TIA Technical Session

Dallas Texas

Preservation

Increasing Shelf Life

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BAKERY INGREDIENTS

2014 TECHNICAL CONFERENCE

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

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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

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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

Oil	Shelf Life
Coconut Oil	**12 months**
Palm Oil	**12 months**
Avocado Oil	**12 months**
Canola Oil	12 months
Corn Oil	9-12 months (opened)
Olive Oil	**6-12 months**
Macadamia Oil	**6-12 months**
Almond Oil	6-12 months
Safflower	6 months
Soybean Oil	6 months
Peanut Oil	6 months (opened)
Grape Seed Oil	3-6 months
Sunflower Oil	3 months
Walnut Oil	2-4 months
Sesame Oil	2-4 months

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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

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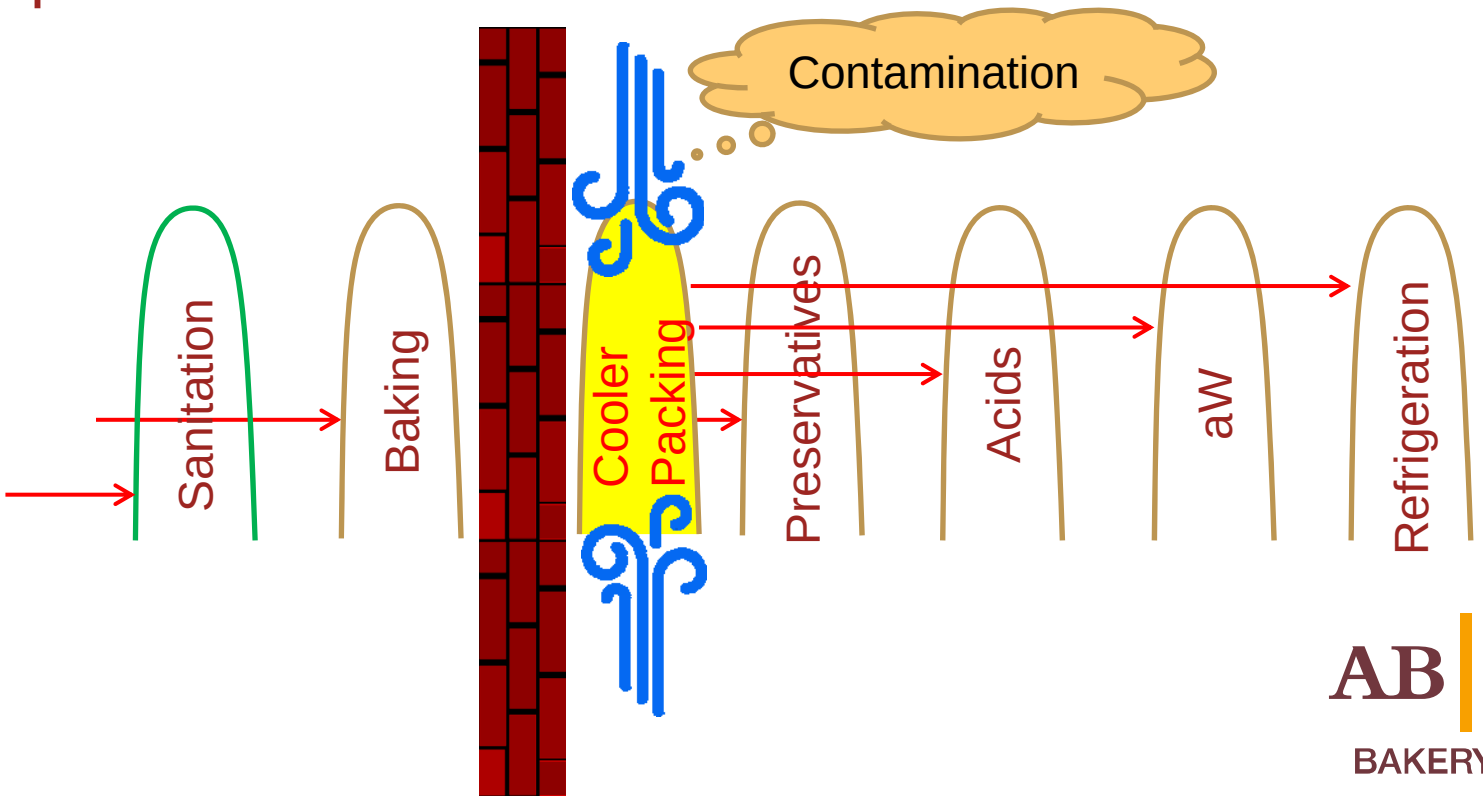
Hurdle Technology
Combined method technology

