Ecosystem Health and Sustainable Agriculture

Ecology and Animal Health

Editors: Leif Norrgren and Jeffrey M. Levengood
Many food-borne pathogens and opportunistic bacteria such as enterococci can have natural habitats in food animals. They can contaminate meat and milk products during slaughter and milking or contaminate raw vegetables when the soil is fertilised with animal manure. The molecular analysis of antibiotic resistance genes, plasmids and transposons has demonstrated that identical elements are found in animals and humans. The phenomenon applies to pathogenic, opportunistic and commensal bacteria: the use of antibiotics in veterinary medicine, similar to its use in agriculture and aquaculture, selects resistant bacteria, which are released into the environment. Specific food items, water and direct contact can spread these bacteria from animal microfloras to human microfloras (Teuber, 2004).

The development of antimicrobial resistance in pathogenic bacteria is a matter of increasing concern. There is growing scientific evidence that the use of antimicrobials in food animals leads to the development of resistant pathogenic bacteria that can reach humans through the food chain (Van Looveren et al., 2001). These human food safety concerns have been influential in prompting the European Union to ban the use of antimicrobials as growth promoters in food production and to increase their surveillance for bacterial resistance in food-borne pathogens and indicator organisms (Smith et al., 2007). In farm environments, commensal and environmental bacteria may be a reservoir for the transfer of antimicrobial resistance genes to pathogenic bacteria. Bacteria acquire most resistance genes through horizontal transfer, while conjugative genetic elements such as plasmids and transposons are common vectors for the dissemination of antimicrobial resistance genes to diverse microorganisms (Smith et al., 2007). Many scientists and public health specialists expect this resistance problem to worsen unless we act decisively.

Estonian antimicrobial susceptibility studies (Roasto et al., 2007) of Campylobacter strains revealed high resistance patterns for several antimicrobials. A high proportion of multidrug-resistant isolates (27.5%) was found. All of these isolates were resistant to enrofloxacin and all except one were resistant to nalidixic acid. Hakanen et al. (2003) noted that 20% of the human isolates associated with travelling were resistant to three or more antimicrobials. Multiresistant isolates reported in the Roasto et al. (2007) study consisted of a combination of all tested antimicrobials. The results showed that multidrug resistance was significantly associated with enrofloxacin and nalidixic acid resistance (correlation coefficient 0.372 and 0.310, P<0.01). These findings suggest that the use of fluoroquinolones may select multiresistant strains, since resistance to erythromycin, gentamicin or oxytetracycline was rare without simultaneous resistance to fluoroquinolones. A recent study on antimicrobial resistance of Escherichia coli at a farm where no antimicrobial treatment of the birds was performed during one year before
the sampling showed that the resistance to tetracycline, gentamicin and streptomycin persisted but all isolates were susceptible to enrofloxacin (Smith et al., 2007). Thus multiresistant strains may reflect the past history of antimicrobial usage during a longer period. This phenomenon may partly explain the rather high number of multiresistant strains in the Estonian study (Roasto et al., 2007). Antimicrobial susceptibility patterns of *C. jejuni* isolates from broiler chickens in Estonia in 2005-2006 are shown in Table 26.1.

In addition, the costs of treating antimicrobial-resistant infections place a significant burden on society. For example, it has been estimated that the in-hospital costs of hospital-acquired infections caused by just six common kind of resistant bacteria were at least 1.3 billion USD (1 billion euros) in 1992 (http://www.hhs.gov/news/press/2001pres/20010118b.html; accessed 24 May 2007). Multiresistance to antimicrobials (resistance to three or more unrelated antimicrobials) is a major public health problem because it limits chemotherapeutic options. The concept of Critically Important Antimicrobials, both for humans and animals, should be used by EU member states for setting priorities in improved management of antimicrobials in animal production.

### Table 26.1. Antimicrobial susceptibility of *C. jejuni* isolates (n = 131) from broiler chickens in Estonia, 2005-2006.

<table>
<thead>
<tr>
<th>Antimicrobial agenta</th>
<th>Antimicrobial concentration range (µg/ml) VetMIC&lt;sup&gt;TM&lt;/sup&gt;Camp</th>
<th>Breakpoint (µg/ml)</th>
<th>No. of resistant strains (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Am</td>
<td>0.5-64</td>
<td>32</td>
<td>10 (7.6)</td>
</tr>
<tr>
<td>Ef</td>
<td>0.03-4</td>
<td>1</td>
<td>96 (73.3)</td>
</tr>
<tr>
<td>Em</td>
<td>0.12-16</td>
<td>16</td>
<td>26 (19.8)</td>
</tr>
<tr>
<td>Gm</td>
<td>0.25-8</td>
<td>8</td>
<td>25 (19.1)</td>
</tr>
<tr>
<td>Nal</td>
<td>1-128</td>
<td>32</td>
<td>99 (75.6)</td>
</tr>
<tr>
<td>Tc</td>
<td>0.25-32</td>
<td>4</td>
<td>42 (32.1)</td>
</tr>
</tbody>
</table>

a Antimicrobial agents: Am, Ampicillin; Ef, Enrofloxacin; Em, Erythromycin; Gm, Gentamicin; Nal, Nalidixic acid; Tc, Oxytetracycline.


Mortensen, S. 1998. PRRS-infection through semen (Danish) In: Veterinarinformation, 2 pp 3-9


Chapter 26


Chapter 27


