Relative Resistance of the Red, Dry, and Rough (RDAR) and Smooth and White (SAW) Morphotypes expressed by *Salmonella* to a steam blanching treatment

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Abstract:
The acquired ability of *Salmonella* to express varying morphotypes when placed in nutrient-limited conditions is hypothesized to predict increased resistance to food processing interventions. Two of the morphotypes expressed by *Salmonella* are Red, Dry, and Rough (RDAR) and Smooth and White (SAW). Increased resistance is predicted for the RDAR morphotype due to the expression of thin aggregative fimbriae (taf) coupled with production of cellulase and other potentially protective extracellular polysaccharides. SAW strains are hypothesized to be less resistant due to their lack of taf and cellulase production. Strains of *Salmonella*, previously classified as RDAR (n=3) and SAW (n=3), were separately inoculated on the shell surface of hazelnuts and steam blanched (88°C, 1 min) to determine resistance patterns between the two morphotypes. The steam treatment resulted in insignificant reduction (<1.0 log CFU/g) of all *Salmonella* strains; therefore, differences in the relative resistance of the two morphotypes were unable to be determined. Additional, steam treatments with longer hold times will be tested to further explore the potential difference between morphotypes.

Objectives:
- Characterize *Salmonella* isolates from in-shell hazelnuts by morphotype on Congo Red Agar
- Evaluate the relative thermal resistance of *Salmonella* strains of differing morphotype (RDAR vs. SAW) on a low moisture product (in-shell hazelnuts).

Methodology:

**Strain characterization and selection:**
- Inoculate Congo Red Agar
- Incubate 37°C, 3 days
- Characterize
  - RDAR: Red, dry, and rough
  - *Salmonella* Typhimurium 1900
  - *Salmonella* Typhimurium 1908
  - *Salmonella* Saintpaul 1915
  - *Salmonella* Thompson 1901
  - *Salmonella* Thompson 1904
  - *Salmonella* Thompson 1905
- SAW: Smooth and white
- *Salmonella* Thompson 1901
- *Salmonella* Thompson 1904
- *Salmonella* Thompson 1905

**Inoculum and sample preparation:**
- Inoculate TSA
- Incubate 37°C, 24 hrs
- Harvest
- Inoculate (12.5 ul spot)
- Basal Scar
- Dry
- Package:
  - In-shell Hazelnut
  - Sample (50 g: 10 g inoculated + 40 g uninoculated)

**Steam treatment and recovery:**
- Steam Treatment: 88°C, 1 min

Results:

<table>
<thead>
<tr>
<th>Morphotype</th>
<th>Survivors (Log CFU/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDAR</td>
<td>7.08 ± .27</td>
</tr>
<tr>
<td>SAW</td>
<td>6.59 ± .63</td>
</tr>
</tbody>
</table>

Figure 1. Impact of steam blanching treatment (88°C, 1 min) on *Salmonella* strains of varying morphotypes inoculated onto in-shell hazelnuts.

RDAR = Red, Dry, and Rough; SAW = Smooth and White.

Values reported are the mean ± standard deviation

<table>
<thead>
<tr>
<th>Results</th>
<th>RDAR</th>
<th>RDAR</th>
<th>SAW</th>
<th>SAW</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.08</td>
<td>6.46</td>
<td>6.74</td>
<td>6.59</td>
<td></td>
</tr>
</tbody>
</table>

Conclusion:

With the selected thermal parameters, the lethality was insufficient to determine potential differences between the morphotypes.

Future Plans:

For future experiments, longer hold times need to be implemented to determine if the RDAR morphotype is more resistant to steam treatments on inoculated in-shell hazelnuts than the SAW morphotype.

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