- Each method of preservation acts as a hurdle or barrier to prevent spoilage
- For tortillas the hurdles would be formulated and processed as such:



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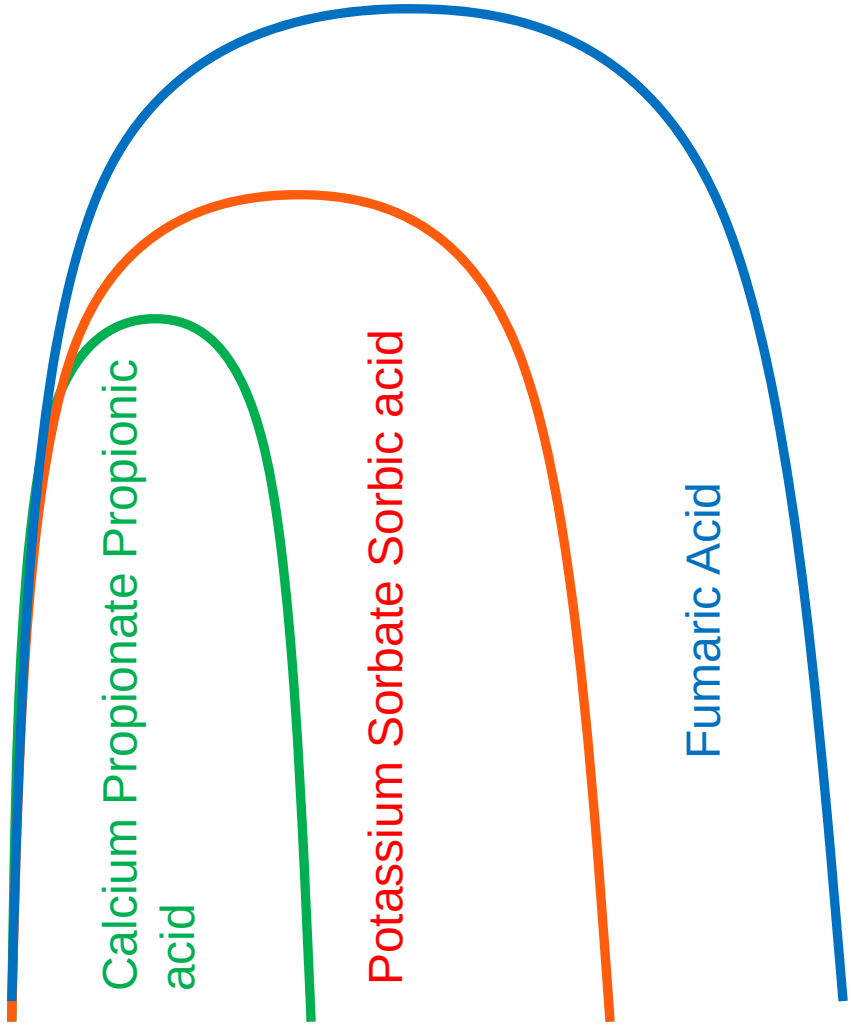
Cumulative Effect of Preservatives and Acids

Raising the Barrier Against Spoilage



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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

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Definition of Preservation

- 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

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Preservation System Flour Tortilla

	Bakers %	Total %
Flour	100	56.7
Water	55	31.2
Fat	12	6.8
Salt	2	1.1
Sugar	1	0.6
Preservatives	1.25	0.7
Acids	0.5	0.3
Leavening	2	1.1
Gum	0.5	0.3
Emulsifier	1	0.6
Gluten	1	0.6
	176.25	100.0

