BACON PROCESSING TODAY

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Goals

- Maximize Value from the Pork Belly
- Uniform, Consistent & High Quality Bacon
- Good Color, Shelf Life, Consumer Value & Expectations
- Greater “Consistency” - Freedom From Defects
- Expand Product Development Opportunities
- Compliance with Regulatory Requirements
Definition

• Bacon: The weight of cured pork bellies ready for slicing and when labeled as “Bacon” shall not exceed the weight of the fresh uncured pork belly.
  – **DRY CURED** - Curing materials applied in dry form to belly surfaces
  – **IMMERSION CURED** - Bellies are immersed in a curing solution
  – **PUMPED** - Machine injected
    • Stitch needle type
    • Spray needle type
What Is Bacon Today?

• Injected/Pumped Bacon = 97+% of bacon produced
• Dramatic Change in Demand and Usage
• Highly demanded ingredient for sandwiches, salads, hand held foods, appetizers, casseroles
• “FLAVOR – TEXTURE – EYE APPEAL”
• Bacon is a highly sought out specialty product
• Condiment/Ingredient for Flavor, Texture, Eye Appeal
What is the Impact of Bacon?

- 108,000,000 pigs / year U.S.
- $13.09 lb/pig
- 1,413,720,000 lb bellies
- $ 18.5 Billion
- 212,058,000 lb bellies for single rib export – 15%

- HOG CUT OUT DATA - (Week 5/25/2009
  - Loins $76.06/cwt
  - Bellies $77.19/cwt
  - Butts $72.46/cwt
  - Hams $45.06/cwt
INGREDIENTS

- Meat Ingredients
- Non-Meat Ingredients
Source of Bellies

- Pork Carcass
- NAMP #408 skin-on
- NAMP #409 skinless
- NAMP 409A (export, single-rib)
- Sorted and marketed by weight range
- Typically shipped fresh in bulk quantities
The Pumped Bacon Regulations

• 120 ppm Sodium Nitrite (In-going Target)
• 550 ppm Sodium Ascorbate (In-going Target)
• Green Weight Regulation

Code of Federal Regulations
9 CFR 318.7, 319.107
FSID Directive
7310.6
Standard Operating Procedures

- Pickle Formulation
- Pre-Pump Handling of Bellies
- Pumping Operations
- Post-Pump Handling of
- Regulatory Requirements
- Taste and Quality Level
- Injection Percentage
- Thermal Processing Schedule
- Slicing, Grading, Packaging Standards
# Pickle Composition

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Function</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Carrier &amp; Yield</td>
<td>Green Weight Rule</td>
</tr>
<tr>
<td>Salt</td>
<td>Flavor &amp; Anti-Microbial</td>
<td>Flavor Profile</td>
</tr>
<tr>
<td>Sodium Nitrite</td>
<td>Cure- Color Development, Anti-Microbial</td>
<td>120 ppm</td>
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<tr>
<td>Sodium Ascorbate</td>
<td>Cure Accelerator</td>
<td>550 ppm</td>
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<tr>
<td>Sodium Phosphate</td>
<td>Moisture Balance</td>
<td>5000 ppm</td>
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<tr>
<td>Sugar</td>
<td>Sweetener</td>
<td>Flavor Profile</td>
</tr>
<tr>
<td>Soluble Flavorings</td>
<td>Flavor Profile/Coatings</td>
<td>Flavor Profile</td>
</tr>
</tbody>
</table>
Non-Meat Ingredients

- Bulk Ingredients
  - Sanitation of Bulk Delivery Trucks
  - Condition of Lixator, Saturation Tables
- Bagged Ingredients
  - Removal of Outer Bag
  - Ingredient Purity
- Security of Regulated Ingredients
  - Sodium Nitrite or Cure, Sodium Ascorbate/Erythorbate
- Weight vs. Volume Measurements
Potable Water

Bulk Salt

Lixator

Mixing Tanks

NO Dip Sticks
1. Cold Water Soaking

2. Skinning

3. Whizzards Knife Trimmed

4. Fresh Bellies Injection
1. Combing
2. Dwell/Diffusion/Staging
3. Blast Chill/Tempering
4. Pressing Tempered Slab
Pressed Bacon Slab

Bacon Slicer

Sliced Bacon Draft

Net Weight
Order of Ingredients

• 1. Water
• 2. Phosphates, Ascorbates/Erythorbates
• 3. Salt, Sugar, Dextrose, Flavorings
• 4. Nitrites
Pumping Percent

- Desired Percent = 10-18%
- Skin-on vs. Skin-off Bellies ~ 10% difference
  - 120 ppm = 94-144 ppm (±20%)
  - 550 ppm = 440-660 ppm (±20%)
- Green Weight Regulations
Things to Remember!

- Weights not Volumes
- Pre-mix – Unit-Packs – Complete Cures
- Mechanical Agitation – Never Direct Air or Steam
- Gentle Not Violent (trapped air & protein foam)
- Cold Brines – Never Hot – Always < 40°F (5°C)
- Never Overnight – Always < 12 Hours Old
- Never Reuse Pickle from yesterday
<table>
<thead>
<tr>
<th>Sample Calculations</th>
<th>Value</th>
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<tbody>
<tr>
<td>Pounds of Pickle Desired</td>
<td>500#</td>
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<tr>
<td>Pumping Percentage</td>
<td>0.12</td>
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<tr>
<td>Percent Nitrite – 120 ppm</td>
<td>0.00012</td>
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<tr>
<td>Percent Ascorbate – 550 ppm</td>
<td>0.00055</td>
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<tr>
<td>Percent Salt</td>
<td>0.02</td>
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<tr>
<td>Percent Sugar</td>
<td>0.0075</td>
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<tr>
<td>Percent Phosphates</td>
<td>0.0050</td>
</tr>
<tr>
<td>Percent Flavorings</td>
<td>0.0000</td>
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</table>
SINGLE SLICE LAYOUT

