Summary & PowerPoint

Pushing the Boundaries of Freshness through Hurdle Technology

Many factors have an influence on a product's shelf life. This can range from the ingredients used in a formulation, to the conditions and processes of the facility where it is produced, to the methods of distribution. Finding the perfect balance for each brand poses challenges for even the largest and most experienced bakery manufacturers. This presentation will focus on a range of ingredient solutions that effectively tackle three key issues facing baked goods - staling, molding, and oxidation - and how combing a series of "hurdles" can help you best meet consumers' needs for safe, affordable, nutritious, and stable foods. It will also outline the newest emerging technologies available when you're asked to push the shelf life extension boundaries.

Learning Objectives

- Understand a hurdle technology approach to shelf life extension
- Appreciate ingredients' role in maintaining product quality and freshness throughout shelf life
- Recognize how hyper-extended shelf life might be applied within your brand portfolio

Presenter
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Presentation Time
Monday, February 25, 2019
1:30 pm - 2:05 pm

Session
Breakout 2

Pushing the Boundaries of Freshness Through Hurdle Technology

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What is shelf life extension?

Shelf life extension is the ***survivability of a product*** *that delivers* ***acceptable quality*** *over an extended period of time, while* ***remaining safe****.*

What is shelf life extension?

- Short-term shelf life: 0 days to 3 days
- Traditional shelf life: 4 days to 14 days
- Extended shelf life (ESL): 15 days to 30 days
- Hyper-Extended Shelf Life (HESL): 30+ days

WHY shelf life extension?

- Quality improvement?
- Change in delivery strategy?
- Food protection?
- Reduction in food waste?

Shelf life extension

Three parts of shelf life extension:

- **Antistaling**
- Antimicrobials
- Antioxidants

Antistaling

Softness and moistness (anti-staling) *are key attributes to keeping the* ***survivability of the product quality****, deemed* ***acceptable by consumers,*** *over an extended period of time.*

Antistaling

What are the options for maintaining softness and moistness?

- Enzymes
- Emulsifiers
- Hydrocolloids

What are the factors to consider?

- Intended shelf life time
- Formulary costs
- Label restrictions

Antistaling & Enzymes

Enzyme softening blends can have many different enzymes in them:

- Amylases (bacterial, fungal, maltogenic, maltotetrogenic (G4/G+), Glucoamylase, etc.)
- Xylanases
- Lipases

Antistaling & Enzymes

"Why is it necessary to understand what enzymes are in my softening blend?"

- Expense for the length of shelf life intended
- Type of formulation: lean, high fat, high sugar
- Type of processing
- Application type

Antistaling & Enzymes

***Carefully select** which **enzyme blend** you are using for **each product**. You may **solve** for one **issue** and **create** a more **undesirable issue** in that product.*

Antistaling & Hydrocolloids

What if the bakery manufacturer wants to go out to beyond 35 days of shelf life?

An extra piece of the softening quality is the **moisture control**. So, what would we need to add to maintain moisture control?

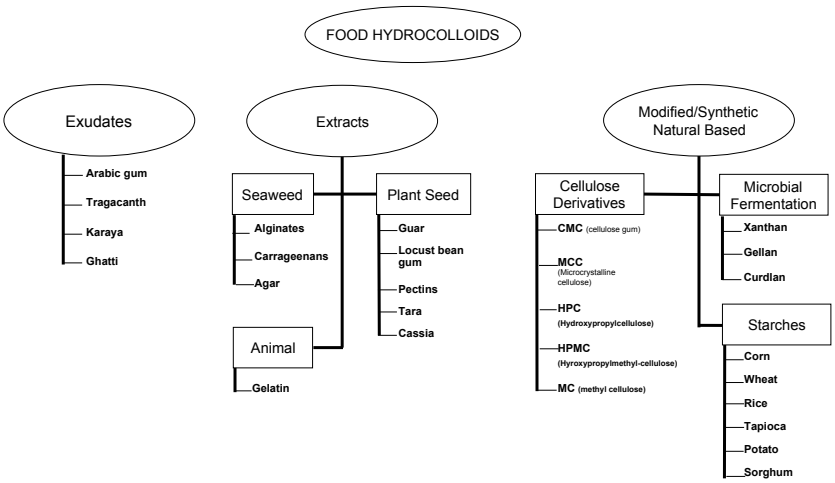
Hydrocolloids

Antistaling & Hydrocolloids

What are hydrocolloids?

