Salmonella Heidelberg

**Background:** Salmonella enterica subsp. enterica serovar Heidelberg (antigenic formula 1,4,[5],12:r:1,2) is a serovar of the O:4 (B) serogroup. S. Heidelberg is commonly found in poultry meat in North America. In the U.S. and Canada, it has caused numerous infections in chickens. In the U.S., this serovar has caused a number of outbreaks that included the recent outbreak (October, 2013), linked to raw chicken; this outbreak was caused by a multdrug resistant S. Heidelberg strain (resistant to ampicillin, chloramphenicol, gentamicin, kanamycin, streptomycin, sulfisoxazole, and tetracycline). S. Heidelberg accounts for the 8.6% of ceftriaxone-resistant Salmonella isolated from humans in the U.S. Recently, a phage typing scheme was developed for serovar Heidelberg in Canada; this scheme recognizes 49 phage types.

**Animal reservoir:** S. Heidelberg is mostly found in chickens and turkeys.

**Geographical distribution:** Mostly reported from North America, serovar Heidelberg is the second and seventh most common serovar isolated from humans in Canada and in the U.S., respectively. In Europe this serovar is rare (approx. 180 cases/year).

**Outbreaks:** Multiple Heidelberg outbreaks have been linked to poultry, most of them in the U.S.

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Associated source</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>US-multistate</td>
<td>Contact with Dairy Calves</td>
<td>21</td>
</tr>
<tr>
<td>2013</td>
<td>US-multistate</td>
<td>Raw chicken</td>
<td>278</td>
</tr>
<tr>
<td>2011</td>
<td>US-multistate</td>
<td>Kosher Broiled Chicken Livers</td>
<td>190</td>
</tr>
<tr>
<td>2011</td>
<td>US-multistate</td>
<td>Ground turkey</td>
<td>136</td>
</tr>
<tr>
<td>2011</td>
<td>Europe</td>
<td>In-flight catering from Tanzania to Europe</td>
<td>22</td>
</tr>
<tr>
<td>2005</td>
<td>US-WI</td>
<td>Pig roast</td>
<td>25</td>
</tr>
<tr>
<td>2004</td>
<td>Canada</td>
<td>Food handler</td>
<td>45</td>
</tr>
<tr>
<td>2001</td>
<td>Australia</td>
<td>Eggs</td>
<td>12</td>
</tr>
</tbody>
</table>

**Relevant genetic characteristics:** Whole genome sequences for 15 strains of S. Heidelberg have been deposited at GenBank as of October, 2013. Genomic characteristics of the sequenced S. Heidelberg include (i) a genome size ranging from 4.73 to 4.98 Mb, (ii) a mol G+C% of 52.1, and (iii) 5,578 to 5,039 predicted genes. Many of these sequenced strains have been implicated in recent outbreaks (2011 and 2012), in the U.S. Salmonella Heidelberg str. SARA33 is a multidrug resistant strain. This strain was found, in silico, to contain a novel integron cassette; in addition, it was found to carry the following resistance genes: aac(6)-Iy, aadA5, aadB, aad(6)-33, and aadA1, sul1 and sul2, blaOXA-2 and blaTEM, tetD. Resistance genes in S. Heidelberg have been identified in the chromosome (resistant islands) and in plasmids. Different incompatibility types (A/C, FIB, HI2) have been identified in the plasmids that carried resistance genes in S. Heidelberg.

Phylogenetic and pan-genomic analyses that included two of the sequenced S. Heidelberg strains and other Salmonella serovars concluded that S. Heidelberg (i) belongs to clade A, according to den Bakker et al. (2011) classification, (ii) appears to have a single evolutionary origin, and (iii) contains 74 gene families unique to this serovar.

**Genome sequences available:**

**Relevant links and references:**
3. http://jcm.asm.org/content/41/9/4279.full