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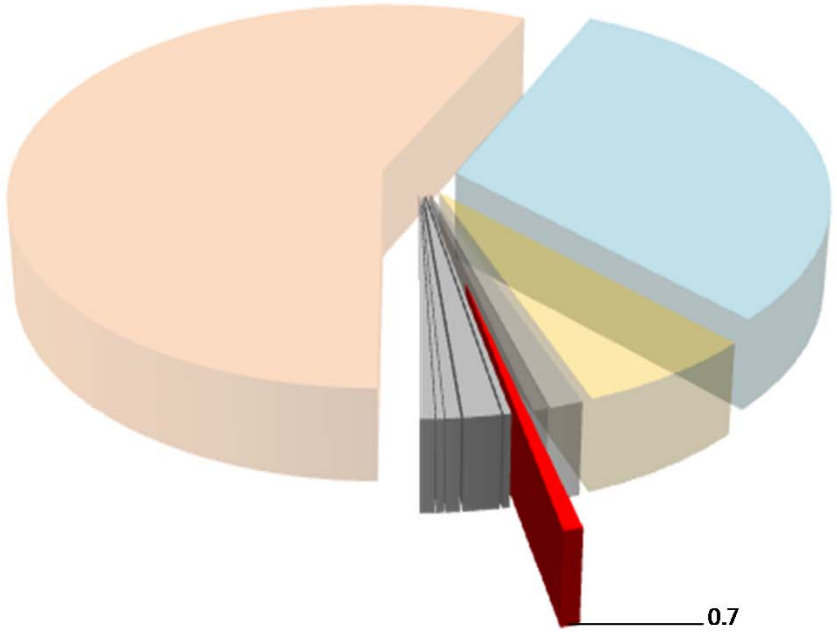
Mold Inhibitors

% of Total Formula



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

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Preservatives

- Propionates
  - Calcium propionate
  - Sodium propionate
  - Propionic acid
- Sorbates
  - Potassium sorbate
  - Sorbic acid
- Fermentation
  - Cultured dairy whey
  - Cultured wheat
  - Cultured corn syrup solids

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Acidulants

- Fumaric acid
  - Hot water soluble
  - Encapsulated
- Citric acid
  - Encapsulated for flour tortilla
- Malic acid
  - Encapsulated
- Vinegar / acetic acid
  - Translucent flour / corn tortillas

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Antimicrobials

acetic acid	disrupts cell membrane function (bacteria, yeasts, some molds)
benzoic acid	disrupts cell membrane function/inhibits enzymes (molds, yeasts, some bacteria)
natamycin	binds sterol groups in fungal cell membrane (molds, yeasts)
nisin	disrupts cell membrane function (gram-positive bacteria, lactic acid-producing bacteria)
nitrates, nitrites	inhibits enzymes/disrupts cell membrane function (bacteria, primarily *Clostridium botulinum*)
propionic acid	disrupts cell membrane function (molds, some bacteria)
sorbic acid	disrupts cell membrane function/inhibits enzymes/inhibits bacterial spore germination (yeasts, molds, some bacteria)

