Antimicrobial Susceptibilities of Food-Isolated Strains of *Yersinia enterocolitica, Y. intermedia, Y. frederiksenii, and Y. kristensenii*

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The in vitro antimicrobial susceptibility of *Yersinia enterocolitica* and newly related species isolated from foods was examined. Only 4 of 375 isolates displayed resistance to non-β-lactam antibiotics. MICs of ampicillin and carbenicillin determined by agar dilution with respect to 125 isolates showed the high susceptibility of *Y. kristensenii* and biovar 3 of *Y. enterocolitica* to carbenicillin (MIC for 90% of the strains, < 8 μg/ml). In contrast with data available concerning classical enterobacteria such as *Escherichia coli* and *Salmonella* spp., which are well documented, comparatively little is known about the antibiotic susceptibility of *Yersinia* spp. Cornells et al. (3, 4, 7, 12) studied extensively the β-lactamases produced by a number of strains of *Yersinia enterocolitica* of human or animal origin and characterized two chromosomally mediated β-lactamases, types A and B. On the other hand, recent reports on in vitro activities of new β-lactam antibiotics have shown that clinical isolates of *Y. enterocolitica* were susceptible to these newer antimicrobial agents (10, 18). With respect to non-β-lactam antibiotics, resistant *Yersinia* strains seem to be very uncommon. Some resistance plasmids have been found in strains of *Y. enterocolitica* isolated from human beings (6, 11, 20), but two recent studies of in vitro antimicrobial susceptibility of isolates from human, environmental, and animal sources have shown that they displayed essentially equal susceptibility patterns (9, 15).

Recently, three new species of *Yersinia*, previously called *Y. enterocolitica*-like and now named *Y. intermedia, Y. frederiksenii*, and *Y. kristensenii* (2), have been described. To our knowledge no data is yet available concerning the antimicrobial susceptibility of these new species. In this report we present the results of a study concerning in vitro antibiotic susceptibility of a number of bacteria of this group isolated from various foods in Alsace, a region of eastern France. *Yersinia* strains were isolated from foods as follows. A 10-g sample of homogenized food was preenriched in 100 ml of phosphate-sorbitol-bile medium (13) at 4°C for 9 days. The preenriched mixture (1 ml) was transferred to 100 ml of bile-oxalate-sorbitose selective enrichment broth (17), which was incubated at 22°C for 5 days. The enrichment broth (0.5 ml) was mixed with 4.5 ml of a 0.25% KOH solution and held for 2 min. (8). One loopful of the alkalii-treated broth was finally streaked onto cefsulodin-irgasan-novobiocin agar (16), which was incubated at 28°C for 48 h. Presumptive colonies were identified by using the API-20E system (Montalieu-Vercieu), and then serogrouping, biovar, and phagovar determinations were carried out by H. H. Mollaret (Institut Pasteur, Paris).

Foods analyzed were pork, sausages, salads, cakes, ice creams, and raw milk, originating from pork butchers, cafeterias, and retailers in the Strasbourg area and neighbor-
TABLE 1. In vitro susceptibility to ampicillin and carbenicillin of 125 strains of *Yersinia* spp. isolated from foods

<table>
<thead>
<tr>
<th>Organism (no. of strains)</th>
<th>Biovar</th>
<th>Serogroups* (no.)</th>
<th>Antibiotic</th>
<th>MIC (μg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Range</td>
</tr>
<tr>
<td><em>Y. enterocolitica</em> (49)</td>
<td>1</td>
<td>O:5 (11); O:7,8 (8); O:6 (5); O:10,34,K₁ (5); O:10,K₁ (2); O:14 (3); O:4 (1); O:25,35 (2); O:30,47 (2); O:30 (1); O:27 (1); O:7,8,19 (1); O:39,41 (4); O:48 (2); N(1)</td>
<td>Ampicillin</td>
<td>8–128</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td><em>Y. enterocolitica</em> (12)</td>
<td>3</td>
<td>O:7,8 (2); O:7 (1); O:7,19 (1); N (8)</td>
<td>Carbenicillin</td>
<td>4–64</td>
</tr>
<tr>
<td><em>Y. intermedia</em> (27)</td>
<td></td>
<td>O:3 (1); O:4 (1); O:4 (1); O:48 (7); O:50 (1); O:52 (2); O:14 (2); O:36 (1); N (9); AA (1)</td>
<td>Ampicillin</td>
<td>8–128</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2–256</td>
</tr>
<tr>
<td><em>Y. frederiksenii</em> (12)</td>
<td>1</td>
<td>N (5); O:35 (3); O:52, 53 (1); N (3); AA (4)</td>
<td>Carbenicillin</td>
<td>8–128</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2–256</td>
</tr>
<tr>
<td><em>Y. kristensenii</em> (25)</td>
<td>2</td>
<td>O:11 (9); O:12 (2); O:12, 25 (4); O:26, 35 (3); O:28 (1); O:35 (1); O:28,35 (1); O:46 (1); O:16,34,46 (1); N (2)</td>
<td>Carbenicillin</td>
<td>2–15</td>
</tr>
</tbody>
</table>

* N. Nonagglutinable by antisera; AA, autoagglutinable.

strains. On the other hand, *Y. enterocolitica* biovar 1, *Y. intermedia*, and *Y. frederiksenii* are always resistant to carbenicillin (MIC₉₀ > 256 μg/ml). Twelve years ago, Cornelis et al. found an homogeneous susceptibility to β-lactams within each serological group of isolates of *Y. enterocolitica* from different origins (7). Two groups displayed high susceptibility to carbenicillin (MIC, ≈8 μg/ml): serogroup 5, 27 (or 5b) and a group including serogroups 11, 12, 23, 24, 25, and 26. Interestingly, the latter corresponds to strains belonging to *Y. kristensenii* in our study. Our observations on carbenicillin susceptibility of *Yersinia* spp. could be of interest in the taxonomy of these bacteria.

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LITERATURE CITED

9. Hammerberg, S., S. Sorger, and M. I. Marks. 1977. Antimicro-