*Hydrocolloids are **water soluble polymers**, which function by **controlling the structure and mobility of water**.*

Antistaling & Hydrocolloids



Antistaling & Hydrocolloids

Factors to consider in selection of hydrocolloid:

- Product type
- Desired texture
- Processing conditions, shear, temperature
- Mixing requirements and equipment
- pH of the system
- Hydration Time/Particle Size
- Desired stability
- Interactions / competition with other ingredients
- Cost / functionality desired
- Legal requirements
- Customer requirements for label declaration or ingredient restrictions

Antistaling & Hydrocolloids

Alginates:

- Gel forming
- Thickening/viscosity
- Mouthfeel
- Foam stabilization
- Film-forming: glazes
- Heat stability

Pectin:

- Improved dough characteristics in frozen dough (volume, handling)
- Texture, moisture management, gelation in bake fillings
- Multiple benefits in bake glazes

Antistaling & Hydrocolloids

MCC & HPMC:

- Reversible thermal gelation
- Water soluble
- Thickening
- Emulsification/encapsulation
- Film formation
- Binding (hot and cold)
- Air entrainment
- Foam stability
- Freeze-thaw stability
- Provide soluble fiber

CMC:

- High water absorption/good water retention
- Improved dough stability & machinability
- Improved specific volumes
- Delayed retrogradation of amylose
- Prolonged freshness
- Improved texture and gloss
- Increased plasticity and elasticity
- Gluten free
- Freeze-thaw stability
- Barrier (fillings)

Shelf life extension

Remember the original definition of shelf life extension?

"It is the **survivability** of a product that delivers **acceptable quality** over an extended period of time, while **remaining safe**."

Three parts of shelf life extension:

- Antistaling
- **Antimicrobials**
- Antioxidants

Antimicrobials

What are food antimicrobials?

Any **treatment**, or **substance** of natural, semisynthetic, or synthetic origin that **kills or inhibits** the **growth of microorganisms**, but causes **no damage** to the **consumer**.

Antimicrobials

The use of **antimicrobials** is just an **insurance policy** and **not** a **"fix it"** solution. The **higher** the **microbial load** on a bakery product, the **more stress** the load puts on the **antimicrobial**.

Antimicrobials

Antimicrobial Considerations

- Appropriate tool for the job
- Order of addition: In formula, or exterior
- Allergen concerns
- Label: Traditional or Clean
- Ease of application
- Flavor/sensory impact
- Cost-in-use
- Effect of food environment on activity

Antimicrobials

Chemical Preservatives

The basic synthetic antimicrobials that we have been using for many years are **calcium propionates**, **sodium propionates**, **sorbates**, and **benzoates**.

Antimicrobials

Natural Preservatives

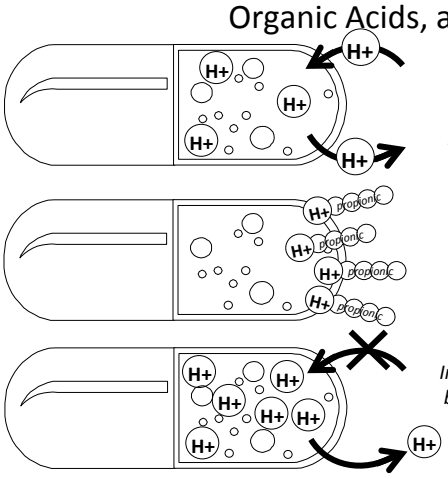
Clean label preservation is a trending topic in bakery goods. **Natural** options include:

- Fermentates
- Natamycin

Antimicrobials

Synthetic and Organic Acids

Application Details: Mode of Action of Synthetic and Organic Acids, as Inhibitors



In microbial cells, the internal pH of the cell stays near a pH of 7 - regardless of the pH of the environment. So, ***the amount of hydrogen ion H+ entering and leaving the cell is balanced****.*

