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Premature Mold Spoilage in Tortilla

Conventional and Clean Label Formula Challenges

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Dr. Srivastava is the Business Development Manager for Bakery Technical Services at Kerry Ingredients, collaborating with baking industry clients on emulsifiers, enzymes, preservation, taste, health, and clean label ingredients. Previously, she led Anya Baking Lab until May 2024, offering consulting and education in bakery innovation and formulation. Her background includes roles at Kemin, GC Ingredients, and Dabur Research Foundation in product development. She holds a PhD and MS in Food Science from the University of Georgia and an MS in Food Technology from GBP University, India.

On this session

- **Fixated on Freshness**
- **Understanding Mold**
- **Tortilla Types**
- **Preservation Technology**
- **Case Studies**

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FIXATED ON FRESHNESS

This is Sustainable Nutrition

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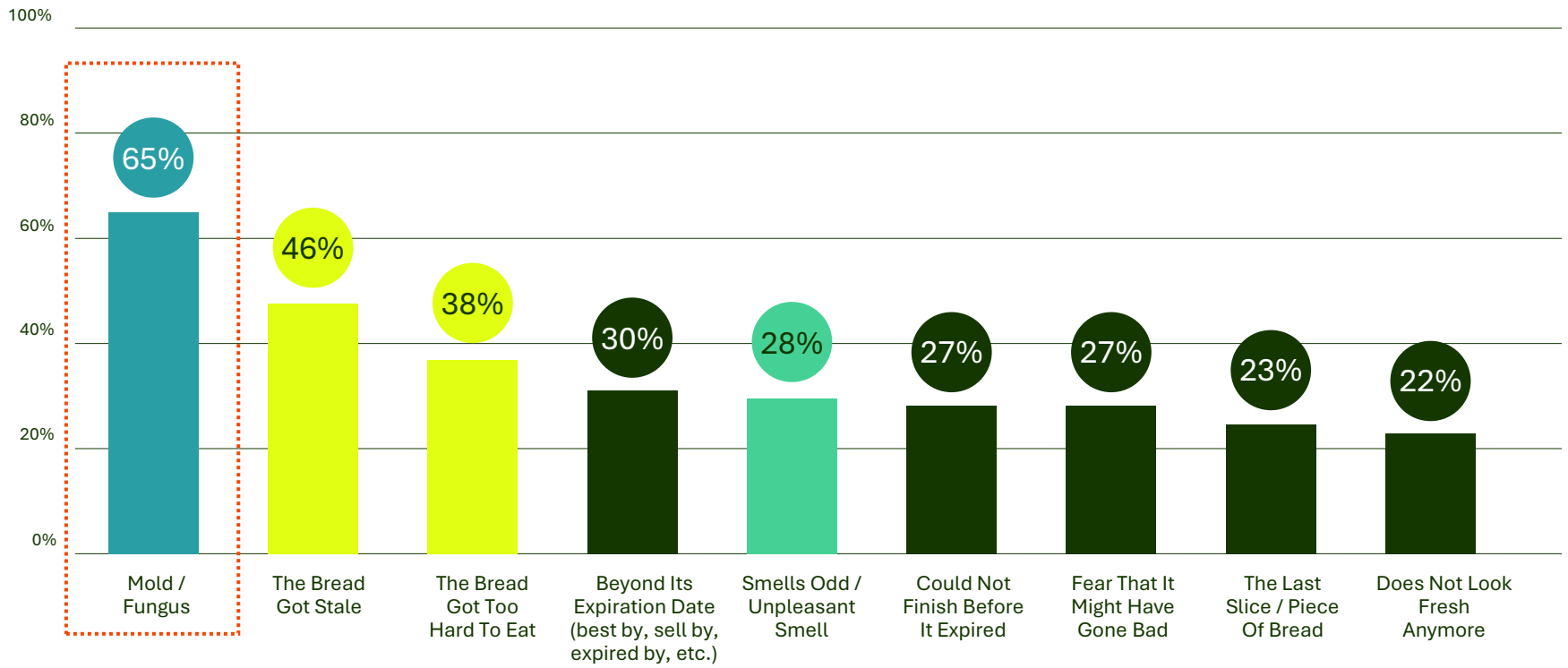
CONSUMERS HATE TO WASTE.

The top reasons for waste can be solved through shelf-life extension

MOLD FREE | TEXTURE | TASTE



TOP TIP:
Extending shelf-life or shrinking pack size can help reduce bread waste

32%

of consumers find themselves regularly having to throw away bread

Source: Kerry Proprietary Consumer Research – Left on the shelf 2023

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UNDERSTANDING MOLD

Types & Characteristics

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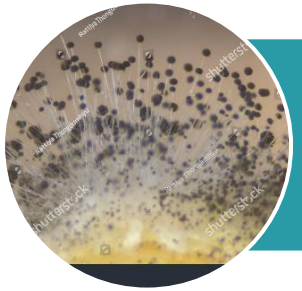
Mold Biodiversity

