Antimicrobial Agents to Control
*Listeria monocytogenes.*

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Topics

- Why use antimicrobials
- Lactate/Diacetate
- Antimycotics
- Newer technologies
- Final thoughts
Preservative Methods to Reduce Foodborne Pathogen Risk*

- Prevent inadvertent contamination

- Removal of contamination
  - Thermal destruction by cooking
  - Surface treatments at packaging
  - Post-package pasteurization treatments

- Inhibit Growth

* Adapted from Sofos, et al., 1998
What happens with no growth inhibitors and Lm contamination

Ham at 4C
2.5% Salt, 75% Moisture, Sodium Tripolyphosphate
pH 6.2

Turkey Breast at 4C
1.6% Salt, 75% Moisture, Sodium Tripolyphosphate
pH 6.2
How can we inhibit growth of \textit{L. monocytogenes} in RTE meats?

- Extend the lag-phase or diminish the rate during log-phase of growth

- Cured meats
  - Nitrite makes the effort easier

- Uncured meats
  - More difficult to achieve
Lactate and Diacetate

- Most widely used Lm growth inhibitors in the US
- ~70% of RTE cured meats use this approach
Sodium and Potassium Lactate

- Weak acids
- Produced from fermentation of sugar
- Usage level of 2 - 4% (of 60% solution)
- Slight salty flavor
- Disrupts bacterial membrane pH gradients
- Inhibits energy metabolism
- Antibotulinal agent
Sodium Diacetate

- Half neutralized vinegar
- Dissociates into 40% acetic acid and 60% sodium acetate
- Lower product pH due to presence of acetic acid
- Usage levels, 0.10 - 0.15%
Why is a combination needed?

- Lactate salts alone are only bacteriostatic at high concentrations (>3-4%)
  - Flavor quality impacted
  - Sodium?

- Sodium diacetate alone only is bacteriostatic at high concentrations
  - Product stability impacted - purge, texture
  - Flavor quality impacted
  - Legal maximum in U.S. is 0.25%
The Purac Opti.Form® Model

- Developed in 2001-2002
  - Growth model
  - Factors – Salt, Product Moisture, Lactate, Diacetate
  - No cured model
- Updated in 2003
  - Boundary “time to failure” presentation
- Refined – Expanded in 2007
  - Returned to a growth model
  - Added pH and temperature as inputs
  - Includes cured and uncured predictions
Two Ham Scenarios at 4C Storage

- 2.5% Salt, 75% Moisture, 2% Potassium Lactate, 0.14% sodium diacetate, sodium tripolyphosphate, pH 6.2

- 2.5% Salt, 75% Moisture, 2% Potassium Lactate, 0.14% sodium diacetate, pH 5.8
Two Uncured Turkey Breast Scenarios at 4C Storage

1.6% Salt, 75% Moisture, 2% Potassium Lactate, 0.14% Sodium Diacetate, Sodium Tripolyphosphate, pH 6.2

1.6% Salt, 75% Moisture, 2% Potassium Lactate, 0.14% Sodium Diacetate, pH 5.8
Advantages of Lactate/Diacetate

- Proven effective and reliable
- Easy to verify
- Relative low cost
- Tested with consumers and widely accepted
- Protects vs. risk of contamination by consumer after package is opened
Antimycotics

- Benzoate
- Sorbate
- Propionate
Control of *Listeria* on Cured Ham stored at 4°C (2.2% NaCl whole; 156 ppm nitrite, 75% moisture)

Glass, et al, JFP 2007
Effect of benzoate, moisture, NaCl, Diacetate on *Lm* in cured RTE meats

Seman et al., 2008 JFP 71:1386
Differences from Glass et al, extended testing time to 18 wks; decrease NaCl
Other antimicrobials

- Fermentation & Fermentation Blends
  - Danisco – MicroGARD™, NovaGARD™
  - Kemin - SHIELD®
  - Kerry – Alta®
  - Purac - Verdad®
  - WTI - Ional ®
Uncured Turkey Listeria Testing

3.5 % VERDAD NV55 controls Listeria for 80 days
Compared to 26 days for Opti.Form PD4

Source: Courtesy of Purac America

Food Research Institute
University of Wisconsin-Madison
Frankfurter Listeria Testing

Effect of Verdad NV15 and NV55 on Listeria monocytogenes in frankfurter

Source: Courtesy of Purac America
Surface Applied Agents

- Flexibility
  - Low Levels
  - Multiple possibilities
    - Organic Acids, Spice Extracts, Bacteriocins Lauric Arginate

- Equipment is available
  - USDA’s SLIC™ concept
  - RapidPak™ surface application during packaging
  - Capital costs?

