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Use of Organic Acid Salts to Control 
*Listeria monocytogenes* on Processed Meats

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Summary and Implications

Four organic acid salts including sodium lactate,  
sodium diacetate, potassium benzoate and potassium sorbate  
were evaluated, alone and in all combinations, for inhibitory  
effectiveness against *Listeria monocytogenes* on ready-to-eat (RTE) meats.  
Sodium diacetate alone, sodium diacetate + potassium benzoate and  
sodium lactate + sodium diacetate + potassium benzoate were most effective for  
inhibiting growth during storage.  
These results indicate that sodium diacetate provides an effective means of  
improved control of *L. monocytogenes* on RTE meats.

Introduction

Processed, RTE meat products such as frankfurters  
have been the source of several *L. monocytogenes* illness outbreaks and the United States Department of Agriculture  
Food Safety Inspection Service (USDA-FSIS) has established a zero tolerance policy for this organism on RTE products.  
Consequently, new ingredients and processes for  
improved control of *L. monocytogenes* on RTE products are critical to continued production of these products.  
The salts of several organic acids including lactate, acetate, sorbate and  
benzoate, have been reported to be significant antimicrobial agents.  
These salts have been suggested as significant means to control *L. monocytogenes* on RTE meats.  
More importantly, however, these salts, in combination, may offer synergistic effects that would allow use of lower concentrations than when used alone.  
Therefore, a study of organic acid salts, alone and in  
combination, was initiated to determine effectiveness for  
control of *L. monocytogenes*.

Materials and Methods

Frankfurters were prepared for this study using  
conventional processing.  
Finished frankfurters were then dipped in 3% or 6% solutions of sodium lactate, sodium diacetate, potassium benzoate or potassium sorbate, alone and in all combinations.  
Dipping for 3 minutes achieved 0.08% total pickup of the compounds.  
Frankfurters were then placed in vacuum bags and inoculated with a 5-strain cocktail of *L. monocytogenes* before the packages were  
sealed.  

Storage of packaged frankfurters was at -2.2, 1.1, 4.4, 10.0 or 12.8°C for 90 days.  
Packages were analyzed for *L. monocytogenes* survivors every 48 hours.  
Three growth parameters, lag phase duration, generation time and  
maximum population density were calculated from the  
growth data to compare treatment effectiveness.

Results and Discussion

Preliminary results identified three treatments, sodium diacetate alone, sodium diacetate + potassium benzoate, and  
sodium lactate + sodium diacetate + potassium benzoate that had the greatest initial impact on *L. monocytogenes*.  
Consequently, these three were utilized for comparison of effectiveness during an extended storage period and at a  
range of storage temperatures.  
Of the growth parameters determined, maximum population density provided the best comparison of the treatments.  
The results for maximum population density are shown in Table 1.  
The treatment with 6% sodium diacetate alone resulted in the lowest  
population density at -2.2, 1.1 and 4.4°C.  
However, a high degree of variation in the means resulted in limited  
statistical differences.  
At the same time, coupled with the other measures of *L. monocytogenes* growth, sodium diacetate was consistently the most effective.  
It should be noted that, regardless of the treatment, *L. monocytogenes* growth occurred, and temperature was the singly most  
important determinant of growth.  
Therefore, organic acid salts such as sodium diacetate offer some improvement in  
control of *L. monocytogenes* on RTE meats but would be best coupled with additional inhibitors to achieve more  
complete inhibition of this organism.

Acknowledgement

Support for this research from the USDA Cooperative  
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Table 1. Effects of inhibitors on the maximum population density (Log CFU/g) of *L. monocytogenes* on frankfurters

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Treatment</th>
<th>Mean$^1$</th>
<th>Temperatures (°C)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-2.2</td>
<td>1.1</td>
<td>4.4</td>
<td>10.0</td>
<td>12.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>5.30 ab</td>
<td>0.95 a A</td>
<td>4.52 b B</td>
<td>6.65 ab B</td>
<td>6.96 a B</td>
<td>7.00 a B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3%SD</td>
<td>5.59 a</td>
<td>1.38 a A</td>
<td>5.75 b B</td>
<td>6.39 ab B</td>
<td>7.16 a B</td>
<td>7.30 a B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6%SD</td>
<td>4.23 b</td>
<td>0.74 a A</td>
<td>0.82 a A</td>
<td>4.43 a B</td>
<td>7.75 a C</td>
<td>7.44 a C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3%SL/SD/PB</td>
<td>4.69 ab</td>
<td>2.14 a A</td>
<td>4.19 ab AB</td>
<td>5.18 ab B</td>
<td>5.54 a B</td>
<td>6.41 a B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6%SL/SD/PB</td>
<td>5.54 a</td>
<td>1.84 a A</td>
<td>3.10 ab A</td>
<td>7.42 b B</td>
<td>7.55 a B</td>
<td>7.82 a B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3%SD/PB</td>
<td>5.13 ab</td>
<td>1.63 a A</td>
<td>3.17 ab A</td>
<td>6.30 ab B</td>
<td>7.62 a B</td>
<td>6.95 a B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6%SD/PB</td>
<td>5.01 ab</td>
<td>1.22 a A</td>
<td>3.51 ab A</td>
<td>6.44 ab B</td>
<td>7.06 a B</td>
<td>6.83 a B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature mean$^2$</td>
<td>1.41 A</td>
<td>3.64 B</td>
<td>6.12 C</td>
<td>7.09 C</td>
<td>7.11 C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^1$Overall mean across all temperatures (−2.2, 1.1, 4.4, 10.0 and 12.8 °C) for each treatment

$^2$Overall mean across all treatments at each temperature (−2.2, 1.1, 4.4, 10.0 and 12.8 °C)

Different letters A-C within each row indicate significant differences (*P* ≤ 0.05)

Different letters a-b within each column indicate significant differences (*P* < 0.05)