Natural Curing for Meats

Niche Meat Processor Assistance Network
Thursday, March 4
10am Pacific/ 1pm Eastern

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University of Wisconsin
Madison, WI
Purpose of Sodium Nitrate / Nitrite

- Cured meat color
- Cured meat flavor
- Preservative properties
  - Growth of *Clostridium botulinum*
- Powerful antioxidant
  - Effective in controlling fat oxidation
**Cured Meat Color Development**

Addition of sodium nitrite

Nitric oxide (gas)

Heat

**Myoglobin**

**Nitrosomyoglobin**

**Nitrosohemochrome (Pink cured meat color)**
Natural, Organic and Conventional Labeling Claims

- **Organic**
  - 100% organic
  - Organic
  - Made with organic
  - Less than 70% organic

- **Natural**

- **Uncured**

More Restrictive

Less Restrictive
Natural Labeling

- USDA, Food Standards and Labeling Policy Book
- 21 CFR 101.22
  - ‘(1) the product does not contain any artificial flavor or flavoring, coloring ingredient, or chemical preservative (as defined in 21 CFR 101.22), or any other artificial or synthetic ingredient; and (2) the product and its ingredients are not more than minimally processed….'
Organic Meat and Poultry Products

National Organic Program (NOP)
- Agricultural Marketing Service (AMS)
- www.ams.usda.gov/nop/NOP/standards/ListReg.html

The National List of Allowed and Prohibited Substances
- 7 CFR
  - § 205.605 Nonagricultural (nonorganic) substances allowed as ingredients in or on processed products labeled as “organic” or “made with organic (specified ingredients or food group(s)).”
  - § 205.606 Nonorganically produced agricultural products allowed as ingredients in or on processed products labeled as “organic” or “made with organic (specified ingredients or food group(s)).”
USDA Definition of Uncured Meat Products

- Definition found in 9 CFR 317.17 and 9 CFR 319.2
  - Normal cured products that can be made without nitrites or nitrates added

- Statements/words that must be added
  - “Uncured” before common name
    - i.e. Uncured Frankfurters
  - “No Nitrate or Nitrite Added …..”
  - “Keep Refrigerated Below 40°F At All Times”
“Natural Curing” Systems

- Vegetable juice powders and juices
  - Standardized up to 30,000 ppm nitrate

- Pre-converted vegetable juice powders and juices
  - Standardized up to 10,000 ppm nitrite

- Lactic Acid Starter Cultures
  - Staphylococcus carnosus
  - Staphylococcus carnosus / vitulinus
  - Staphylococcus carnosus / utilis

- Cherry Powder
  - Ascorbic acid
### Natural Sources of Nitrate

**Vegetable sources of “natural” nitrate (avg. ppm):**

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Nitrate (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radishes</td>
<td>2600</td>
</tr>
<tr>
<td>Celery</td>
<td>3151</td>
</tr>
<tr>
<td>Lettuce</td>
<td>2330</td>
</tr>
<tr>
<td>Spinach</td>
<td>2470</td>
</tr>
<tr>
<td>Carrots</td>
<td>274</td>
</tr>
<tr>
<td>Beets</td>
<td>3288</td>
</tr>
<tr>
<td>Cabbage</td>
<td>712</td>
</tr>
<tr>
<td>Beans</td>
<td>466</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>80</td>
</tr>
<tr>
<td>Potatoes</td>
<td>150</td>
</tr>
<tr>
<td>Turnip Greens</td>
<td>9040</td>
</tr>
<tr>
<td>Onions</td>
<td>235</td>
</tr>
<tr>
<td>Melon</td>
<td>4932</td>
</tr>
<tr>
<td>Rhubarb</td>
<td>2900</td>
</tr>
<tr>
<td>Broccoli</td>
<td>1014</td>
</tr>
</tbody>
</table>

R. Walker (1990), Food Add. Contam. 5:717-768.
Curing Ingredient Activity

- Sodium/Potassium Nitrate = INACTIVE COMPOUND
- Sodium/Potassium Nitrite = ACTIVE COMPOUND
“Natural Curing” Cured Meat Color Development

Addition of nitrate source and starter culture.

