Influence of osmoprotectants on survival of Salmonella Typhimurium strains during desiccation

Christensen, Nanna; van der Berg, Franciscus Winfried J; Risbo, Jens; Knøchel, Susanne

Publication date: 2012

Document version
Peer reviewed version

Citation for published version (APA):
Influence of osmoprotectants on survival of Salmonella Typhimurium strains during desiccation

Nanna Christensen*, Frans v.d. Berg*, Jens Risbo* and Susanne Knochel*
*Department of Food Science, University of Copenhagen, Rolighedvej 36, 1958 Frederiksberg C, Denmark

Background
Outbreaks caused by Salmonella associated with low moisture products are commonly reported, and Salmonella is known to survive desiccation well. The environment incl. food contains naturally occurring osmoprotectants, which may increase the survival of Salmonella cells in low moisture environments.

Method
- 20µl of 10^8 CFU/ml cell solution was desiccated in 0.9% NaCl, saline added 0.1% NaCl, peptone and 1%, 5%, glucose (PSP-G) in 48 well plates in closed chambers at 22°C, 43%RH (Figure 1).

- Sampling was performed after resuscilation for 30 min in PSP and plating of appropriate dilutions on BH (incubated at 37 °C, 23 ± 1 h).

- Reduction was calculated using Equation 1 and plotted against time for modelling starting from day 1.

- (Day 0 to day 1 was not included due to initial growth)

- Testing with osmoprotectants was performed with 1mM betaine, 50mM betaine, proline, and carnitine, and 10%, 50%, sucrose in PSP-G.

Equation 1: Reduction [CFU/ml] = log \( \frac{N_t}{N_0} \)

Equation 2: % Reduction = \( \frac{\text{mean (Reduction day 14 in control) - mean (Reduction day 14 in Treatment)}}{\text{mean (Reduction day 14 in control)}} \times 100 \)

Results

<table>
<thead>
<tr>
<th>S. Typhimurium strains</th>
<th>Strains selected for testing with osmoprotectants</th>
<th>Origin</th>
<th>Reduction day 14 [CFU/ml]</th>
<th>One way ANOVA p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. Typhimurium 364/87</td>
<td>Lowest reduction</td>
<td>Chocolate</td>
<td>-3.18 ± 0.6</td>
<td>-</td>
</tr>
<tr>
<td>S. Typhimurium U292</td>
<td>Pig</td>
<td>-3.50 ± 0.8</td>
<td>0.54</td>
<td></td>
</tr>
<tr>
<td>S. Typhimurium 6/7</td>
<td>Boilite</td>
<td>-6.65 ± 2.0</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>S. Typhimurium 224/87</td>
<td>Clinical</td>
<td>-5.75 ± 1.2</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>S. Typhimurium OT12</td>
<td>Clinical</td>
<td>-3.79 ± 1.3</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>S. Typhimurium U292</td>
<td>Clinical</td>
<td>-8.67 ± 0.5</td>
<td>&lt;0.00</td>
<td></td>
</tr>
</tbody>
</table>

S. Typhimurium CS

| S. Typhimurium CS | Highest reduction | Mousse | -9.94 ± 0.7 | <0.00 |

Values are significant (p<0.05) from S. Typhimurium 364/87 in a One way ANOVA test based on the p-values.

Discussion

- S. Typhimurium strains tested varied in desiccation tolerance based on reduction (Table 1). S. Typhimurium 364/87 and S. Typhimurium CS (marked with red) represented highest and lowest desiccation tolerance.

- Previous studies have demonstrated a positive effect of betaine, proline and carnitine on survival of Salmonella subjected to NaCl stress (Cairney et al. 1985a; Cairney et al. 1985b; Gutierrez & Csorba 1995). Here, desiccation tolerance increased for both strains investigated (364/87 and C5) with carnitine and, in particular, with sucrose (Figure 2A-B) while limited effect was seen for proline and betaine.

- Hardly any reduction was seen within the period with sucrose (Figure 2A-B).

- Sucrose and carnitine had a significant (p<0.05) positive effect on desiccation tolerance based on reduction on day 13 (Table 2)

Conclusion

- Desiccation tolerance differs within the same serovar.

- The presence of 10% sucrose and 50mM carnitine, respectively, increased the desiccation tolerance in that order for S. Typhimurium 364/87 and S. Typhimurium CS, with a very marked effect of sucrose.

References: