TIA Technical Session
Dallas Texas

Preservation
Increasing Shelf Life

October 2014
Preservation and Shelf Life

- **Shelf Life**
  - The length of time that a commodity may be stored without *becoming unfit* for use or consumption.

- **Causes for product *becoming unfit***

- **Staling**
  - Tortillas is the lack of rollability and foldability
  - Dry, brittle

- **Rancidity**
  - Fat naturally present in ingredients or added to formula
  - Oxidation of fats causing undesirable flavor

- **Microbial spoilage**
Preventing Staling

- Traditional shelf life extenders
  - Higher fat
  - Gums / fibers
  - Added sugar
  - Higher emulsifier
    - Monoglycerides
    - SSL
- Cause of staling = starch retrogradation
  - Enzymes
    - Specialized starch degrading / modifying enzymes
Preventing rancidity
Choosing the right fat

• Unsaturated fats tend to have a shorter shelf life
  • Tend to be healthier
• Saturated fats are more stable

• Avoid exposure to oxygen
  • MAP packaging for long shelf life, > 3 months
Microbial spoilage

• There’s an old saying in the baking industry:

“If it wasn’t for ovens, bakers would have killed everybody off ages ago”.

Ovens sanitize - People contaminate
Hurdle Technology
Combined method technology

• Each method of preservation acts as a hurdle or barrier to prevent spoilage
• For tortillas the hurdles would be formulated and processed as such:
Cumulative Effect of Preservatives and Acids
Raising the Barrier Against Spoilage

- Calcium Propionate Propionic acid
- Potassium Sorbate Sorbic acid
- Fumaric Acid
Forms of Preservation

- Mold inhibitors
  - Artificial
  - Clean label
- pH - Acidic or high lime (basic)
- Reducing water activity (aW)
- Modified atmospheric packaging
- UV Light
- Irradiation
- Freezing, refrigeration
- Fermentation
• Preservatives:
  • Antimicrobial agents used to preserve food by preventing the growth of microorganisms such as mold, yeast and bacteria.

• Also known as:
  • Mold inhibitor
  • Antimicrobial
  • Antimycotic
  • Antifungal
### Preservation System Flour Tortilla

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Bakers %</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flour</td>
<td>100</td>
<td>56.7</td>
</tr>
<tr>
<td>Water</td>
<td>55</td>
<td>31.2</td>
</tr>
<tr>
<td>Fat</td>
<td>12</td>
<td>6.8</td>
</tr>
<tr>
<td>Salt</td>
<td>2</td>
<td>1.1</td>
</tr>
<tr>
<td>Sugar</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Preservatives</td>
<td>1.25</td>
<td>0.7</td>
</tr>
<tr>
<td>Acids</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Leavening</td>
<td>2</td>
<td>1.1</td>
</tr>
<tr>
<td>Gum</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Emulsifier</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Gluten</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>176.25</strong></td>
<td><strong>100.0</strong></td>
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</tbody>
</table>
Mold Inhibitors
% of Total Formula

- Flour
- Water
- Shortening
- Salt
- Sugar
- Preservatives
- Acidulants
- Baking powder
- Gluten
- Gum
- Emulsifier
- Enzymes
Preservatives

- **Propionates**
  - Calcium propionate
  - Sodium propionate
  - Propionic acid

- **Sorbates**
  - Potassium sorbate
  - Sorbic acid

- **Fermentation**
  - Cultured dairy whey
  - Cultured wheat
  - Cultured corn syrup solids
Acidulants

- Fumaric acid
  - Hot water soluble
  - Encapsulated
- Citric acid
  - Encapsulated for flour tortilla
- Malic acid
  - Encapsulated
- Vinegar / acetic acid
  - Translucent flour / corn tortillas
<table>
<thead>
<tr>
<th>Antimicrobials</th>
<th>Function/Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>acetic acid</td>
<td>disrupts cell membrane function (bacteria, yeasts, some molds)</td>
</tr>
<tr>
<td>benzoic acid</td>
<td>disrupts cell membrane function/inhibits enzymes (molds, yeasts, some bacteria)</td>
</tr>
<tr>
<td>natamycin</td>
<td>binds sterol groups in fungal cell membrane (molds, yeasts)</td>
</tr>
<tr>
<td>nisin</td>
<td>disrupts cell membrane function (gram-positive bacteria, lactic acid-producing bacteria)</td>
</tr>
<tr>
<td>nitrates, nitrites</td>
<td>inhibits enzymes/disrupts cell membrane function (bacteria, primarily <em>Clostridium botulinum</em>)</td>
</tr>
<tr>
<td>propionic acid</td>
<td>disrupts cell membrane function (molds, some bacteria)</td>
</tr>
<tr>
<td>sorbic acid</td>
<td>disrupts cell membrane function/inhibits enzymes/inhibits bacterial spore germination (yeasts, molds, some bacteria)</td>
</tr>
</tbody>
</table>
## Preservatives and Acidulants

