Resistance of spice-related Salmonella serotypes and Pediococcus faecium NRRL B-2354 to dehydration, gamma-irradiation and dry storage

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INTRODUCTION

Validating control measures for pathogen control is paramount in ensuring the effectiveness of food safety programs. Validation is especially needed for low moisture foods, such as spices, since increased pathogen thermal resistance has been reported. Using spice-related strains (SRSS) will increment the accuracy of the results of validation studies, since non-SRSS may not accurately represent the potential adaptation to dry environments (3). For in-plant validation, the use of adequate surrogate bacteria is necessary since pathogens cannot be introduced in food processing environments. Dry-inoculation methods using the same spices or inert powders, such as talcum powder, as a vehicle of Salmonella, have been used for challenge studies in low-moisture foods (2). The objective of this research was to test the resistance of SRSS, non-SRSS, and Pediococcus faecium to desiccation, irradiation and dry storage.

MATERIALS AND METHODS

1. Inoculation of dry matrices and enumeration of microorganisms

Fifty-gram batches of sterile talcum powder (TP) and onion powder (OP) were inoculated separately with cocktails of Salmonella and Pediococcus faecium (PF) containing 109 cells/ml.

2. Effect of desiccation using an inert powder and onion powder

TP, as an inert medium, and OP were used to test the effect of desiccation on the survival of Salmonella and P. faecium at 35 °C and 25 °C, respectively. The survival of each group of bacteria was measured by inoculating sterile TP or OP, as previously described, and comparing their concentration before and after desiccation.

3. Gamma irradiation treatments

Two-g samples of dried inoculated TP and OP sets were gamma-irradiated at the University of Iowa Radiation Research laboratory with a J.L. Shepard and Associates Model 81 irradiator with a Cs137 source and an output of 24.5 Gy/min. D37-values were calculated as the negative inverse of the slope of the line obtained by plotting the microbial populations at the applied irradiation dose, and the doses to achieve a 5 log10 reduction were determined.

4. Survival during storage

The survival of Salmonella and P. faecium were monitored in TP and OP stored at 25, 4, and -18 °C during 15 weeks.

RESULTS AND DISCUSSION

Effect of desiccation

Non-SRSS strains showed a higher susceptibility to desiccation than SRSS strains and PF in TP and OP (P<0.05), while PF showed the highest resistance (P>0.05).

Gammar irradiation treatments

<table>
<thead>
<tr>
<th>Bacteria inoculated</th>
<th>D0 values (kGy)</th>
<th>Dose required to achieve 5 log10 reduction (kGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Talcum powder</td>
<td>Onion powder</td>
</tr>
<tr>
<td>P. faecium</td>
<td>0.74 ± 0.014a</td>
<td>1.70 ± 0.13a</td>
</tr>
<tr>
<td>SRSS</td>
<td>0.67 ± 0.06a</td>
<td>1.01 ± 0.06a</td>
</tr>
<tr>
<td>Non-SRSS</td>
<td>0.62 ± 0.03a</td>
<td>0.75 ± 0.14a</td>
</tr>
</tbody>
</table>

*Mean D0 values within a column with different superscripts are statistically different (P<0.05).

Survival during storage

Talcum powder: SRSS, non-SRSS and PF showed no significant differences by the end of the 15th week of storage at -18, 4 and 25 °C (P>0.05). However, the concentration of non-SRSS had more variability than SRSS during the 15-week storage period (Fig 2-3).

Onion powder: Temperature of storage affected the survival of Salmonella spp. and P. faecium in OP. In general, the greatest reduction for the 3 groups of microorganisms was at 25 °C with 3.6, 3.6, and 1.9 log cycles for non-SRSS, SRSS, and PF, respectively. SRSS and non-SRSS had similar reduction patterns for all three temperatures and no statistically significant differences were detected (P>0.05) (Fig 4-5).

CONCLUSIONS

SRSS showed a higher resistance to desiccation than the non-SRSS. The gamma irradiation dose to achieve a 5 log reduction did not differ between SRSS and non-SRSS when using TP, whereas the SRSS cocktail was significantly more resistant to irradiation than non-SRSS in OP. These results emphasize the importance of selecting adequate strains of pathogenic bacteria when designing challenge studies. PF was more resistant than SRSS and non-SRSS to dehydration, irradiation, and storage at different temperatures, supporting its potential use as a surrogate of Salmonella.

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REFERENCES