Appendix B (Chilling) and Alternatives

Acknowledgements

Cooling and Stabilization Research at the University of Wisconsin - Madison
2011-2015 Meat Lab and Food Research Institute

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Topics

What is Appendix B?
- Stabilization Options for Uncured Products
  - Inhibitors to C. Perfringens Growth
- Stabilization for Cured Products
  - Impact of Nitrite and Ascorbate/Erythorbate
- Stabilization for Alternatively Cured Products
- Modeling

The Regulatory Basis for Appendix B

The Regulatory Basis for Appendix B


AGENCY: Food Safety and Inspection Service, Agriculture.

ACTION: Final rule.

SUMMARY: The Food Safety and Inspection Service (FSIS) is amending the Federal meat and poultry products inspection regulations by converting into performance standards the regulations governing the production of cooked beef, roast beef, and cooked corned beef products, fully and partially cooked meat patties, and certain fully and partially cooked poultry products. Unlike the previous requirements for these products, which mandated step-by-step processing measures, the new performance standards spell out the objective level of food safety performance that establishments must meet, but allow establishments to develop and implement processing procedures customized to the nature and volume of their production. Establishments that do not wish to change their processing practices may continue following the previous requirements for these products, which will be disseminated as “safe harbors” in Agency guidance materials. ....

Vegetative cells and spores can be found in raw materials

<table>
<thead>
<tr>
<th>Raw product category</th>
<th>No. of samples</th>
<th>% positive</th>
<th>% positive to spores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cured whole muscle</td>
<td>58</td>
<td>1.6</td>
<td>5</td>
</tr>
<tr>
<td>Cured ground or emulsified</td>
<td>162</td>
<td>49.7</td>
<td>5.3</td>
</tr>
<tr>
<td>Uncured whole muscle</td>
<td>81</td>
<td>14.8</td>
<td>0</td>
</tr>
<tr>
<td>Uncured ground or emulsified</td>
<td>18</td>
<td>38.9</td>
<td>16.7</td>
</tr>
<tr>
<td>All categories combined</td>
<td>445</td>
<td>21.6</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Adapted from Taormina, Bartholomew, and Dorsa (2003)

Thermal processing destroys vegetative cells, but spores are heat shocked by thermal processing and germinate

Temperature range 15-55°C (59-131°F)
- Optimal growth temperature 43-47°C (109-117°F)
**FSIS Appendix B Stabilization Guidelines**

**Goal:** less than 1-log increase

**Uncured Product Cooling Profile**
- Stage 1: 1.5 hours to cool 130°F to 80°F
- Stage 2: 5 hours to cool 80°F to 40°F

**Cured Product Cooling Profile**
- Stage 1: 5 hours to cool 130°F to 80°F
- Stage 2: 10 hours to cool 80°F to 45°F
- Cured defined as 100 ppm sodium nitrite
- No other formulation limits are defined

**Cook-in-bag Uncured Turkey Breast Cooling**

**Linear Cooling- Cook-in-bag Uncured Turkey Breast with added K Lactate**

<table>
<thead>
<tr>
<th>Hour</th>
<th>Set Temp (F)</th>
<th>Set Temp (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>140</td>
<td>60</td>
</tr>
<tr>
<td>1</td>
<td>120</td>
<td>48.9</td>
</tr>
<tr>
<td>2</td>
<td>110</td>
<td>43.3</td>
</tr>
<tr>
<td>3</td>
<td>100</td>
<td>37.8</td>
</tr>
<tr>
<td>4</td>
<td>90</td>
<td>32.2</td>
</tr>
<tr>
<td>5</td>
<td>80</td>
<td>26.7</td>
</tr>
<tr>
<td>6</td>
<td>70</td>
<td>21.1</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>15.6</td>
</tr>
<tr>
<td>8</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>40</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Cooling Curve Protocol for 10 Hour period

**Growth of C. perfringens (Log/CFU) during a 10 Hour Chilling Period from 160°F to 40°F**

**Conclusion**

2% Potassium Lactate in Cook-in-bag Uncured Turkey Breast enables slower chilling without >1 log growth of C. perfringens
Impact of Deviations to Cooling Uncured Products

J. Sabez 2012 Research Institute - unpublished

3% Cultured Sugar and Vinegar in Cook-in-bag Uncured Turkey Breast enables slower chilling without growth of C. perfringens

K. Osterbauer 2014 Food Research Institute - manuscript in preparation

Conclusions
Based on Uncured Turkey Breast Experiments

- 1st stage of Appendix B – necessary
- 2nd stage – less critical than stage 1
- Longer time in optimum range = increased growth overall
- Listeria Growth inhibitors delay C. perfringens growth during slower chilling
Impact of Deviations to Cooling Cured Products

Conclusions

For hams cured with >100 ppm NaNO₂ and 547 ppm sodium erythorbate:
• Cooling in phase 1 can be extended by up to 5 hours, with no C. perfringens growth
• Cooling in phase 2 can be extended by up to 5 hours with no C. perfringens growth
≥150 ppm nitrite + 250 ppm erythorbate is effective at preventing growth of C. perfringens in a cooling curve of 25 hours
Conventional vs. alternative curing effects on *C. perfringens* Growth during chilling

**Antimicrobials to inhibit *C. perfringens* growth in deli style turkey breast (uncured and alternatively cured with 50 ppm ingoing nitrite from pre-converted celery)**

**Alternatively Cured Conclusions**

Effects of nitrite and ascorbate on *C. perfringens* growth inhibition are independent of the source (natural or purified)

The uncured chilling requirements of Appendix B are appropriate given the variable but generally <100 ppm ingoing nitrite from natural sources and inconsistent inclusion of a source of ascorbate in these products

Chilling using the cured requirements of Appendix B is feasible, however, combinations of ingredients in any particular situation needs to be validated

Questions and Discussion