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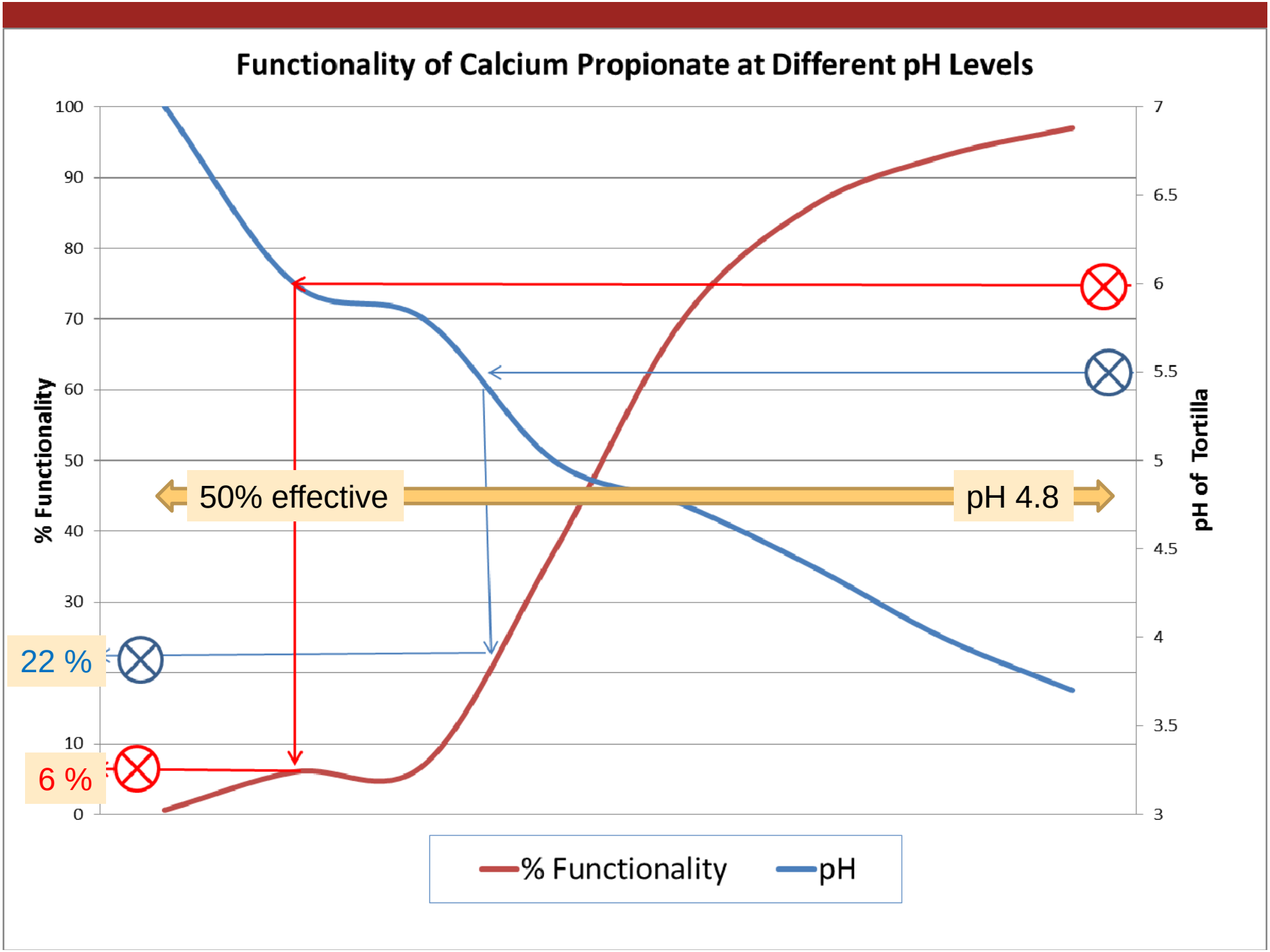
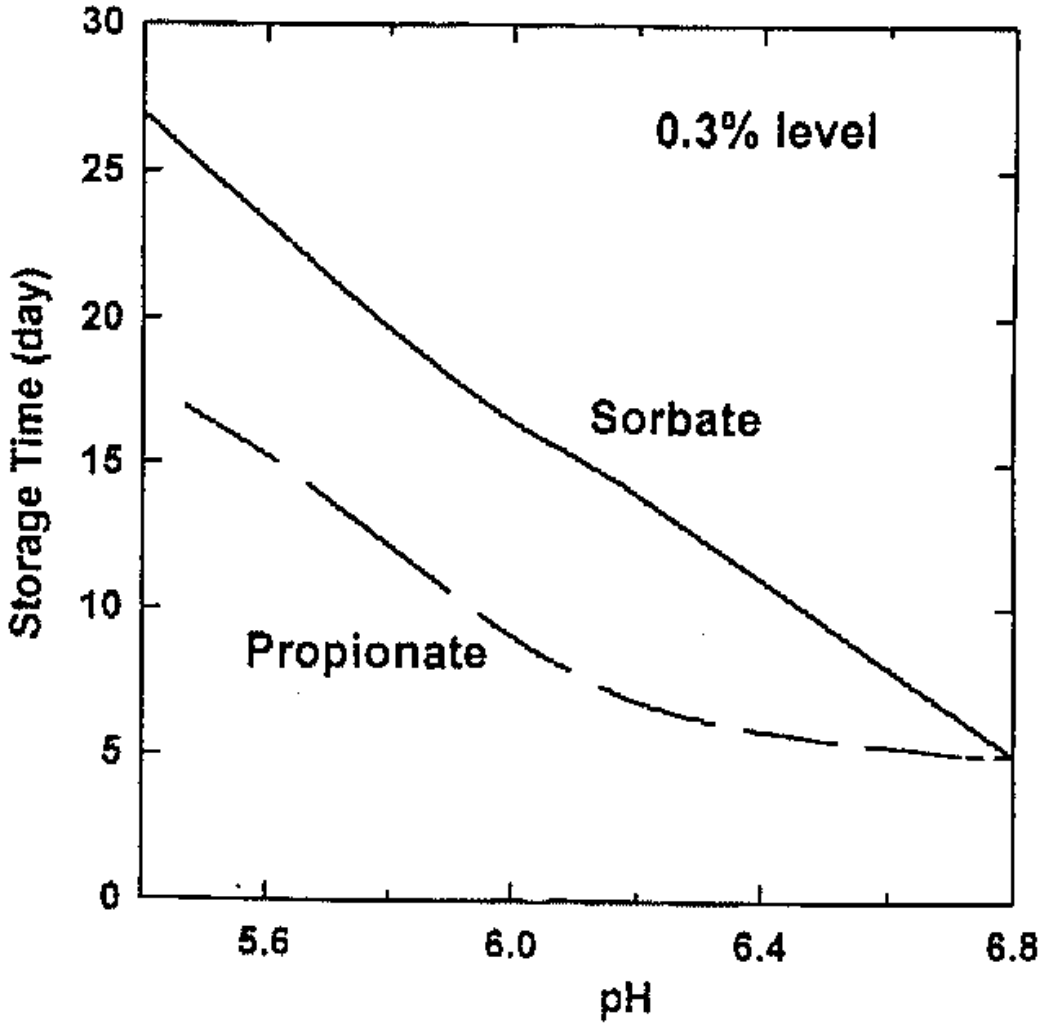
Preservatives and Acidulants