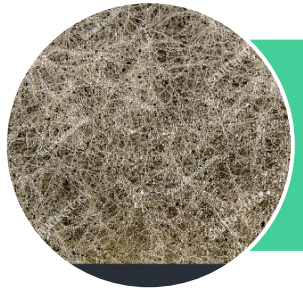
Aspergillus
Black, yellow, green

Yeast Geotrichum
Creamy colonies
(Machine Index)



Rhizopus
"Black bread mold"
Rapid Decay

Neurospora
"Red bread mold"



Mucor
Rapid growth, cottony colonies

Bacterial
Bacillus subtilis
Rope formers

Baked goods are perfect heaven for the microbial community

- Excellent Nutrition Source
- Moisture Content = 30-50%
- pH = 4.8 -6.0
- a_w = 0.80-0.95

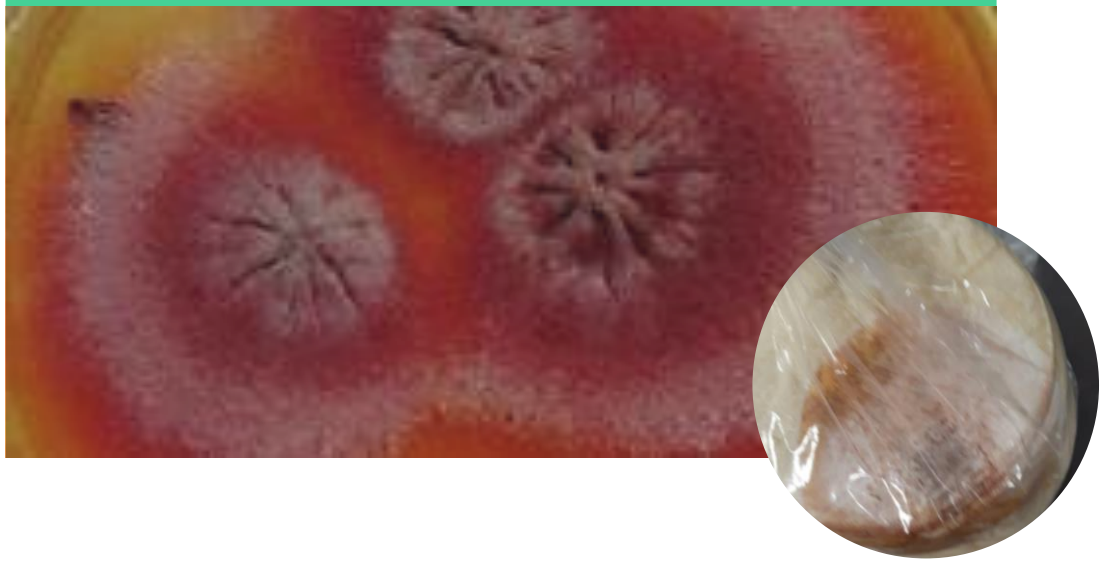
Mold Biodiversity

Penicillium

- Various colors, typically green
- A few species are PRM (Preservative resistant mold)

Heat Resistant Mold (HRM)

- Monascus spp: e.g., Monascusruber, M. pilosus



Potential Source of Mold

Quality/Storage

Incoming raw material
Packaging material

Processing

Equipment food build up
Packaging condensation

GMP

Cleaning/Sanitation, environmental conditions

Formulations

Antimicrobials, pH, a_w

Plant Environment and Processing Conditions

Baking

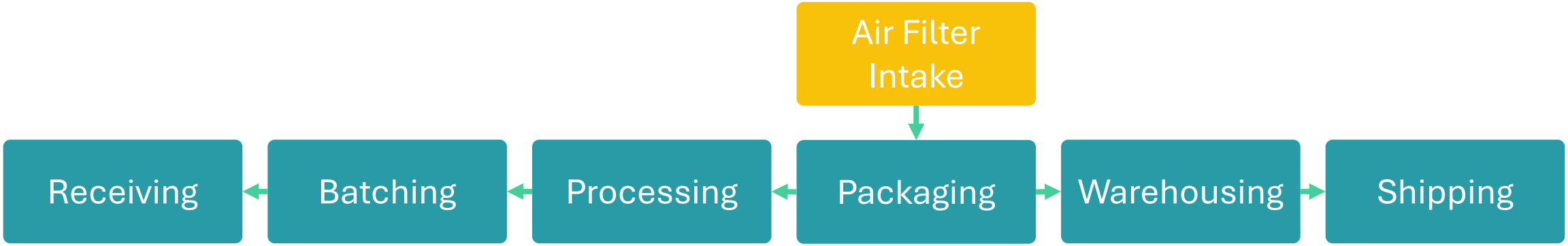
- HRM spores can survive baking temperature
- Contaminate food equipment surfaces
- Grow better in warmer months

Air Quality

- Create positive air pressure in plant
- Air condition the plant and keep doors & windows closed
- Limit Maintenance activity to down days

Cooling/Temperature gradient

- Condensation
- Surface wall ceilings, overhead piping
- *P. roqueforti* can grow in colder months



