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Helping Bakeries Adapt to a more Sustainable Food Supply

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Agenda

- Moving to plant-based formulations through egg replacement
 - Understanding egg functionality
 - Strategies for replacing eggs
- Extending shelf life to reduce food waste
 - Maintaining product texture over shelf life
 - Delaying microbial growth
 - Delaying oxidation of fats and oils
- Improving processing efficiencies
 - Improving processing time
 - Packaging solutions
- Questions



Moving to Plant- Based Formulations Through Egg Replacement



Egg Replacement

- Motivations for moving away from eggs
 - Rising cost
 - Growing interest in plant-based diets
 - Sustainability: Plant-based foods are viewed as more sustainable; sustainable also associated with natural
 - Handling and storage concerns: liquids eggs have short shelf life and require frozen or refrigerated storage

Challenge = Egg are highly functional in baked goods

Understanding Egg Functionality

Egg White

- Foaming action in batter
- Texture & Structure
 - on heating, egg protein network coagulates = gives rigidity of the crumb
 - Good cohesiveness, springiness, resiliency

Egg Yolk

- Contains lecithin = natural emulsifier
- Stabilizes air cells to keep air in during baking
- Contributes colour and flavour

Whole Eggs

- 2 parts egg white + 1 part yolk
- Contribute strength & structure from proteins
 - Volume and tenderness from lecithin in yolk



Strategies for Replacing Eggs

Build back functionalities by combining different ingredients together

Structure Builders:

Ingredient	Functional Properties	Notes
Pea Protein	Provides emulsification and binding	Contributes flavour, binds water
Soy Protein	Provides structure and binding	Contributes flavour, allergen
Fava Protein	Good binding properties and viscosity	Contributes flavour, binds water
Wheat Protein	Provides strength and emulsification, improved resiliency	Clean flavour, does not typically introduce new allergen

Strategies for Replacing Eggs

Supporting Ingredients:

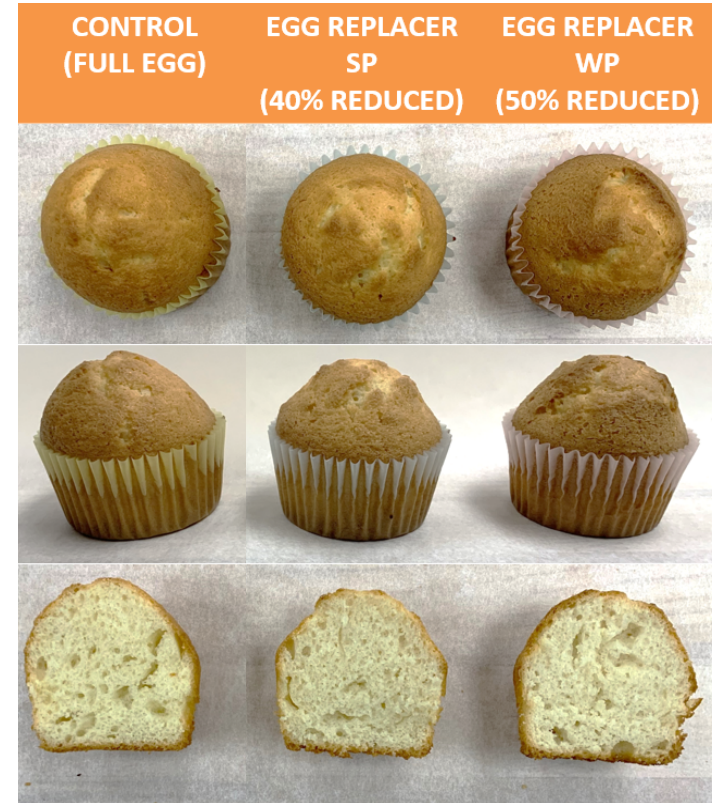
Ingredient	Functional Properties	Examples
Hydrocolloids	<ul style="list-style-type: none">• Control batter viscosity• Bind water• Forms gels to support structure	<ul style="list-style-type: none">• Xanthan• Alginate
Fruit & Vegetable Fibers	<ul style="list-style-type: none">• High water holding capacity to help improve moisture retention• Emulsifying properties	<ul style="list-style-type: none">• Carrot Fiber• Citrus Fiber
Emulsifiers	<ul style="list-style-type: none">• Stabilize air cells for batter stability and finer crumb structure & improved volume• Promote crumb softness	<ul style="list-style-type: none">• Lecithin• Mono & Di-glycerides

