Comparative lethality of *Salmonella Enteritidis* and *Salmonella Typhimurium* in broiler chickens

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Lethal dose_{50} is an accurate estimate of the virulence and pathogenicity of a pathogen. Recent increase in the number of food poisoning outbreaks due to *Salmonella Enteritidis* and *S. Typhimurium* is attributed to increased virulence of this potentially zoonotic enteric pathogen contaminating the poultry meat, eggs and egg products (Utrarachkij et al. 2011). Both of these pathogens are capable of developing into recovered carriers after disease and are being shed for indefinite period of time. This study was based upon the hypothesis that variations in mortality rates, clinical signs, faecal shedding, and frequency of eggs contamination in broiler chickens could be associated with differential lethality of *S. Enteritidis* and *S. Typhimurium* therefore it is essential to determine the virulence/lethality of these *Salmonella* species in our locality. As a virulent strain spreads through the body faster, persists for a longer period and is more invasive and difficult to treat than an avirulent strain therefore the information about the increased lethality may help to insight the complex pathogenesis of virulent *Salmonella*.

One-day-old broiler chickens (400) were equally divided into 2 main groups designated as group A (for *S. Enteritidis*) and B (S. Typhimurium). Each group was further divided into 10 subgroups comprising 2 replicates. At seventh day of age, the birds in the first 9 subgroups of both group A and B were infected orally with various dilutions of *S. Enteritidis* and *S. Typhimurium* (1 mL/bird of 10^{-1} to 10^{-9}.

Table 1. Calculation of dead percentage of broiler chickens by various doses of *S. Enteritidis* and *S. Typhimurium*

<table>
<thead>
<tr>
<th>Bacterial dilution inoculated</th>
<th>No. of birds</th>
<th>Accumulated No. of birds</th>
<th>Proportion</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Dead</td>
<td>Live</td>
<td>Dead</td>
<td>Live</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>S. Enteritidis</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10^{-1}</td>
<td>10</td>
<td>0</td>
<td>31</td>
<td>0</td>
</tr>
<tr>
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<td>10</td>
<td>0</td>
<td>21</td>
<td>0</td>
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</tr>
<tr>
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<td>7</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
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<td>10</td>
<td>0</td>
<td>19</td>
</tr>
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<td>29</td>
</tr>
<tr>
<td>10^{-7}</td>
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<td>0</td>
<td>39</td>
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<tr>
<td>10^{-8}</td>
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<td>0</td>
<td>49</td>
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<td>10^{-9}</td>
<td>0</td>
<td>10</td>
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<td>59</td>
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<tr>
<td><em>S. Typhimurium</em></td>
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<td>10^{-1}</td>
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<td>10</td>
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<td>65</td>
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</tbody>
</table>

*P < 0.05.

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Table 2. Calculation of probits of killing to determine LD50 for S. Enteritidis and S. typhimurium

<table>
<thead>
<tr>
<th>Group</th>
<th>Dose (Log dose)</th>
<th>% Dead</th>
<th>Corrected% Probits</th>
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<tbody>
<tr>
<td></td>
<td>Group A</td>
<td>Group B</td>
<td>Group A</td>
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<tr>
<td>1</td>
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<td>-1</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>10^{-2}</td>
<td>-2</td>
<td>100</td>
</tr>
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<td>85</td>
</tr>
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<td>10^{-4}</td>
<td>-4</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>10^{-5}</td>
<td>-5</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
</tr>
<tr>
<td>9</td>
<td>10^{-9}</td>
<td>-9</td>
<td>0</td>
</tr>
</tbody>
</table>

Group A, S. Enteritidis; group B, S. Typhimurium; *P < 0.05.

dilutions, respectively) while the 10th or control group in group A and B was inoculated with normal saline and served as an uninfected control. The inoculated birds were observed for a period of 1 week for any morbidity or mortality (David et al. 1998). This data was then used to determine the LD50 of S. Enteritidis and S. Typhimurium by the method of Randhawa (2009).

The lethal dose (LD50) of S. Enteritidis and S. Typhimurium determined was 10^3.58/mL and 10^3/mL respectively (Tables 1, 2).

These results indicated differential killing ability of these 2 Salmonella species in broiler chickens under same environmental and nutritional conditions. S. Typhimurium was more lethal as compared to S. Enteritidis as it could infect the birds even at low dose rate. These findings are in close agreement with previous study (Diez-Garcia et al. 2012), which described the differential ability of Salmonella species to cause disease in poultry birds.

Our results are also supported by Boldrin-de-Paiva et al. (2011) who concluded greatly variable ability of Salmonella species to kill day-old chickens. They also described that age of bird and route of infection can play an important role in determining the virulence of Salmonella and found that 14 strains belonging to 11 food poisoning serotypes other than S. Typhimurium were practically non-lethal when given orally but were lethal by the intramuscular route. Moreover, the bacterial species, strain, phage type, age of bird and inoculum size might also affect the outcome of an infection.

In addition some previous studies (Barrow et al. 1987, Gast and Benson 1995) explained that the virulence of S. Typhimurium in day-old broiler chickens was dependent upon breeds and found that some breeds were more susceptible than others. However, according to them there was no difference between oral and parenteral administration as far as virulence was concerned.

Our findings also correlated with those of Allen et al. (2001) who also stated the severity of clinical illness and enhanced virulence in S. Typhimurium DT104. The difference in lethality of S. Enteritidis and S. Typhimurium may be associated with differences in lipopolysaccharides (Rehman et al. 1997) or virulence related plasmid (Jose et al. 1997). There is further need to investigate the difference in genes coding for the virulence in these 2 Salmonella species.

**SUMMARY**

The present study determined the comparative lethality of Salmonella Enteritidis and S. Typhimurium by calculating the lethal dose (LD50) of these 2 Salmonella species in broiler chickens. The objective was to investigate that which Salmonella can affect broiler birds at low dose rate and faster than other. The serial 10-fold dilutions of each bacterium were inoculated in 1 week-old broiler birds. The present study revealed that the calculated LD50 of S. Typhimurium (10^3/mL) was less than S. Enteritidis (10^3.58/mL). Therefore it can be assumed that S. Typhimurium is more virulent than S. Enteritidis.

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**REFERENCES**