Hurdle Concept
Optimizing Tortilla

External hurdles

- Temperature
- Humidity
- Cleaning & Sanitation
- Plant conditions

Inactivate spoilage or pathogenic microorganisms

Internal hurdles

- pH
- Aw
- Sugar/Salt
- Antimicrobials
  Calcium Propionate
- Acidulants

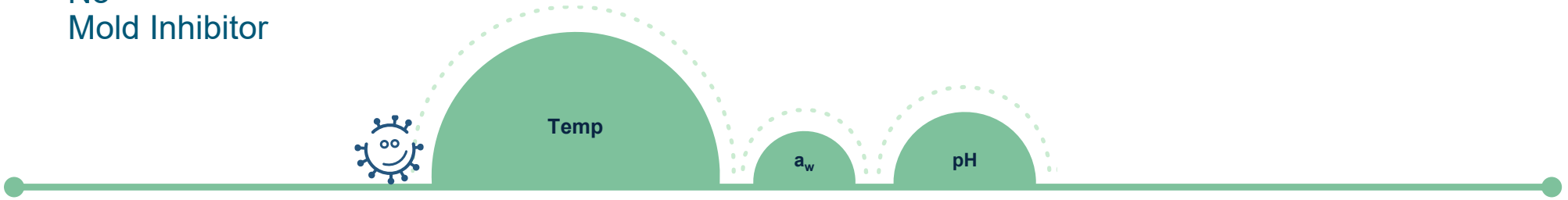
Inhibit sporulation and retard mold growth

Each hurdle adds stress to mold outgrowth

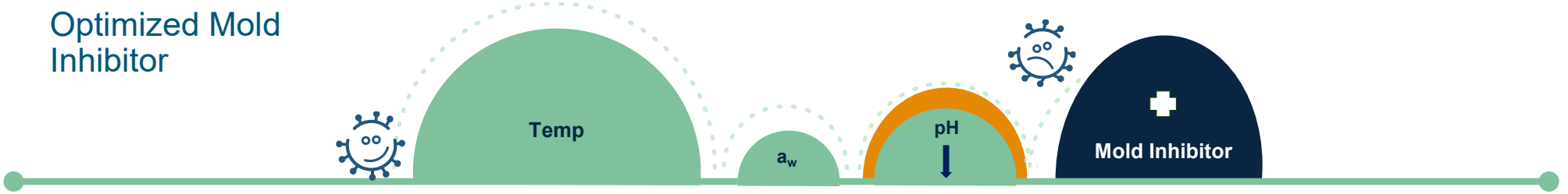
Lengthening lag phase of mold sporulation & increasing food protection

Leistner Hurdle Concept Demonstrating Additive Effect

No
Mold Inhibitor



Addition of
Optimized Mold
Inhibitor



Mold Free Shelf-Life & Three Common Terminologies

1

MOLD INHIBITOR
(CONVENTIONAL& CLEAN LABEL)

Mold Inhibitors/Antimicrobial: Substances that Inhibit the growth of Microorganisms

Calcium Propionate
Fermented Flour

2

ACIDULANTS
(CONVENTIONAL& CLEAN LABEL)
WATER ACTIVITY

Acidulants: pH adjustors or acidity Regulators
Water Activity(a_W) : available water for microbial metabolism

Fumaric Acid
Malic Acid
Citric Acid

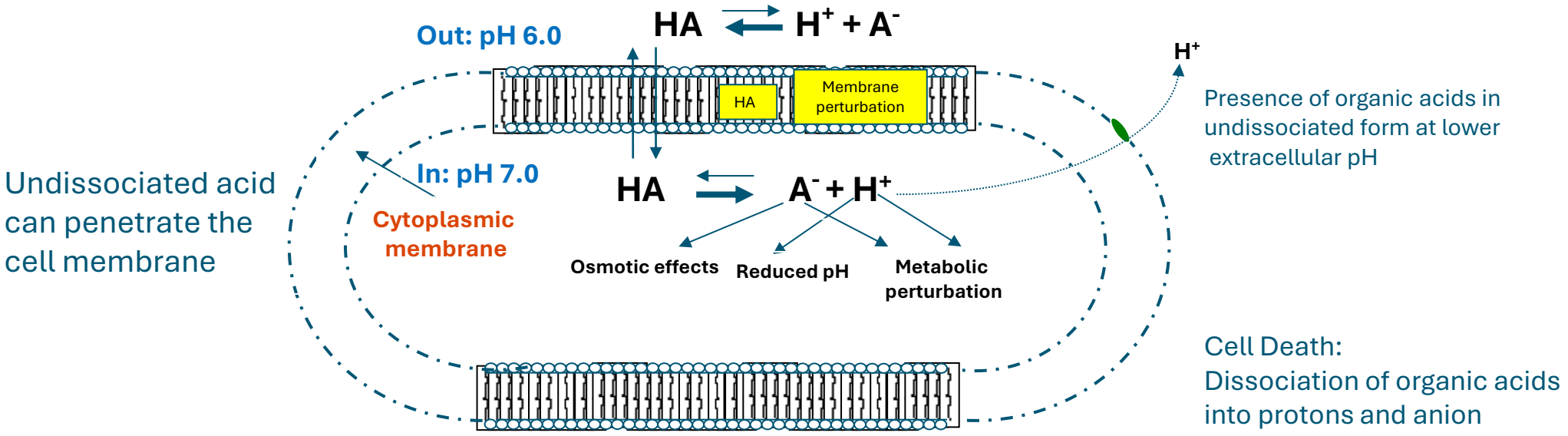
3

UNDISSOCIATED ACIDS

Undissociated acid: an intact acid
[$HA = H^+ + A^-$]