- May help achieve Alternative 1 status
- Requires ongoing verification/validation
- Not easy to do on sliced products
  - Slicing speed
  - Surface area to cover
Resources for Information

- Academia
- Suppliers
- USDA Directive 7120.1
- FDA GRAS notices
  - http://www.accessdata.fda.gov/scripts/fcn/fcn
    Navigation.cfm?rpt=grasListing
### Antimicrobials

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Product Type</th>
<th>Usage Requirements</th>
<th>Acceptability</th>
<th>Listed by Common or Usual Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>An aqueous solution of sodium diacetate (4%), lactic acid (4%), pectin (2%), and acetic acid (0.5%)</td>
<td>Cooked meat products</td>
<td>Not to exceed 0.5 percent of finished product formulation.</td>
<td>Acceptability determination</td>
<td>Listed by common or usual name in the ingredients statement (2)</td>
</tr>
<tr>
<td>Bacteriophage preparation (a mixture of equal proportions of six different individually purified lytic-type)</td>
<td>Various RTE meat and poultry products</td>
<td>Applied as a spray at a level not to exceed 1 ml of the additive per 500 cm² product surface area</td>
<td>21 CFR 172.785</td>
<td>Listed by common or usual name (i.e., bacteriophage preparation) in the ingredients</td>
</tr>
<tr>
<td>A blend of encapsulated nisin preparation (90.9 percent), rosemary extract (8.2 percent) and salt (0.9 percent)</td>
<td>Frankfurters and other similar cooked meat and poultry sausages</td>
<td>Not to exceed 550 ppm of the product formulation</td>
<td>Acceptability determination</td>
<td>Listed by common or usual name in the ingredients statement (4)</td>
</tr>
<tr>
<td>Skim milk or dextrose cultured with <em>propionibacterium freudenreichii</em> subsp. Shermani</td>
<td>Meat and poultry sausages including those with standards of identity which permit the use of antimicrobial agents</td>
<td>Not to exceed 2 percent by weight of the finished product</td>
<td>GRAS Notice No. 000128</td>
<td>Listed by common or usual name in the ingredients statement (2)</td>
</tr>
</tbody>
</table>
GRAS Notice Inventory

The inventory of GRAS notices provides information about GRAS notices filed within each year since 1998, when FDA received its first GRAS notice. Once FDA has responded to a GRAS notice, the text of FDA’s response will also be available as part of the record for that notice. We will update this information approximately monthly. More information about this inventory is available on the GRAS Notice Inventory Introduction page.

Records shown on this page: This page is a partial listing of all records in the database. Additional pages/records are available for selection at the bottom of the page. To view all records in the database select the All button at the bottom of the page. To search for a specific food ingredient, enter the term in the Search Criteria box and select Show Items to display only those records that contain the selected term. To view the text of the agency’s response to the GRAS notice, select the text in the FDA’s Letter column describing the response. Select the specific GRN number in the GRN No. column to view additional detail about any GRAS notice, including in some cases the submission itself. The agency has removed nondisclosable information from these submissions. All copyrighted information has also been removed and the bibliographic information listed in a reference table at the end of the submission.

<table>
<thead>
<tr>
<th>GRN No. (select GRN No. for detailed record)</th>
<th>Substance</th>
<th>FDA’s Letter (select to view letter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>251</td>
<td>Carbon monoxide</td>
<td>Pending</td>
</tr>
<tr>
<td>250</td>
<td>Plant sterols and stanol from pine trees</td>
<td>FDA has no questions</td>
</tr>
<tr>
<td>249</td>
<td>Synthetic dihydrocapsate</td>
<td>FDA has no questions</td>
</tr>
</tbody>
</table>

Search Criteria

Sort by: [Dropdown]

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No of Records Found: 301
Lm Growth Inhibitors, Regulations and Public Health

- Do not change likelihood of Listeria contamination in products

- Do not kill Listeria

- By inhibiting growth expect less likelihood of related Listeriosis
Listeria Growth Inhibition
Estimated Benefit to Public Health*

*Based on Growth Model for 50 gm of RTE cured processed meat and median mortality risk for neonates published by FDA/USDA Fall 2003 Listeria monocytogenes
Risk Table IV-12 and Figure IV-7
Summary

Environmental monitoring and preventative equipment interventions or process changes that minimize contamination in finished product

PLUS

Listeria Growth inhibitors in product

EQUALS

Effective reduction in Lm risk