Technology Strategies to Improve the Nutritional Value of Processed Meat Products

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The Role of Red Meats in a Healthy Diet
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Presentation Outline

• Contributions of Processed Meats to a Healthy Lifestyle

• Sodium Reduction
  – Food contributors to sodium intake
  – Sources of sodium in processed meats
  – Salt in processed meats
  – Lactate in processed meats
  – Phosphates in processed meats
  – Alternatives for sodium reduction

• Fat Reduction
  – Fat in processed meats
  – Alternatives for fat reduction

• What is Oscar Mayer doing?
I. Contributions of Processed Meats to a Healthy Lifestyle

• Contributions to the Diet
  – Excellent source of various essential nutrients:
    • High-quality protein
    • B vitamins (thiamin, riboflavin, niacin, B₆, B₁₂)
    • Minerals: iron, zinc, selenium
      – Minerals from meat have higher bioavailability than those from vegetable sources
  – Satiety
  – Variety
  – Enjoyment

• Socio-cultural Contributions
  – Convenience/Comfort (ease of use, time)
  – Safety
  – Accessibility to meat
II. Sodium Reduction
Food Contributors to Sodium Intake

United States, 1994*

Grain products: 37%
Meat, poultry, fish, dry beans, eggs & nuts: 7%
Vegetables: 13%
Dairy products: 35%
Fats & oils: 7%
Beverages, sugars & sweets: 4%
Fruits: 2%

* 75% of total intake; does not include sodium from salt added in the home during food preparation or at the table, estimated at 20% of total intake

Food Contributors to Sodium Intake
Canada, 2004

# Sodium Sources in Processed Meats

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Na content, %</th>
<th>Usage level, %</th>
<th>Function</th>
<th>Na contribution, mg/100 g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium chloride</td>
<td>39.3</td>
<td>1.0–2.5</td>
<td>Water and fat binding, Preservation, Safety, Flavor</td>
<td>393–983</td>
</tr>
<tr>
<td>Sodium lactate</td>
<td>20.5</td>
<td>1.0–2.5</td>
<td>Safety, Preservation</td>
<td>205–513</td>
</tr>
<tr>
<td>Sodium tripolyphosphosphate</td>
<td>31.2</td>
<td>0.20–0.50</td>
<td>Water binding and holding</td>
<td>62–156</td>
</tr>
<tr>
<td>Meat</td>
<td>0.007–0.008</td>
<td>50–95</td>
<td>Endogenous content</td>
<td>35–75</td>
</tr>
<tr>
<td>Na ascorbate/erythorbate</td>
<td>11.6</td>
<td>0.30–0.55</td>
<td>Reducing agent</td>
<td>35–64</td>
</tr>
<tr>
<td>Sodium diacetate</td>
<td>16.2</td>
<td>0.05–0.20</td>
<td>Safety</td>
<td>8–32</td>
</tr>
<tr>
<td>Sodium nitrite</td>
<td>33.3</td>
<td>0.006–0.019</td>
<td>Safety, Preservation, Flavor</td>
<td>2–6</td>
</tr>
</tbody>
</table>
Salt in Processed Meats

Functions

- **Solubilization of myofibrillar proteins**
  - Allow proteins to bind water and fat
  - ~4% is required for efficient extraction and solubilization

- **Lowering of the isoelectric (pI)**
  - Lowers the pI from ~5.1 to ~4.0, increasing repulsion between protein chains in the pH range of 5.6-6.3, causing an increase in the water holding capacity

- **Flavor enhancement**
  - In general, consumers tolerate up to ~2%

- **Antimicrobial activity**
  - Retards microbial growth, increasing shelf life and improving food safety
Salt in Processed Meats

*Effects on the pI*

Phosphates in Processed Meats

Types

• Alkaline
  – Sodium (STPP) or potassium tripolyphosphate (KTPP)
  – Sodium (SHMP) or potassium (KHMP) hexametaphosphate
  – Disodium (DSP) or dipotassium (DKP) phosphate
  – Sodium (SPP) or potassium (KPP) pyrophosphate

• Acidic
  – Sodium (SAPP) or potassium (KAPP) acid pyrophosphate
  – Monosodium (MSP) or monopotassium (MKP) phosphate
Phosphates in Processed Meats

**Functions**

- **pH control**
  - Alkaline phosphates raise meat pH (~0.2-0.3 units) and move it further away from the isoelectric point, thus increasing WHC

- **Protein extraction**
  - Dissociate actomyosin complex, thus freeing myosin for emulsification and making more room for water

- **Chelation and sequestration**
  - Bind divalent cations (e.g., Fe$^{+2}$; Ca$^{+2}$; Mg$^{+2}$), which reduces oxidative rancidity

- **Acceleration of the curing reaction**
  - Acidic phosphates accelerate the reaction of nitrite and myoglobin to form nitrosomyoglobin (cured pink pigment)
Lactates in Processed Meats

Functions

• Control of *Listeria monocytogenes*
  – More effective in combination with sodium diacetate
  – Inhibits bacterial growth
  – *Listeria monocytogenes* is the most important pathogen in ready-to-eat processed meat products because
    • It can grow at refrigeration temperatures
    • It tolerates high salt concentrations
Alternatives for Sodium Reduction

- Salt Reduction
- Substitution
- Improvement and/or Masking
- Protein Modification
Alternatives for Sodium Reduction

Salt Reduction

• Possible up to a point, depending on the product

• Limiting factors:
  – Functionality (water retention, emulsification)
  – Antimicrobial activity (safety, shelf life)
  – Flavor/Taste

• May require the addition of binders (e.g., starches, proteins, gums), phosphates and/or other antimicrobials
  – Limitations:
    • It’s difficult to replicate the effects of salt
Alternatives for Sodium Reduction

**Substitution**

- Negative ions (Cl\(^-\), phosphate, lactate) are more important than positive ions (Na\(^+\)), which allows substitution with sodium-free salts.