Mechanism of Microbial Action

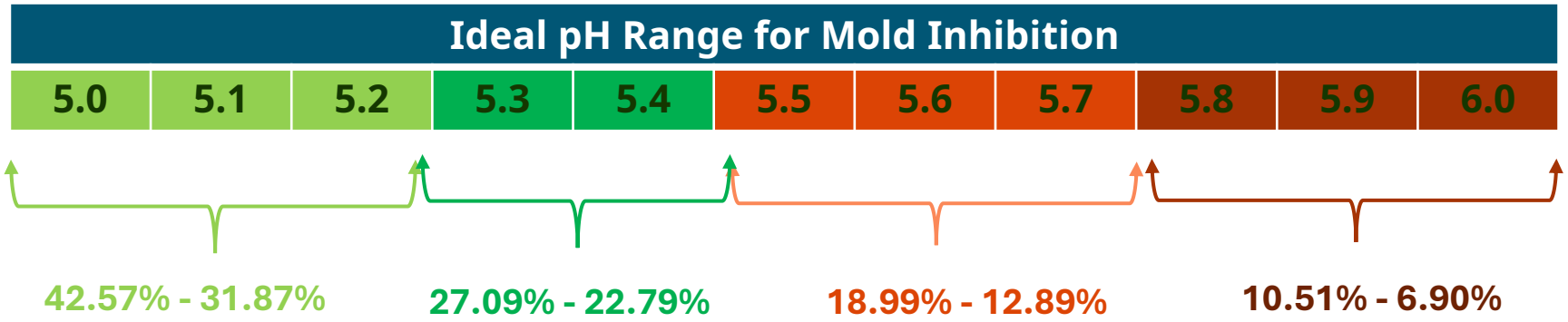
Mechanism of Antimicrobial Action



Undissociated acid can penetrate the cell membrane

Presence of organic acids in undissociated form at lower extracellular pH

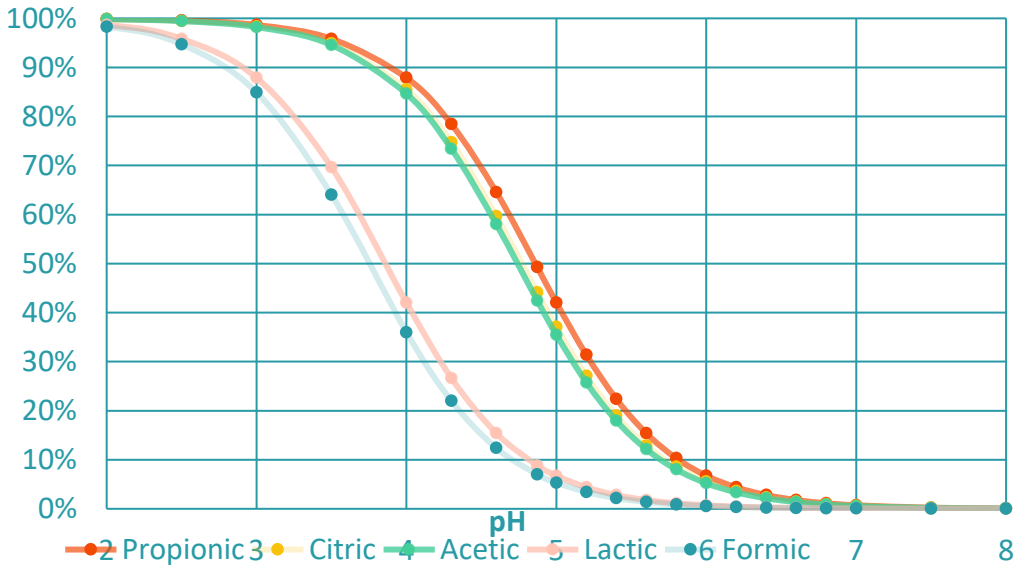
Cell Death:
Dissociation of organic acids into protons and anion



% of **Propionic Acid** added to product that is in its **Undissociated** (functional) form