E number	Chemical Compound	Comment	Production Issues	Canada	Europe
E201-203	benzoic acid, sodium benzoate	used in acidic foods such as jams, salad dressing, juices, pickles, carbonated drinks	ineffective, requires low pH < 5		
E270	lactic acid	used as a food preservative, curing agent and flavoring agent	Reacts with leavening, must be encapsulated		NA
E280 – 283	propionic acid and calcium and sodium propionate	baked goods	Calcium most common form	2000 ppm	2000 ppm
E200 – 203	sorbic acid, potassium or sodium sorbate	common for cheese, wine, chemical leavened baked goods	Sorbic acid helps lower pH, potassium sorbate highly soluble	2000 ppm	2000 ppm
E 297	fumaric acid	used in beverages and baking powders, substitute for tartaric acid and citric acid.	Use "hot water soluble" slower solubility, protects leavening		NA
E 330	citric acid	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.	Reacts with leavening, must be encapsulated. Label friendly		NA
E 296	malic acid	generally used in beverages, bakery and candy It is generally used as a substitute for fumaric acid and occasionally in place of citric acid.	Reacts with leavening, must be encapsulated		NA

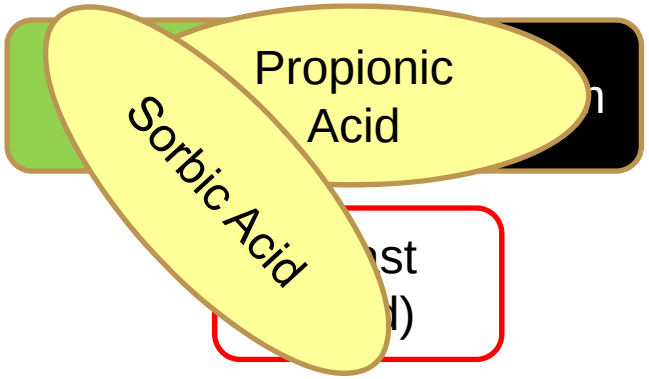

Functionality of Calcium Propionate at Different pH Levels
% Functionality
pH of Tortilla
100
90
80
70
60
50
40
30
10
0
7
6.5
6
5.5
5
4.5
4
3.5
3
50% effective
pH 4.8
22 %
6 %
% Functionality
pH