Nitric oxide (gas) Heat

Incubation reduces nitrate to nitrite

Myoglobin

Nitrosomyoglobin

Nitrosohemochrome (Pink cured meat color)
“Naturally Cured” Product Manufacture – Cultured System
Step # 1:
Addition of ingredient containing naturally occurring nitrates & Nitrate reducing starter culture
Process Formulation

- Vegetable juice powder or juice
  - Nitrate source
  - Can be labeled as “celery powder”, “flavoring” or “natural flavoring”

- Lactic acid starter culture
  - Staphylococcus carnosus
  - Staphylococcus carnosus / vitulinus
  - Staphylococcus carnosus / utilis
Proper Use of Ingredients

- Vegetable Juice or Powder
  - Goal is to maximize levels
    - Minimum of 0.2%
    - Maximum of 0.4% …?
    - Depends on amount of spices in product

- Starter Culture
  - Per manufacturer’s recommendations
    - 25 g per 225 kg recommended
Step #2: Incubation - Conversion of nitrate to nitrite
Requirements for Nitrate Conversion

- **Proper incubation of product essential**
  - Goal is to convert as much nitrate to nitrite as possible
  - **Internal temperature held optimum starter culture function temperatures**
    - i.e.: 50-113 °F (86 °F optimum)
    - ~ 1-2 hours
    - Depends on product diameter
      - Frankfurters = 2 hours
      - Ham = 1 hour (or less)
  - **Optimum time for starter culture function**
    - Nitrate reductase enzymes reduce nitrate to nitrite
Step #3: Cooking
Cooking Requirements

- Besides the addition of an incubation step, no other changes are necessary.
# Uncured Frankfurter Smokehouse Schedule

<table>
<thead>
<tr>
<th>Step</th>
<th>Step Type</th>
<th>Time</th>
<th>Dry Bulb (°F)</th>
<th>Wet Bulb (°F)</th>
<th>RH (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cook</td>
<td>2:00</td>
<td>105</td>
<td>103</td>
<td>93</td>
</tr>
<tr>
<td>2</td>
<td>Cook</td>
<td>00:20</td>
<td>140</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Smoke Cook</td>
<td>00:30</td>
<td>150</td>
<td>118</td>
<td>38</td>
</tr>
<tr>
<td>4</td>
<td>Cook</td>
<td>00:20</td>
<td>160</td>
<td>145</td>
<td>67</td>
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<tr>
<td>5</td>
<td>Cook</td>
<td>IT: 160 F</td>
<td>185</td>
<td>178</td>
<td>85</td>
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</tbody>
</table>

*** Step 1 is where conversion of nitrate to nitrite will occur.***
## Uncured Ham Smokehouse Schedule

<table>
<thead>
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<th>Step</th>
<th>Step Type</th>
<th>Time</th>
<th>Dry Bulb (°F)</th>
<th>Wet Bulb (°F)</th>
<th>RH (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cook</td>
<td>1:00</td>
<td>105</td>
<td>103</td>
<td>93</td>
</tr>
<tr>
<td>2</td>
<td>Cook</td>
<td>00:30</td>
<td>160</td>
<td>110</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>Cook</td>
<td>00:30</td>
<td>165</td>
<td>115</td>
<td>22</td>
</tr>
<tr>
<td>4</td>
<td>Cook</td>
<td>01:00</td>
<td>170</td>
<td>120</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>Cook</td>
<td>00:45</td>
<td>170</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Cook</td>
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<td>170</td>
<td>150</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>Cook</td>
<td>IT: 160 F</td>
<td>180</td>
<td>180</td>
<td>100</td>
</tr>
</tbody>
</table>

*** Step 1 is where conversion of nitrate to nitrite will occur.***
Processing Concerns & Challenges
Whole Muscle Processing Requirements

- Starter culture must be injected into whole muscle cuts
  - Not water soluble
  - Will not penetrate meat during tumbling or immersion curing
Natural & Organic Quality

- **Antioxidant protection**
  - ~ 50 ppm nitrite
  - Dependent on amount of unsaturated lipids

- **Maintaining cured color**
  - 2-14 ppm nitrite induces cured color
  - 40-50 ppm nitrite generally considered adequate

- **Antimicrobial protection**
  - Quality of raw materials
  - Few ingredients available

[Antioxidant neutralizing a free radical](Antioxidant neutralizing a free radical)
Natural & Organic Safety

- Clostridium Botulinum inhibition
  - 50-60 ppm ingoing nitrite?
  - Difficult to assess without challenge studies
  - Difficult to quantify true amount of nitrite generated
Questions?