<table>
<thead>
<tr>
<th>E number</th>
<th>Chemical Compound</th>
<th>Comment</th>
<th>Production Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>E201-203</td>
<td>benzoic acid, sodium benzoate</td>
<td>used in acidic foods such as jams, salad dressing, juices, pickles, carbonated drinks</td>
<td>ineffective, requires low pH &lt; 5</td>
</tr>
<tr>
<td>E270</td>
<td>lactic acid</td>
<td>used as a food preservative, curing agent and flavoring agent</td>
<td>Reacts with leavening, must be encapsulated</td>
</tr>
<tr>
<td>E280 – 283</td>
<td>propionic acid and calcium and sodium propionate</td>
<td>baked goods</td>
<td>Calcium most common form</td>
</tr>
<tr>
<td>E200 – 203</td>
<td>sorbic acid, potassium or sodium sorbate</td>
<td>common for cheese, wine, chemical leavened baked goods</td>
<td>Sorbic acid helps lower pH, potassium sorbate highly soluble</td>
</tr>
<tr>
<td>E 297</td>
<td>fumaric acid</td>
<td>used in beverages and baking powders, substitute for tartaric acid and citric acid.</td>
<td>Use &quot;hot water soluble&quot; slower solubility, protects leavening</td>
</tr>
<tr>
<td>E 330</td>
<td>citric acid</td>
<td>a natural* preservative/conservative which occurs naturally in citrus fruits and is also used to add an acidic or sour taste to foods and drinks.</td>
<td>Reacts with leavening, must be encapsulated. Label friendly</td>
</tr>
<tr>
<td>E 296</td>
<td>malic acid</td>
<td>generally used in beverages, bakery and candy. It is generally used as a substitute for fumaric acid and occasionally in place of citric acid.</td>
<td>Reacts with leavening, must be encapsulated</td>
</tr>
</tbody>
</table>
Functionality of Calcium Propionate at Different pH Levels

- 50% effective at pH 4.8
- 22% functionality at pH 5.5
- 6% functionality at pH 6.0
As pH decreases (becomes more acidic) shelf life increases.

pH 4.8 – 5.5 is the sweet spot for extending product shelf life.
Functionality of Antimicrobials at pH 6

- Propionic Acid
- Sorbic Acid

Mold
Yeast (wild)
Bacterium
Propionic Acid
Functionality of antimicrobials pH 5.5
How to get the most out of your preservative

• Use propionate and sorbate to get full spectrum coverage
  • Calcium / sodium propionate
  • Propionic acid
  +
  • Potassium sorbate
  • Sorbic acid

• Need pH modifier (Acidulant)
  • Fumaric acid, hot water soluble
    • Don’t use cold water soluble = translucency
  • Malic, citric, lactic, acetic
    • All need to be encapsulated for flour tortilla use
      • Translucency
Formulation

• Propionate greater than Sorbate
  • 0.5% Propionate
  • 0.3 % Sorbate
• Acids
  • Use rate dictated by expected shelf life
    • pH < 5.5  gives > 21 days
    • pH 6  gives 7 to 14 days
    • pH 7 gives < 7 days
Preserving Tortillas – Ways to Extend Shelf Life

- Decrease Water Activity
  - Breads, Tortilla 0.95-0.98

<table>
<thead>
<tr>
<th>Microbial Group</th>
<th>Example</th>
<th>(a_w)</th>
<th>Products Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal bacteria</td>
<td><em>Salmonella species</em></td>
<td>0.91</td>
<td>Fresh meat, milk</td>
</tr>
<tr>
<td></td>
<td><em>Clostridium botulinum</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal yeast</td>
<td><em>Torulopsis species</em></td>
<td>0.88</td>
<td>Fruit juice concentrate</td>
</tr>
<tr>
<td>Normal molds</td>
<td><em>Aspergillus flavus</em></td>
<td>0.80</td>
<td>Jams, Jellies</td>
</tr>
<tr>
<td>Halophilic bacteria</td>
<td><em>Wallemia sebi</em></td>
<td>0.75</td>
<td>Honey</td>
</tr>
<tr>
<td>Xerophilic molds</td>
<td><em>Aspergillus echinulatus</em></td>
<td>0.65</td>
<td>Flour</td>
</tr>
<tr>
<td>Osmophilic yeast</td>
<td><em>Saccharomyces bisporus</em></td>
<td>0.60</td>
<td>Dried fruits</td>
</tr>
</tbody>
</table>

- Reduce water
- Add glycerol
- Add salt
- Add sugar

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Preserving Tortillas –
Ways to Extend Shelf Life

- Increase preservative level
- Decrease pH, add more acid
- Minimize cooling / packing contamination
  - Reduce ambient airflow
- Decrease tortilla storage temperatures

Sanitize, Sanitize, Sanitize
AB Mauri
Passionate About Baking

Thank You