Relationship Between pH and Shelf Life Using Antimicrobials

- 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



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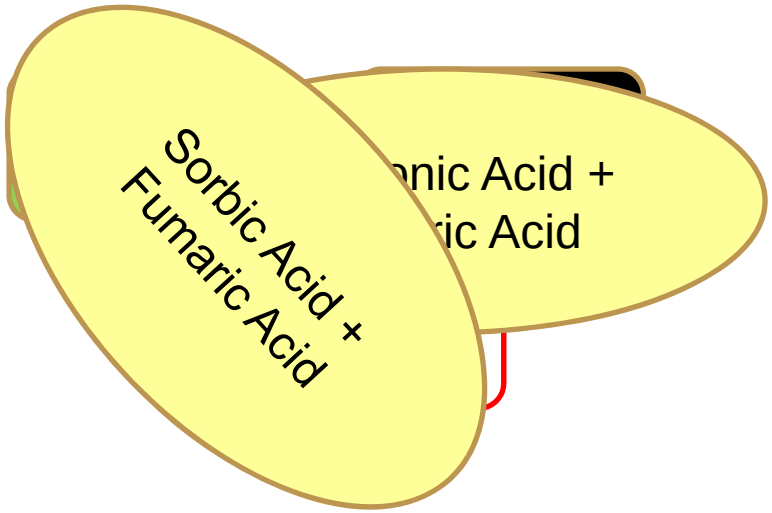
Functionality of antimicrobials pH 5.5



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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

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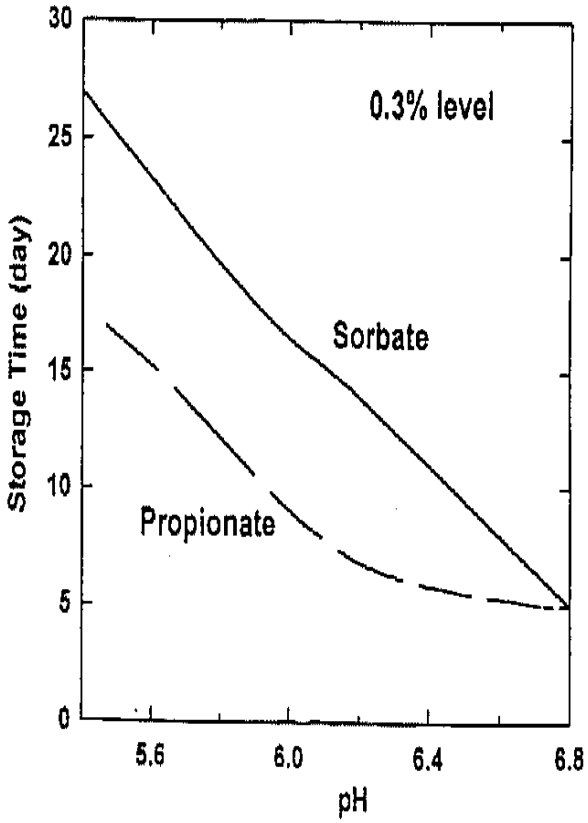
Formulation

- 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



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Preserving Tortillas – Ways to Extend Shelf Life

- Decrease Water Activity
  - Breads, Tortilla 0.95-0.98

Table 1. **Common spoilage organisms and their a_w limits for growth.**

Microbial Group	Example	a_w	Products Affected
Normal bacteria	*Sa1monella species* *Clostridium botulinum*	0.91	Fresh meat, milk
Normal yeast	*Torulopsis species*	0.88	Fruit juice concentrate
Normal molds	*Aspergillus flavus*	0.80	Jams, Jellies
Halophilic bacteria	*Wallemia sebi*	0.75	Honey
Xerophilic molds	*Aspergillus echinulatas*	0.65	Flour
Osmophllic yeast	*Saccharomyces bisporus*	0.60	Dried fruits

  - 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

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Passionate About Baking

Thank You

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