercooked food or cross-contamination of raw poultry to other foods by nonhygienic handling (e.g., unwashed hands, dirty utensils) (1).

No antimicrobial drug therapy is usually required for *Campylobacter* infections, since they are of short duration, clinically mild, and self-limiting. However, antimicrobial drug treatment is indicated for severe infections or persons at risk such as children or immunocompromised patients (1,2), especially in Africa where AIDS has reached epidemic proportions.

Fluoroquinolones are effective synthetic antimicrobial drugs used for treatment of a wide variety of bacterial infections, including campylobacteriosis (5). Because of heavy use of fluoroquinolones in veterinary medicine during the 1990s, numerous fluoroquinolone-resistant *Campylobacter* strains are emerging both in animals and in humans (1). We report the first evidence of ciprofloxacin-resistant *Campylobacter* strains isolated from chickens in Senegal, West Africa.

The Study

From January 2001 to October 2002, a total of 250 chicken carcasses were collected in Dakar, the capital of Senegal, and its suburbs. Chicken carcasses originated from broiler chickens from semi-industrialized areas. These chickens had been raised domestically; no imported animal was included in the study. Chicken carcasses were selected from a random sampling of 80 retail shops and slaughterhouses. In Senegal, the slaughtering process is manual, rudimentary, and often performed by a single person outside in poor hygienic conditions. Each carcass was examined for *Campylobacter*.

Standard methods for isolating *Campylobacter* from the skin were used, and species identification was performed by polymerase chain reaction (4). One colony per positive culture was randomly selected. The strains were maintained as stock culture in glycerol at –80°C and tested further by the E test method for susceptibility to ciprofloxacin (6). As previously reported for *Campylobacter*, the breakpoint used for resistance was ≥4 µg/mL for ciprofloxacin (7). The chi-square test was used for statistical analysis (EpiInfo, version 6, Centers for Disease Control and Prevention, Atlanta, GA). A p value of <0.05 was considered statistically significant.

Campylobacter were isolated from 82% of the samples: 120 *C. jejuni* and 85 *C. coli* were identified. MIC performed by E test showed that 34% of *Campylobacter* strains were resistant to ciprofloxacin without a significant difference between the two species (Table): 71% and 79% of *C. coli*– and *C. jejuni*–resistant strains, respectively, displayed a ciprofloxacin MIC ≥32 µg/mL. These rates were also statistically similar and showed a high level of resistance to ciprofloxacin in strains isolated in Dakar (Table).

Our data showed a significant isolation rate of *Campylobacter* strains (82%). In every retail shop and slaughterhouse, at least one chicken in the three or four randomly selected harbored a *Campylobacter* strain. As previously reported (8), *C. jejuni* was more frequently isolated than *C. coli* (59% vs. 41%). During the microbiologic analysis, one colony per culture was selected and iden-

Table. Distribution of ciprofloxacin MICs for 85 *Campylobacter coli* and 120 *C. jejuni* isolates from broiler carcasses in Senegal

Ciprofloxacin MIC (ì g/mL)	*C. coli*: No. of strains	*C. jejuni*: No. of strains
0.032–0.063	26	34
0.064–0.124	23	27
0.125–0.249	5	18
0.250–0.4	0	1
0.5–0.99	0	1
1.00–1.99	0	0
2.00–3.99	0	0
4.00–7.99	4	5
8.00–15.99	4	2
16.00–32.00	1	1
>32.00	22	31
Total	85	120

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tified. Since different strains and even species of *Campylobacter* can frequently be isolated from poultry products (7), the number of species isolated in our survey might be underestimated.

Conclusions

High levels of *Campylobacter* isolation from chicken carcasses and retail chickens have been previously reported in industrialized countries: 46% in Germany (9), 46% in Japan (10), and 73% to 100% in the United States (11). Although little information is available from developing countries, our results are consistent with those from Kenya, where thermophilic *Campylobacter* organisms were isolated from 77% of chicken samples (12). These results showed that the *Campylobacter* prevalence in chicken carcasses in some African countries may be similar to those observed in industrialized countries.

A high frequency of ciprofloxacin-resistant *Campylobacter* strains was observed in our survey. The prevalence of resistant strains was similar for *Campylobacter* isolated from chickens in Lebanon (13), the United States (11), and Japan (14). The prevalence was lower than the rate of resistant strains from Belgium (7) or Spain (2), where 100% of *C. coli* and 98.7% of *C. jejuni,* respectively, were fluoroquinolone resistant. In Taiwan, Thailand, and Spain, fluoroquinolone-resistance rates, ranging from 56% to 84%, were similar in poultry meat and human isolates (1,2). By contrast, in some countries such as Chile, no ciprofloxacin-resistant *Campylobacter* strains have been described (6).

Since 1991, when Endzt and colleagues (15) identified the first quinolone-resistant *Campylobacter* strains in *C. jejuni* and *C. coli* in the Netherlands, *Campylobacter* resistance to fluoroquinolones has increased throughout the world (2,6,8). This important development in humans and other animals is related to the introduction of fluoroquinolones in veterinary medicine (15). In Senegal, fluoroquinolones (enrofloxacin, norfloxacin) were introduced in veterinary medicine in 1996 in poultry production to treat respiratory and intestinal diseases. Because of the absence of any antibiotic resistance studies in Senegal, correlating the currently observed ciprofloxacin resistance with the introduction of ciprofloxacin into the country is difficult. However, our results show, as in industrialized countries, that fluoroquinolone resistance may become a public health problem for developing countries. Further studies are needed to evaluate how commonly fluoroquinolone resistance occurs among human isolates of *Campylobacter* in Senegal, and to what extent poultry contributes.

Because of their wide treatment spectrum, which includes bacterial infections such as salmonellosis and shigellosis, fluoroquinolones have progressively become the empiric treatment for human gastroenteritis in Senegal. In the region of Dakar, fluoroquinolones are used in all facets of poultry production, including for chickens used for broiling, laying, and breeding. Fluoroquinolones also tend to be the most prescribed drug for treatment of respiratory and intestinal diseases among poultry (approximately 25% of the antimicrobial drugs delivered in veterinary use; C. Biagui, unpub. data). To decrease ciprofloxacin-resistant *Campylobacter* and preserve the effectiveness of fluoroquinolones, their use in veterinary medicine should be more strictly controlled. Our finding of fluoroquinolone-resistant *Campylobacter* in chickens suggests the epidemiology of fluoroquinolone-resistant *Campylobacter* in Senegal is the same as in other countries.

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