Undissociated Acid at Various pH

Propionic Acid is most effective; has highest % undissociated acid at all pHs



% Propionic Acid	Finished Product pH							
	5.05	5.10	5.15	5.20	5.25	5.30	5.35	5.40
0.30	0.119	0.111	0.103	0.096	0.088	0.081	0.075	0.068
0.35	0.139	0.130	0.120	0.112	0.103	0.095	0.087	0.080
0.40	0.159	0.148	0.138	0.127	0.118	0.108	0.100	0.091
0.45	0.179	0.167	0.155	0.143	0.132	0.122	0.112	0.103
0.50	0.199	0.185	0.172	0.159	0.147	0.135	0.124	0.114
0.55	0.219	0.204	0.189	0.175	0.162	0.149	0.137	0.125

Example: Undissociated Target= 0.12 Propionic
Based on Inoculated Shelf-Life Studies or Production Calculations

Organic Acids	pKa	2.5	3.5	4.5	5.0	5.5	6.0	7.0
Propionic Acid	4.87	100.0	96.0	70.0	43.0	19.0	6.9	0.74
Sorbic Acid	4.76	99.0	95.0	65.0	37.0	15.0	5.4	0.57

Lower pH = More Undissociated acid

Formulation & Process Challenges

No premature mold is number 1 challenge!

Deliver high quality product performance over shelf life, while minimizing food waste.

MOLD FREE SHELF LIFE

Longer lasting, minimal waste

Optimization of preservative & acidulants (Regular & Encapsulated acidulant)

PROCESSING DRY OR LIQUID

No dust/easy dispersibility; employee friendly

Dry: Dust Free, Uniform distribution
Liquid: Non-Corrosive

TEXTURE FLAVOR

No off flavor, no bitter note, no effect on texture (Mainly clean label)

Multi-technology Approach

TORTILLA TYPES

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Tortilla Variants

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- **Corn Tortilla**
  - Table Corn Tortilla
  - Corn Chips
- **Wheat Flour Tortilla**
  - Translucent Style/Food Service Style
  - White, Thick, Gordita Style Tortilla

