Meat Preservation

Irradiation and Curing
Objectives

• Examine methods for irradiation, curing and smoking meat products

• Examine the variety of meats made available through curing
Merchandising Strategies

- Today, most meat is sold in containers
- Refrigeration makes this possible
- Traditionally, Curing and sausages were required
Irradiation

- Types of irradiation:
  - Alpha (not used in food industry)
  - Beta
  - Gamma
  - Z-rays
Have you eaten irradiated foods?
Why Cure Meats?

- **Preservation**
  - Traditional form of preservation
  - Equatorial countries are still very good at cure processing

- **Variety**
  - Adds spices and flavors to the same old meat

- **Value Added**
  - Packer/Retailer can charge more for low quality meats
What parts can be cured?

- Hams
- Loins
- Bacon
- Boston Butts
- Jowls
- Pork hocks

Where does Canadian bacon come from?
Which Species is Cured?

- Pork, Pork, Pork, Fish, Lamb……………………Poultry

- What is the most common cured beef product?
  - Corned Beef
  - Corned is from the yellow corn kernel-size salt used as a preservative
Types of Cures

• Dry salt cure
  – Uses only salt
  – Used primarily in pork and beans

• Dry sugar cure
  – Salt and sugar applied in a dry rub
  – Traditional country cured ham

• Sweet pickle cure
  – Most common curing process
  – 90% water
  – Honey baked hams

• Cover pickle cure
  – Immerse in water, seldom used because of expense
Curing Ingredients

• Salt – NaCl
  – Principal cure ingredient*
  – Only ingredient than can be used by itself
  – Adds flavor (major effect)
  – Enhances the transport of other cure ingredients

• How it works!
  – Pulls moisture from the microbes (osmosis)
  – Also pulls moisture from meat
Cure Ingredients

Why salt concentrations are so high in hams and bacon
Cure Ingredients

- **Sugar**
  - Sucrose or dextrose
  - Artificial sweeteners are not allowed
  - Counteracts the taste of salt
  - Has very little sweetening action
  - Colors the product (brown sugar)
  - Energy for bacteria in fermented products
Curing Ingredients

- Nitrates and Nitrites
  - Develop color
  - Prevent outgrowth of *C. botulinum*
  - Prevent warmed over flavor (microwave)
  - Help with flavor intensity
  - Retard rancidity

- Hams = Max of 200 ppm sodium nitrite
- Bacon = Max of 120 ppm sodium nitrite
Sodium Nitrite in Bacon

<table>
<thead>
<tr>
<th>Concentration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ppm NaNO₂</td>
<td></td>
</tr>
<tr>
<td>40 ppm NaNO₂, 0.26% K-SORBATE</td>
<td></td>
</tr>
<tr>
<td>80 ppm NaNO₂</td>
<td></td>
</tr>
<tr>
<td>120 ppm NaNO₂</td>
<td></td>
</tr>
</tbody>
</table>
Curing Ingredients

• Ascorbates
  – Ascorbic acid, Sodium ascorbate, Sodium erythorbate
  – Required for cure pickles (550 ppm)
  – Catalyze conversion of nitrite to nitric oxide
  – Inhibit nitrosamine formation
  – Maintains color
  – Can be sprayed on cut surface to reduce fading during display
Curing Ingredients

- Phosphates
  - Water retention

- Alkaline phosphate
  - Gives more stable color
  - Reduces oxidation
  - Protects against browning

- Increase water holding capacity***
- Necessary for added water product (think chicken)
Cure Ingredients

- Phosphates cont.
- Can Use:
  - Sodium hexametaphosphate
  - Sodium pyrophosphate
  - Sodium triphosphate
- Can use up to 5% in pickle
  - Can have up to 0.5% in finished product
- Decreases purge during cooking
- More juicy and tender
Cure Ingredients

- Cure Accelerators
  - Allow reactions in curing to proceed faster

- Glucono delta lactone
  - In hams and sausages
  - Produces a tangy flavor
  - Very common
  - Mostly sugar

\[
\text{Glucono delta lactone: } \quad \begin{array}{c}
\text{CH}_2\text{OH} \cdot \text{CH} \cdot (\text{CHOH})_3 \cdot \text{CO}
\end{array}
\]
Cure Ingredients

- **Sweeteners**
  - Corn syrup and honey are very common

- **Potassium Sorbate**
  - Antimicrobial

- **Smoke**
  - Liquid or wood

- **Water**
  - Carries all other ingredients and adds juiciness
## Cure timeline (Dry Cure)