Egg Replacer Systems

- Benefits:
 - Optimized results
 - Ease of use
- TruSol Extol Egg Replacer Systems:
 - TruSol Extol Egg Replacer SP: soy protein-based
 - TruSol Extol Egg Replacer WP: wheat protein-based

Case Study

- Muffin demo using Egg Replacement systems for partial replacement of liquid whole egg
- Minimal impact on volume, appearance, taste, and texture





Extending Shelf-life to Reduce Food Waste

Food Waste Facts

- Each year about 60 million tons of food is discarded in the US
 - Estimated to be about 30-40% of the entire US food supply
 - Food waste contributes to 11% of the world's greenhouse gas emissions
 - Breads and cereals are the most wasted food groups

- Factors that contribute to food waste:
 - Misunderstanding of best before dates
 - Food spoilage
 - Over-purchasing





Strategies for Extending Shelf Life

1. Maintaining product texture
2. Delaying microbial growth
3. Delaying oxidation of fats and oils

1. Maintaining Product Texture

- Changes which occur in baked products after baking (physical and chemical processes) that reduce palatability:
 - Loss of crust crispiness
 - Increase of crumb firmness /crumbliness
 - Deterioration of flavor and aroma

Causes:

- Moisture migration
- Starch retrogradation



1. Maintaining Product Texture

How to tackle the staling issue?

Three basic approaches to crumb softness

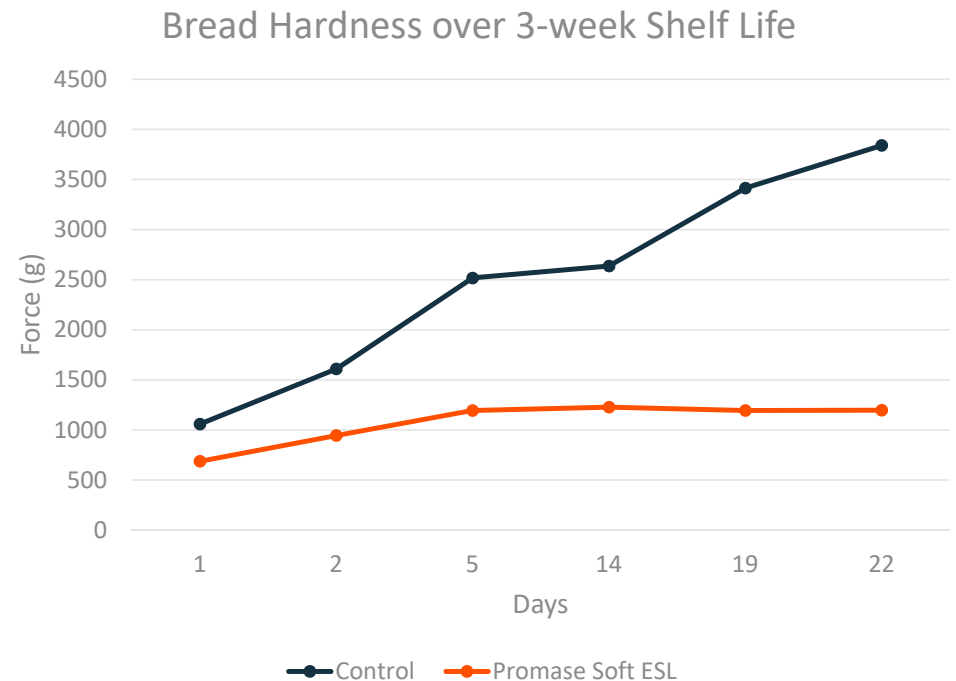
Solution	Example
Delay starch retrogradation	Emulsifiers (ie. Mono and di-glycerides, lecithin)
Hydrolyze starch / fat	Enzymes (ie. Amylases, lipases)
Prevent moisture migration	Water-binding ingredients (ie. Starches, fibers, gums) Water activity control (ie. Invert sugar, glycerine)