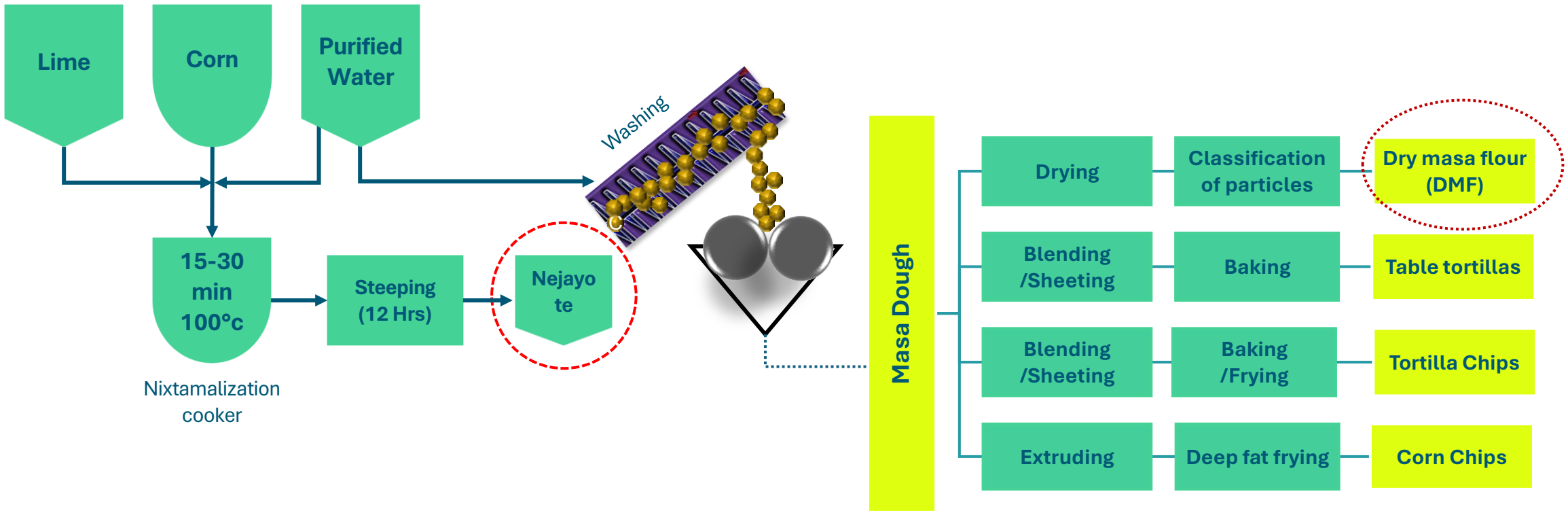
Tortilla Chips, Tostadas, Taco Shells





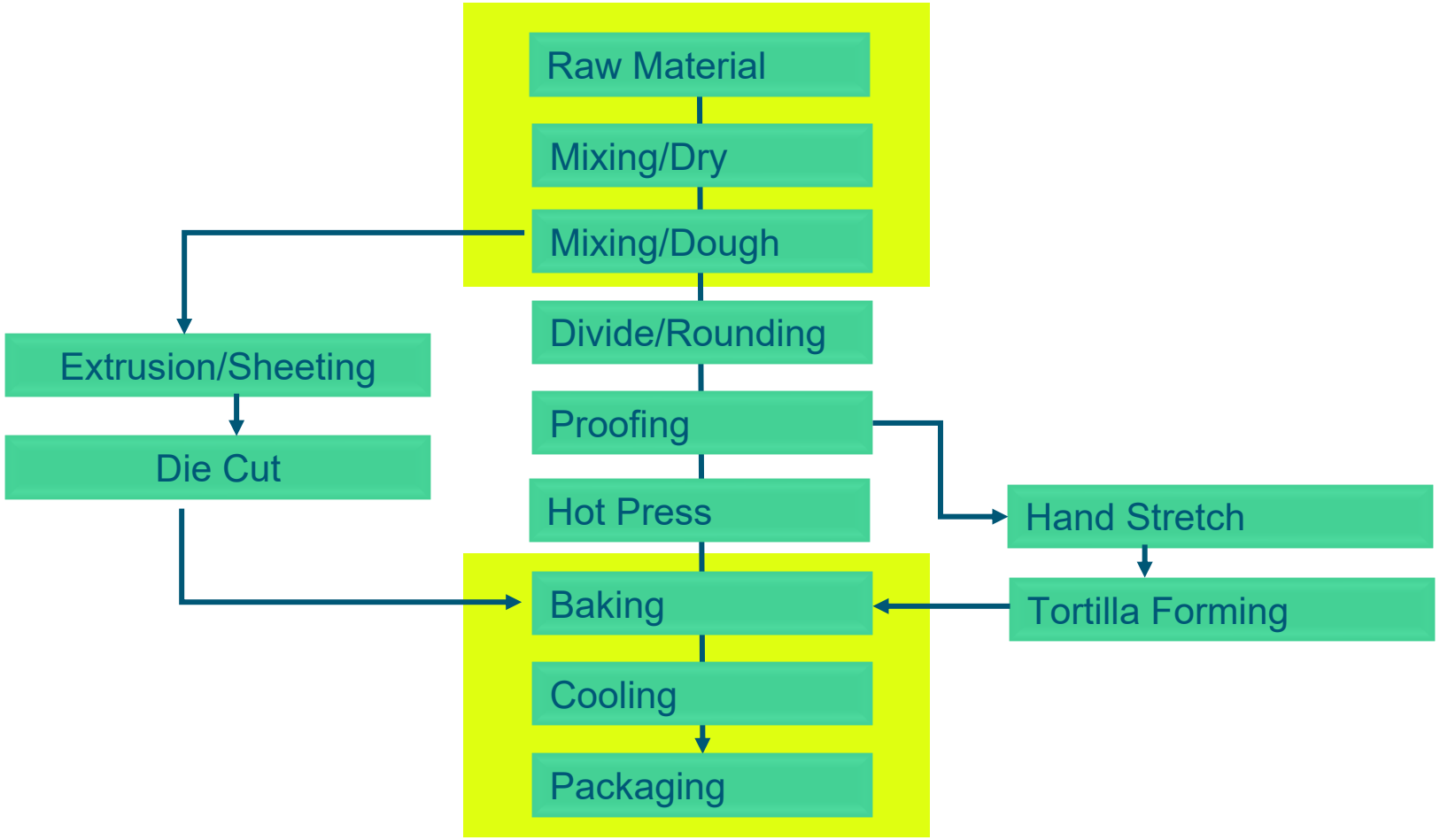
Corn Masa Nixtamalization

Liquid Preservative/Dry Preservative = Acceptable



Flour Tortilla
PFD

Dry Preservative = Acceptable
Encapsulated Acidulants are preferred



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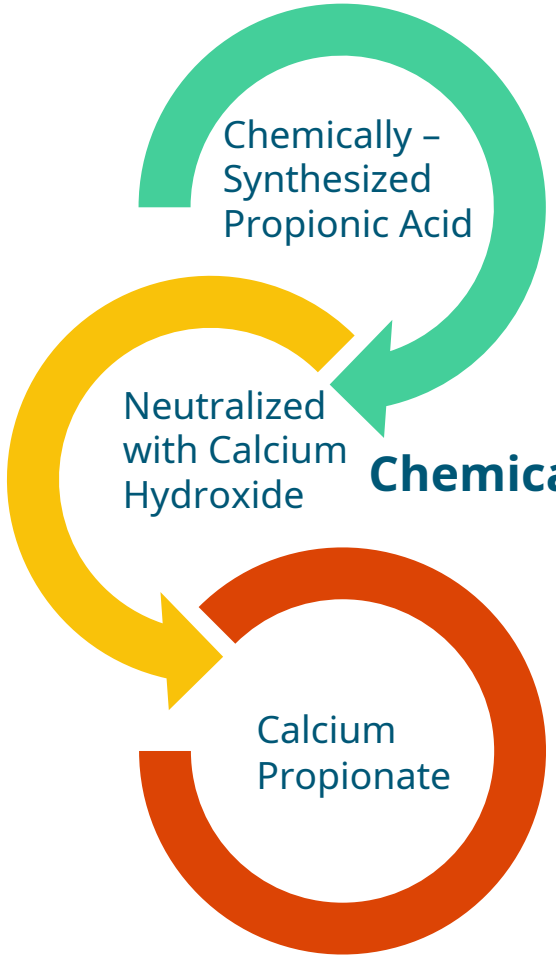
Preservation Technology