<table>
<thead>
<tr>
<th>Task</th>
<th>Cumulative Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kill hogs today</td>
<td>0</td>
</tr>
<tr>
<td>Cut carcasses &amp; “rub” hams</td>
<td>1</td>
</tr>
<tr>
<td>“rub” hams second time</td>
<td>7</td>
</tr>
<tr>
<td>Cure $\bigcirc$ 40 D (1 week/in. of thickness)</td>
<td>41</td>
</tr>
<tr>
<td>Equilibrate (let osmosis “work”)</td>
<td>61</td>
</tr>
<tr>
<td>Smoke at no more than 100°F</td>
<td>62</td>
</tr>
<tr>
<td>Age 42 days (varies)</td>
<td>104</td>
</tr>
<tr>
<td>Slice, wrap and ship</td>
<td>105</td>
</tr>
</tbody>
</table>
Economics of the Dry Cure

• Why are country hams so expensive?

• 105 days to cure * 10,000/day = 1,050,000 hams in stock
• Storage facilities – refrigeration during curing and air conditioning during aging
• Labor
• Almost all country cure business in southeastern U.S.
<table>
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<tr>
<td>0</td>
<td>KILL HOGS TODAY</td>
</tr>
<tr>
<td>1</td>
<td>CUT CARCASSES, PUMP HAMS, AND SMOKE THEM</td>
</tr>
<tr>
<td>2</td>
<td>COOL TO 38°F</td>
</tr>
<tr>
<td>3</td>
<td>SLICE, WRAP AND SHIP</td>
</tr>
</tbody>
</table>

How many hams would this packer have on hand if 10,000 hogs were killed/day?
Skinning of a Ham

- Why skin the ham
  - Allows cure to penetrate
  - Silverside shrinks distorting ham
Dry Cure Ham

- Why is he not required to wear gloves or hair net?

- Why is he salting the bone?
Dry Curing

Box Cured

Shelf Cured
Equilibration Period

- Requires 20 days of equilibration at 38°C
- Osmosis makes cure concentration more uniform
- Can make people sick if eaten too soon
  - Salt
  - Bad meat
Dry Cured Bacon in Aging Room
<table>
<thead>
<tr>
<th>Process</th>
<th>Shrinkage, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curing</td>
<td>2</td>
</tr>
<tr>
<td>Smoking</td>
<td>8 - 9</td>
</tr>
<tr>
<td>1 month of aging</td>
<td>15 - 18</td>
</tr>
<tr>
<td>6 months of aging</td>
<td>30±</td>
</tr>
</tbody>
</table>

**Why do country cured products cost so much?**
Reasons for Pickle Cure

• Cheaper, Cheaper, Cheaper
  – Less overhead cost
  – Water adds weight
  – Less overall shrinkage

• Juicier
• More tender
• Better flavor
• Most people don’t like country cure
• 90% of all hams and bacon is produced this way
Injection Methods

• Stitch Pump
  – Place in several places
Injection Method

- Artery Pump
  - Similar to stitch but use vein/artery to distribute the brine
Injection Methods

- Multi-needle Injector
Injection Methods

X-RAYS - CURE IS DARK

HAM NOT CURED

ARTERY PUMPED

PUMPED W/ SINGLE NEEDLE

AFTER 7-D HOLDING AT 38 F
Injection Methods

X-RAY
Ways to Pump Cure

1. Stitch Pump
2. Artery Pump
3. Multi-needle injector
4. Cover Pickle
5. Combination
Smoking
Smoking

- Hardwoods should be used for smokers
Purpose of Smoking

1. Development of Aroma and Flavor
2. Preservation
3. Creation of new products (value adding)
4. Color development
5. Protection from oxidation
6. Formation of skins
Composition of Smoke

- Phenols
  - Aroma and Flavor, antioxidant

- Alcohols
  - Act as carrier of other components

- Organic acids
  - Skin formation, preservation

- Carbonyls
  - Color and Flavor

- Hydrocarbons
  - Undesirable, carcinogens

- Gases
  - CO2, CO, O2, N2, H2O etc.
Types of Smoke

• Vaporous
  – Contains two phases
    • Particulate (90%)
    • Gaseous (10%)
  – Contains carcinogens and is slower but is cheap

• Liquid smoke
  – Low to no carcinogens
  – Shorter cook/run time
  – Lower pollution
Liquid Smoke Application

1. Dripping/Drenching

2. Direct Application

3. Atomization
THE END