PLATTER STYLE LAYOUT

ACCEPTABLE SHINGLING

BULK BOXED BACON
BACON DEFECTS

- Shattered Bacon
- Lacy Bacon/Pickle Pockets
- Abscess Deep in Belly
- Abscess Below Spareribs
- “Seedy Belly”
- Tiger Striped Bacon (Needle Injector Patterns)
- Tiger Striping (Needle Pattern)
- Tiger Striping (Complete Cure-Different Intensities)
- Two-Toned Bacon
- Poor Quality Bacon
- Wrinkled Bacon
- Vertical Splits
- Dog Ear Bacon
- Severe “S” Folding
- Cooked Slice Distortion
TIGER STRIPING
Needle Pattern

TIGER STRIPING
Complete Cure – Different Intensities

Two Toned Bacon

Poor Quality Bacon

Two-Toned  Metmyoglobin  Tiger Striping
Cooked Bacon Slice Distortion
PRODUCTION

• Making Pickle
  – Calculations
    • Nitrite
    • Ascorbate
    • Salt
    • Sugar
    • Phosphate
    • Water
• Making Bacon
Pickle Ingredient Calculation

- 500 pounds of pickle
  - 12 percent injection level
  - 120 ppm nitrite
  - 550 ppm ascorbate
  - 2 percent salt
  - 0.75 percent sugar
  - 0.5 percent phosphate
Nitrite Calculation

• Formula: Percent (as decimal) required in bacon divided by percent (as decimal) pump equals percent (as decimal) in pickle.

• Assume 120 ppm = .012 percent = .00012 (percent as decimal)

• Nitrite = .00012 * percent in bacon divided by .12 * percent pump = .001 * percent in pickle x 500# of pickle = 0.5# nitrite

* percent as decimal
**Ascorbate Calculation**

- **Formula:** Percent (as decimal) required in bacon divided by percent (as decimal) pump equals percent (as decimal) in pickle
- **Assume** 550 ppm = 0.055 percent = 0.00055 (percent as decimal)
- **Ascorbate** = 0.00055 * percent in bacon divided by 0.12 * percent pump = 0.00458 * percent in pickle x 500# of pickle = 02.29# ascorbate

*percent as decimal*
Salt Calculation

- Formula: Percent (as decimal) required in bacon divided by percent (as decimal) pump equals percent (as decimal) in pickle
- Assume 2.0 percent = .02 (percent as decimal)
- Salt = .02* percent in bacon divided by .12*percent pump = .166* percent in pickle x 500# of pickle = 83.0# salt

*percent as decimal
Sugar Calculation

- Formula: Percent (as decimal) required in bacon divided by percent (as decimal) pump equals percent (as decimal) in pickle
- Assume 0.75 percent = .0075 percent (as decimal)
- Sugar = .0075*percent in bacon divided by .12*percent pump = .0625*percent of pickle X 500# of pickle = 31.25# sugar

*percent as decimal
Phosphate Calculation

- Formula: Percent (as decimal) required in bacon divided by percent (as decimal) pump equals percent (as decimal) in pickle
- Assume 0.5 percent = .005 percent (as decimal)
- Phosphate = .005*in bacon divided by .12 *percent pump = .042 *percent in pickle X 500# of pickle = 20.83# phosphate

*percent as decimal
**Water Calculation**

Total of dry ingredients

- 0.5 lbs nitrite + 2.29 lbs. ascorbate + 83 lbs. salt + 31.25 lbs. Sugar + 20.83 lbs. Phosphate = 137.87 lbs.

- Water = 500 lbs. Batch weight – 137.87 lbs. dry ingredients = 362.13 lbs. of water

Water at 40 degrees F and at sea level, = 8.33 lbs. Per gallon

- 362.13 lbs. of water divided by 8.33 = 43.47 gallons
Pickle Making

• Pickle Making Guidelines
  – Formulate pickle batches as small as possible, yet economical for the operation, weigh all ingredients
  – Completely dissolve ingredients in proper order
  – Don’t re-circulate pickle to mixing tanks
  – Don’t save pickle overnight
  – Use standardized quantities of ingredients, check net weight
Belly Injection
Smoking
Smoking

• Temperature and Relative Humidity
  – Follow an established cook schedule
  – Calibrate wet and dry bulb controllers
  – Change wet bulb sock regularly
  – Use thermocouples to monitor oven and internal product temperatures
  – Remove bellies at consistent temperatures
Bacon Slicing
Bacon Slicing
PRE-COOKED BACON

• Pre-Cooked Bacon
  – Premium Slices – Microwaveable & Convenient

• Continuous Cooking

• Bacon Ends & Pieces
Continuous Cooking
Pre-Cooked Bacon
The Pumped Bacon Regulations

1. 120 ppm Sodium Nitrite (In-going Target)
2. 550 ppm Sodium Ascorbate (In-going Target)
3. Green Weight Regulation
4. Pre-Cooked Bacon
   - Not to yield more than 40% bacon
     = 60% shrink (Green Weight)
Bacon Ends & Pieces
Applewoo
Cherrywoo
Mesquite
or
Cracked Pepper
At Last – The End!

MAYBE NEXT TIME YOU'LL TRY A LITTLE SUNSCREEN...
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et.al.
Questions?

1. How will genetics and market weight impact the future of bacon?

2. How will the cost of feed (grains, distillers byproducts, flax seed feeds, restaurant grease and competition with corn) affect bacon?

3. What role will special label claims such as natural, organic, Omega 3 fatty acids, impact the bacon industry?

4. Which bacon defects have quick solutions?

5. Will bacon popularity and consumption continue to increase?