Probake™
Turning Synthesized Propionic Acid into Calcium Propionate



Chemical Reaction

Probake™

Labeled as “calcium propionate”

Probake™
Conventional Preservation for Bakery

Product	Label	Format	Use Rate	Advantages
Probake™ CP	**Calcium propionate** Produced in Europe & USA	**Granular & Powder** Dedusted for EU-Grade	**0.4-1.0%** on flour weight	Most widely used in bakery
Probake™ CP Crystal	**Calcium propionate** Produced in USA	**Crystal**	**0.4-1.0%** on flour weight	Low dust, crystal grade
Probake™ SP	**Sodium propionate** Produced in Europe & USA	**Granular Powder**	**0.4-2.0%** on flour weight	Better performance in chemical leavened bread

Standard Package
50 lb. bag

Product Format
Powder

Minimum Order Quantity
1 pallet
44,50 lb. Bags
2,200 lb.

Standard Package: 25 kg and 50 lb. bags with bulk sizes available for most SKUs.
Individual data sheets available upon request.
All Probake ®products meet FCC requirement.

Upgrade
Natural Clean Label Preservative

Turning food carbohydrate into natural organic acids by fermentation

- Carbohydrate (Feed)
- Fermentation
- Lactic Acids
- Propionic Acid & Acetic Acid
- **UPGRADE™**

GUARANTEED AUTHENTICITY
Kerry UPGRADE™ is authentic and derived from in-house fermentation. Backed by **C14 analyses** and documented plant audits

Not labeled as “calcium propionate” because includes propionic and acetic acids along with spent media, fermented flavors, pasteurized inactivated culture.

Upgrade™
The Natural Choice for Maintaining Quality and Freshness in Bakery Products

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Product	Label	Format	Use Rate	Advantages
Upgrade™ Pro W5	**Cultured wheat starch and wheat flour**	**Powder**	**0.4-2.0%** on flour weight	Higher strength
Upgrade™ WS	**Cultured wheat starch and wheat flour**	**Powder**	**0.4-2.0%** on flour weight	Wheat
Upgrade™ CS	**Cultured corn syrup solids** OR **Cultured dextrose and maltodextrin**	**Powder**	**0.4-2.0%** on flour weight	Allergen free
Upgrade™ BR	**Cultured brown rice** OR **Brown rice flour**	**Powder**	**0.4-2.0%** on flour weight	Gluten free
Upgrade™ Organic	**Cultured organic wheat starch and organic whole wheat flour**	**Powder**	**0.5-2.0%** on flour weight	Organic 95%

Standard Package
50 lb. bag

Product Format
Powder

Minimum Order Quantity
1 pallet
44,50 lb. Bags
2,200 lb.

CASE STUDIES

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Case Study 1

10” WHITE TORTILLA WRAP

Traditional Preservation

CUSTOMER CHALLENGE

- **Sporadic Mold Growth**
- **Translucent tortilla**
- **Fine dust of Calcium Propionate in the plant**

- 15-20% Reduction in sales
- Tortilla return due to mold
- Employee complaints
- Poor consumer experience

APPROACH

Reformulation : Multi technology Approach

- **Selection of Calcium Propionate with minimal dust**
- **Optimization of antimicrobial and acidulants**
- **Encapsulated Fumaric acid**
- **Identify the areas for high mold/spores count in the plant- Environmental Study**

IMPACT

- Tortilla freshness life :60days
- Probake™ demonstrated highly effective mold control with minimal dust
- Myvatex Supreme NS™ supported provided ant sticking properties in tortilla
- Biobake™ Fresh FBT to reduce the rate of retrogradation / staling for fresh-keeping during storage
- Encapsulated fumaric acid, helped to remove the translucency

MULTI TECH SOLUTION

Preservation

- Probake ™

Emulsifiers

- Myvatex Supreme NS

Enzymes

- Biobake™ Fresh FBT

Environmental Study

Map out the fungal biodiversity within the production site

→

Identify critical control points for those contaminants

To pinpoint the exact issue

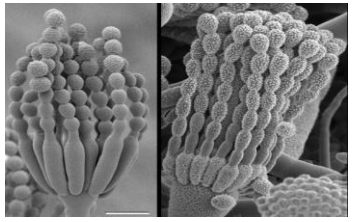
→

Sampling procedures will be conducted in different high-risk areas within the bakery:

Cooling lines
Packaging lines
Fans
Slicers
Surfaces throughout packaging and cooling lines

Environmental Sampling Methods

- Air Sampling
- Surface Sampling
- Preservative-free Baseline Assessment
- Raw Material Assessment



Goal: Aid the bakery in the risk assessment and help the customer better understand and limit product contamination.