- The most common substitutes are potassium salts:
  - e.g., KCl, K phosphates, K lactate
  - Limiting factors:
    - May result in off-flavors (bitter, metallic) at Na replacement levels >15–20%, although this varies by product
    - At higher replacement levels, flavor maskers are required
Alternatives for Sodium Reduction

**Masking and/or Enhancement**

- **Masking Agents**
  - e.g., proprietary technologies; adenosine monophosphate (AMP)
  - Typically used to mask bitter notes caused by potassium salts
  - Limiting factors:
    - Effectiveness tends to be partial and varies by product

- **Flavor Enhancers**
  - e.g., monosodium glutamate, ribonucleotides, hydrolysates, fermentates
  - Typically used to enhance salty notes in low-salt products
  - Limiting factors:
    - Consumer acceptance
Alternatives for Sodium Reduction

**Protein Modification**

- Physical, chemical or enzymatic processes that improve the functionality of endogenous meat proteins
  - e.g., ultra high pressure,

- **Limitations**
  - Effectiveness
    - Difficult to replicate salt and phosphate functionality
    - Results have been varied
  - High costs
  - To date no technology has been identified that offers adequate effectiveness at a reasonable cost

- This is an incipient area that requires more research
Alternatives for Sodium Reduction

Summary

- Sodium reduction in processed meats presents several challenges:
  - Technological, financial, marketing (final consumer)

- Therefore, every sodium reduction strategy should consider various factors:
  - Reduction objectives and technologies to achieve them
    - Product by product approach is needed
  - Production costs vs. sales price
  - Consumers tend to react negatively to drastic changes

- As a result, the industry has adopted a stepwise approach, in which sodium is reduced gradually over time
III. Fat Reduction
Fat in Processed Meats

*Functions*

- Flavor
- Texture
- Appearance
- Succulence and Juiciness
## Fat Content of Traditional Processed Meats

<table>
<thead>
<tr>
<th>Product</th>
<th>Fat Content, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Dogs, Frankfurters</td>
<td>25–30</td>
</tr>
<tr>
<td>Chorizo</td>
<td>30–40</td>
</tr>
<tr>
<td>Bacon</td>
<td>40</td>
</tr>
<tr>
<td>Salami</td>
<td>30–40</td>
</tr>
<tr>
<td>Ham (pork)</td>
<td>1–10</td>
</tr>
<tr>
<td>Turkey Breast</td>
<td>0.5–5</td>
</tr>
</tbody>
</table>
# Degrees of Saturation of Animal Fats*

<table>
<thead>
<tr>
<th>Species</th>
<th>Saturated, %</th>
<th>Monounsaturated, %</th>
<th>Polyunsaturated, %</th>
<th>Degree of Saturation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef**</td>
<td>45–55</td>
<td>40–50</td>
<td>3–7</td>
<td></td>
</tr>
<tr>
<td>Pork**</td>
<td>35–45</td>
<td>40–50</td>
<td>12–15</td>
<td></td>
</tr>
<tr>
<td>Turkey</td>
<td>35–45</td>
<td>25–40</td>
<td>20–35</td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td>25–35</td>
<td>37–47</td>
<td>20–30</td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td>20–30</td>
<td>15–25</td>
<td>50–60</td>
<td></td>
</tr>
</tbody>
</table>

* Mean values; ranges vary according to anatomical location of the fat

** Stearic acid (C18:0) does not raise serum cholesterol levels. Subtracting this fatty acid, “bad” saturated fats in pork and beef is 25–30%
Alternatives for Fat Reduction

- Removal
- Substitution
Alternatives for Fat Reduction

Removal

• At high reduction levels, it may result in significant changes in organoleptic quality (flavor, color, texture, appearance, etc.)

• In high-fat (25-40%) products (e.g., hot dogs, chorizo, bologna), reductions of up to ~25% can be accomplished in this manner. Greater reductions may result in lower consumer liking.
Alternatives for Fat Reduction

*Substitution*

- e.g., starches, proteins, proprietary technologies
- Better option to achieve greater reductions
- Difficult to replicate the organoleptic properties of fat
Alternatives for Fat Reduction

Summary

- Fat makes a fundamental organoleptic contribution to many processed meat products.
- Fat reduction technologies exist. However, research studies and real-world experience show that the majority of consumers are reluctant to believe that low-fat products are organoleptically equivalent to their full-fat counterparts.
- Therefore, fat reduction strategies must be accompanied by effective marketing and communication strategies.
What is Oscar Mayer Doing?

• We have already reduced sodium significantly
  – White Turkey lunchmeats – ≥15% (2008)
  – Chicken Breast Strips – 20% (2009)
  – Beef Franks – ≥20% (2010)
  – Bologna – ≥15% (2010)
  – Turkey (resealable pouch) – ≥30%(2010)
  – Ham (resealable pouch) – ≥30% (2010)

• We are committed to lower sodium an additional 10% over the next two years
What is Oscar Mayer Doing?

• Sodium reduction is complex
  – Requires balancing consumer taste preferences, food safety and functionality
  – We will not compromise on product safety and our consumers will not compromise on taste

• We are constantly looking for new technologies to help us as we push for greater reductions over the long term

• We have offered low-fat versions of most of our products (e.g., hot dogs, bologna, bacon) for many years