Promase Soft ESL

- Enzyme-based dough conditioner
- Maintain soft crumb
- Yeast-raised applications & flatbreads

Case Study

- Shelf-life comparison in white pan bread
 - Control = no treatment
 - Promase Soft ESL = 0.02% on flour
- Tested hardness of bread over 3-week period
 - Higher force = firmer crumb
- Result = Promase Soft ESL leads to significantly softer crumb over shelf life



2. Delaying Microbial Growth

Conventional Preservatives:

- Chemicals that inhibit the growth of spoilage microorganisms (e.g. mold)
- Examples:
 - Calcium propionate (active component = propionic acid): effective up to pH 6
 - Potassium sorbate (active component = sorbic acid): effective up to pH 6.5, suitable for chemically leavened applications

Natural Mold Inhibitors:

- Products of fermentation that create natural sources of organic acids to prevent mold growth
 - Cultured starches, flours, or sugars
- Effective at pH <5.6
- Most effective in yeast-raised applications

TruSol Mold-X Clean Label Mold Inhibitor

- Based on cultured carbohydrates
- Works best in combination with acidulant to lower the pH
- Recommended for yeast-raised applications

Case Study

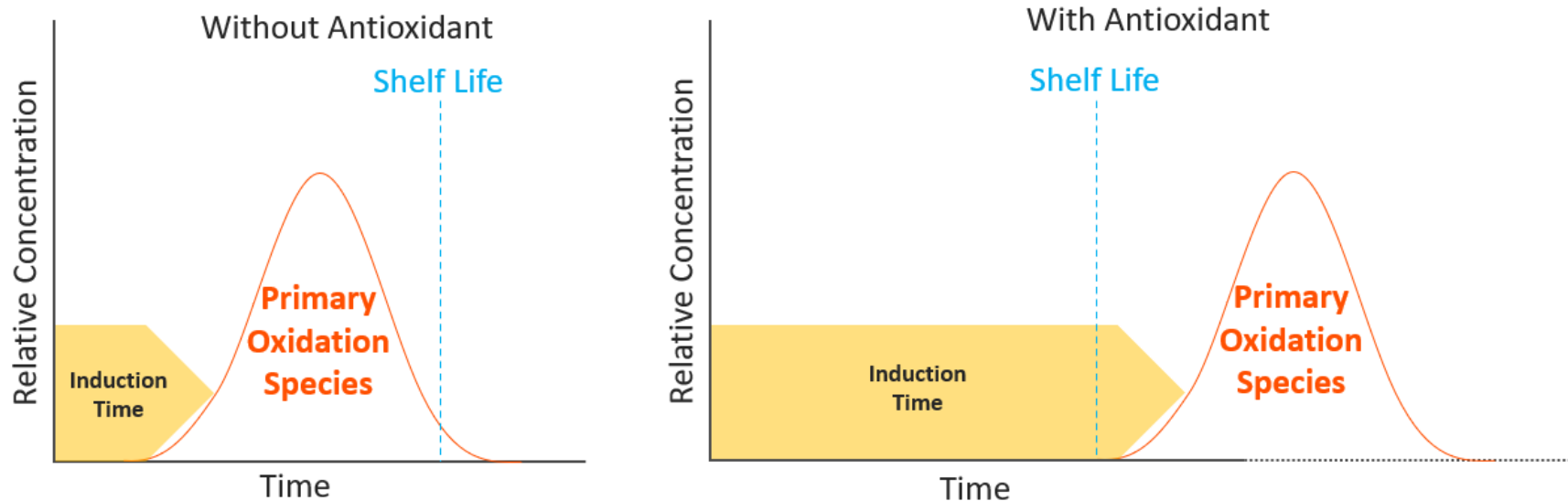
- Shelf-life study in white pan bread
- Treatments:
 - Negative Control (no preservative)
 - Positive Control (calcium propionate)
 - Test 1 – 1.4% Mold-X
 - Test 2 – 1.4% Mold-X + 0.3% 200 grain vinegar