Case Study 2

8” TORTILLA

Clean Label Preservation

CUSTOMER CHALLENGE

- **Premature Mold Growth**
- **Dry Texture**
- **Off /Bitter Taste**

- Poor eating experience with dry/hard texture and Bitter Taste
- 15-20% market return due to premature mold

APPROACH

Reformulation : Multi technology Approach

Selection of clean label preservation technologies with modified taste profile.
Softness enzyme for **performance and softness over shelf life**
Dough relaxing enzymes to improve mixing efficiency by reducing the mixing time

IMPACT

- Tortilla freshness life : 30 days
- Upgrade™ ProW5 demonstrated highly effective mold control with clean taste profile
- Biobake™ Fresh FBT to reduce the rate of retrogradation / staling for fresh-keeping during storage
- Biobake™ BPN helped to reduce mixing time by ~25%

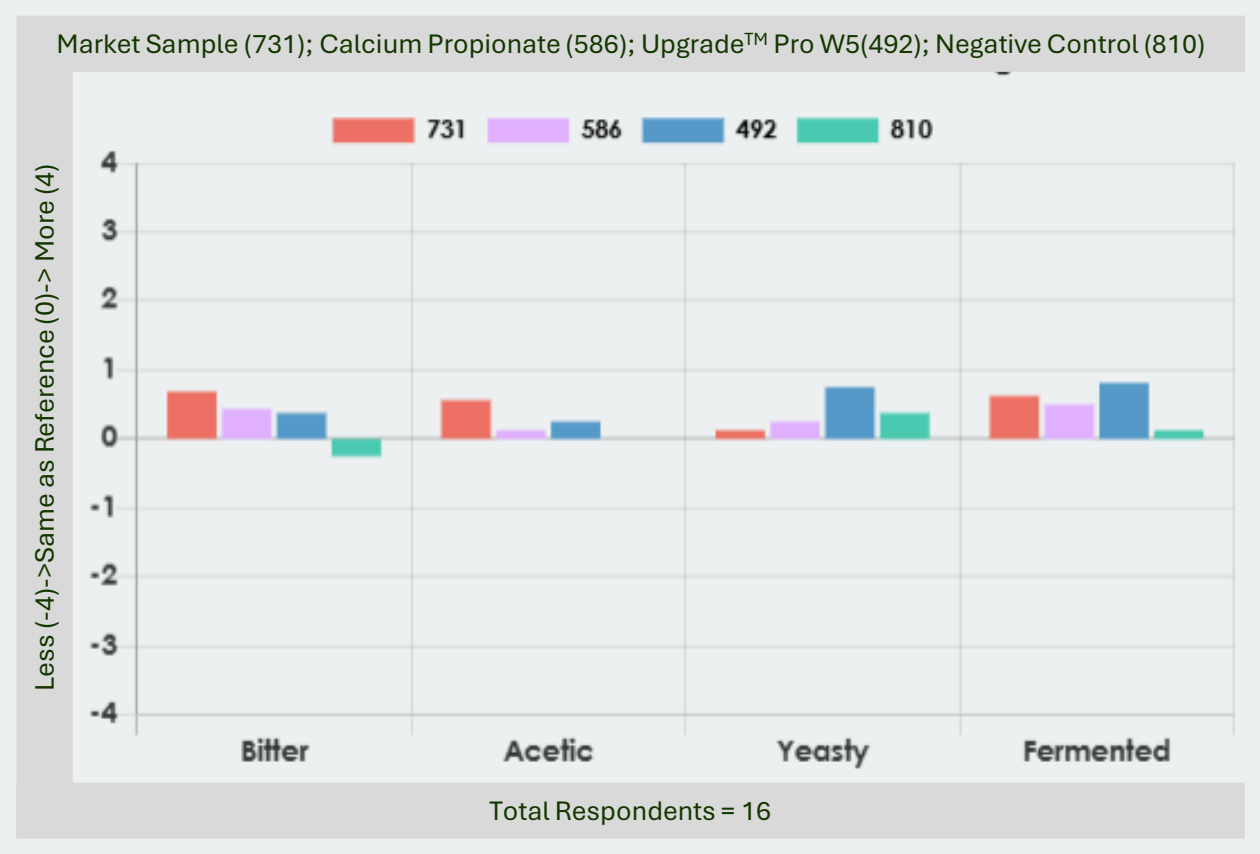
MULTI TECH SOLUTION

Preservation
- Upgrade™ Pro W5

Enzymes
- Biobake™ Fresh FBT
- Biobake™ BPN

Clean Label Preservative Taste Profile

8” Tortilla with Upgrade ProW5



Premature Mold Spoilage in Tortilla

Conventional and Clean Label Formula Challenges

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Key Takeaways:

Mold free tortilla success come with optimization of preservatives and acidulants

Challenges: Premature Mold, Dough Rheology, Texture, Taste

Reformulation driven by three core pillars: Mold-Free Preservation, Texture, and Taste.”

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THANK YOU

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