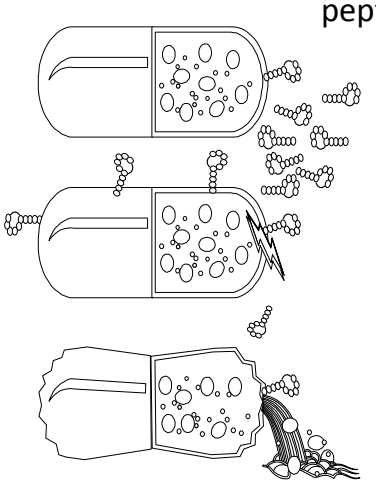
Propionic acid in the undissociated acid form can penetrate the cell and release H+ - which then increases the amount of H+ in the cell, ***causing the pH of the cell to lower****.*

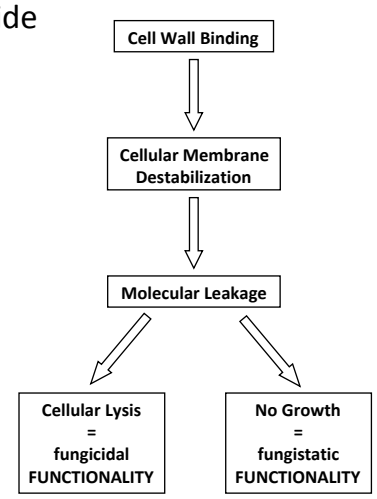
In order to maintain the cell pH the H+ must be pumped out of the cell which takes a lot of energy and reduces cell growth.

Antimicrobials

Natamycin

Mode of Action: Natamycin, a natural antimicrobial peptide





Antioxidation

The last key to **protect** the **freshness** of the finished bakery product is **antioxidation**. It becomes important as the **shelf life is extended beyond 30 days**.

Antioxidation

Lipid Oxidation

- Major cause of quality deterioration in foods
- Change in flavor, odor, color and texture
- Loss of nutritional value
- Production of toxins
- Limited product shelf-life

Antioxidation

What is rancidity?

It is the natural degradation of fats and oils by oxidation and/or hydrolysis.

Antioxidation

What causes rancidity?

Key Factors that Jumpstart Rancidity:

- Temperature (heat)
- Light
- Oxygen present around the product
- Time

Antioxidation

Antioxidants are substances that, when present in foods at low concentrations compared with that of an oxidizable substrate, markedly **delay or prevent the oxidation of the substrate**.

Benefits:

- Minimize oxidation
- Reduce rancidity
- Maintain nutritional value
- Extend shelf-life

Antioxidation

Classes of Antioxidants by Mode of Action

Primary or chain-breaking antioxidants

- Scavenge free radicals, and break chain reactions
- Examples: phenolics, tocopherols, carotenoids, ascorbate, ascorbyl palmitate, BHA, BHT, TBHQ, propyl gallate

Secondary antioxidants

- Metal chelators: citric acid, phosphoric acid, EDTA
- Reducing agent: ascorbic acid, phenolics
- Singlet oxygen quenchers: ascorbic acid, beta-carotene
- Synergistic antioxidants: regenerate primary antioxidants

Antioxidation

Antioxidant Considerations

- Type and level of oil
- Formulation and processing factors
- Type of antioxidant/natural extract
- Regulatory aspects
- Sensory impact
- Desired shelf life
- Method of application

Hyper-Extended Shelf Life

Hyper Extended Shelf Life (HESL) in bakery products

When pushing the boundaries for HESL, there are different factors to consider: moistness, softness, resilience, stackability, flavor, freshness, mold-free, safe to consume, etc.

Putting it all together

Shelf life	Recommended ingredients	Affect
0 to 3 days	Emulsifiers, Enzymes (Fungal Amylase, MAA)	Short term softening.
4 to 14 days	Emulsifiers, Enzymes (MAA, G+/ G4), Antimicrobials (synthetic, fermentates)	Intermediate softening and minimal food protection.
15 to 30 days	Emulsifiers, Enzymes (MAA, G+/ G4), Hydrocolloids, Antimicrobials (synthetic, fermentates, Natamycin)	Longer term softening, moisture control, and food protection
35+ days	Emulsifiers, Enzymes (MAA, G+/ G4, bacterial amylase), Hydrocolloids (CMC), Antimicrobials (synthetic, fermentates, Natamycin), Antioxidants	Hyper extended shelf life maximum softening, moisture control, maximum food protection, and freshness control

Thank you!