	Negative Control	Positive Control	Test 1	Test 2
Bread pH	5.77	5.67	5.71	5.61
# Days without visible mold	6	17	13	22

3. Delaying Oxidation of Fats and Oils

Preservation of fats and oils in products during and throughout shelf life:

- Oxidation of fats/oils leads to rancidity.
- Important for **taste**, **texture**, and overall **consumer experience**.



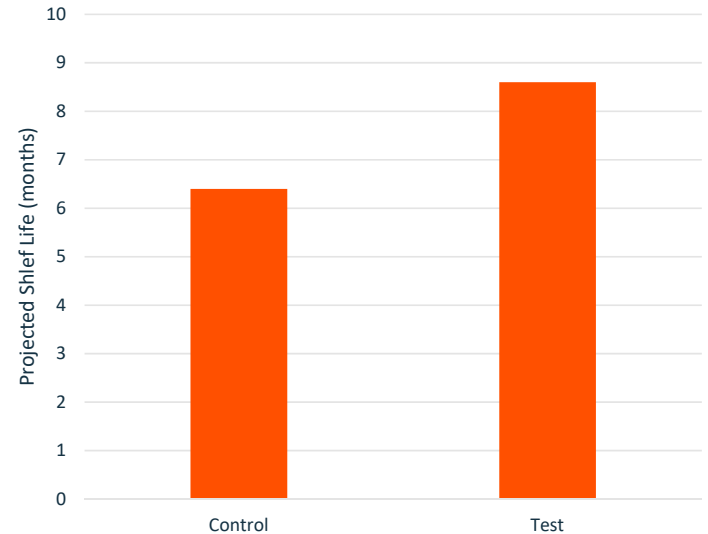
Dadex[®] Antioxidant Systems

- Antioxidant Systems: multi-component for synergistic effects
- Applications
 - Products with topical oil spray (crackers and snacks)
 - Baked goods with high levels of seeds or grains (bread, crackers, bars)

Case Study: Dadex[®] systems in Crackers

- Treatments:
 - Control= Canola Oil
 - Test= Canola oil dosed with Dadex AR-HS at 0.3%
- Measured projected shelf life using accelerated oxygen bomb testing

Shelf Life Comparison of Crackers made with Canola Oil vs Canola Oil Dosed with Antioxidant





Improving Processing Efficiencies

Dough conditioners to improve process time

Type of dough conditioner	Function	Benefits	Examples
Dough Relaxers	Reducing agents that function to relax the dough	Reduce mix time Prevent shrinkage to reduce waste Improve handling of dough	<ul style="list-style-type: none">• L-cysteine• Inactive yeast• Protease enzyme
Proofing Accelerators	Ingredients that increase yeast activity	Increased gas production and reduced proof time	<ul style="list-style-type: none">• Minerals for yeast food (phosphate, calcium, magnesium)• Amylase enzyme (converts starch to sugar for the yeast)

Packaging Solutions

- Pre-blending of micro ingredients
 - Complete mix: pre-blend of all dry ingredients, just adds liquids
 - Concentrate or Base: blend of functional micro-ingredients
- Customized pack size & weights
 - Totes (1100 lb)
 - Cartons or Valve bags (22 – 50 lb)
 - Pouches or sachets (1 oz to 4.4 lb)
- Benefits:
 - Consolidated supply chain
 - More efficient scaling
 - More accurate scaling of micro ingredients
 - Prevent production losses





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Incremental Packaging Blends
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Thank You!

Questions?



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