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 multidrug 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 in silico. Most outbreaks of *S. Heidelberg* were reported from North America. 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: *aad(6)-Iy, aadA5, aadB, aa(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](http://jcm.asm.org/content/41/9/4279.full)