FLOUR TORTILLA CHARACTERISTICS & MICRO INGREDIENT FUNCTIONALITY WITH CURRENT TREND USAGE

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KEMIN INDUSTRIES, INC.

Approximately **2,800 employees** worldwide

Manufacturing plants located in **15 countries**

Business operations in more than **90 countries**

More than **$900M** annual revenue

More than **500 patents** and applications

Founded in 1961 by R.W. & Mary Nelson

Independently owned by the Nelson family

AGENDA

- *Tortilla Characteristics*
- *Tortilla Ingredients*
- *Minor Ingredients*
- *Special Ingredients*
- *Trends*
- *Kemin Differentiation*

HISTORY OF TORTILLAS

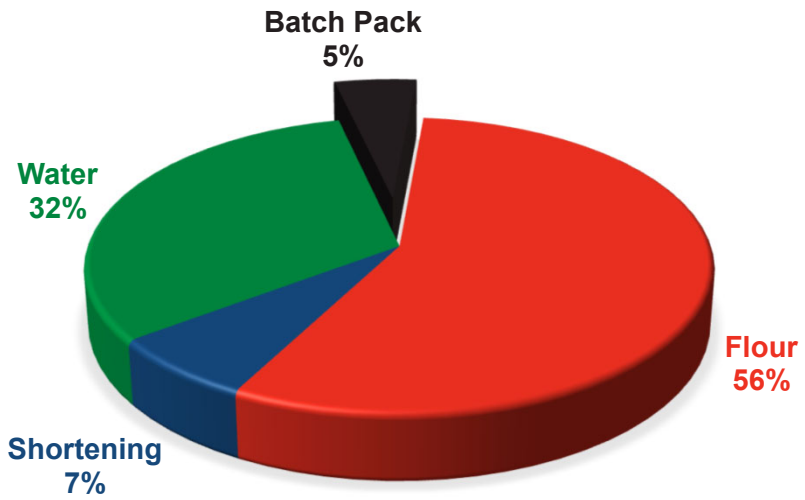
- The Tortilla word comes from the Spanish word “Torta” meaning round cake-like
- History of Corn Tortilla goes back to 10,000 BC
- Spaniards brought wheat to the new world in 1519, creating wheat tortillas
- The Tortilla is type of flat bread
- Some other examples of flat bread are:
  - Khubz
  - Lavash
  - Pita
  - Roti
  - Naan
  - Parantha

TORTILLA CHARACTERISTICS

- Uniform round shape with evenly distributed blisters
- White with opacity or translucence
- Uniform edges with soft texture
- Excellent rollability and stretchability
- Good foldability
- Resistance to cracking or breaking
- No zippering; no sticking
- Optimal shelf-life (NO MOLD)

BASIC INGREDIENTS

Basic Ingredients: Flour, Shortening, Water, & *Minor Ingredients*



WHEAT FLOUR: A MAJOR INGREDIENT

Wheat Flour Components and Functionality

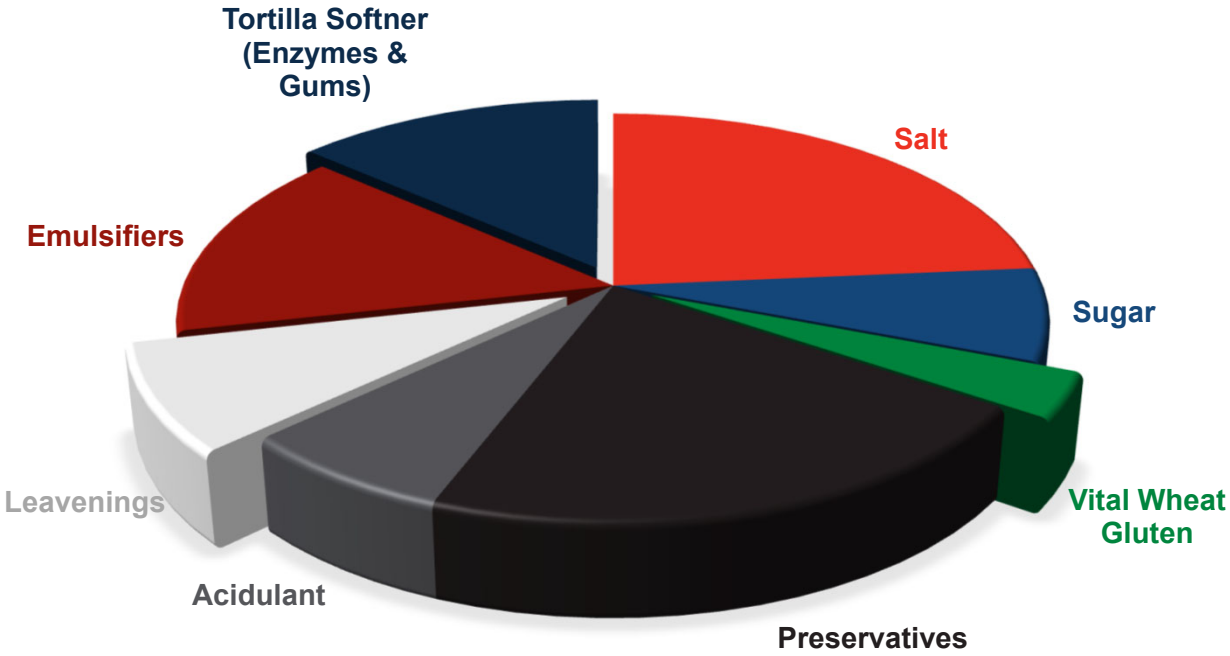
Components	Approx	Functionality
Starch	65-70%	Helps in water binding, provide texture and color
Gluten	7-16%	Gluten network, gas holding, extensibility
Arabinoxylans	1-3%	Water binding, texture

MINOR INGREDIENTS: BATCH PACK

Minor Ingredients <5.0 %: complex blend of:

- Leavening system
- Preservative system
- Emulsifiers
- Dough Softeners
- Dough Strengtheners
- Tortilla Softeners

MINOR INGREDIENTS: BATCH PACK



MINOR INGREDIENTS: BATCH PACK

Salt

- Taste modifier
- Salt strengthens and toughens the gluten network
- Reduces the stickiness of the dough
- Reduces the water activity of the product, increasing shelf life

Sugar

- Taste modifier
- Provides moistness to tortilla
- Toast points

MINOR INGREDIENTS: BATCH PACK

Leavenings: made with leavening base and leavening acids

Leavening base:

- Sodium bicarbonate, generate CO_2
- Finer particles will dissolve faster than larger particles
- Based on Tortilla characteristics, CO_2 release is controlled.
- Sometimes formula also involves encapsulation of sodium bicarbonate to release CO_2 at baking stage

Reference: Heidolph, 1996; Brose and Becker, 2001

MINOR INGREDIENTS: BATCH PACK

Leavening Acids:

- SALP, SAPP, SAS

Leavening acid reacts under three conditions

1. Dough Stage: (SAPP)
2. Time delayed: (SAPP)
3. Temperature activated (SAS & SALP)

Neutralizing Value (NV)

- NV is the measure of available acidity in leavening acids. The value is used to determine the amount of acid or acids required to produce neutral pH.

SAPP: Sodium Acid Pyrophosphate, SAS: Sodium Aluminum Sulfate, SALP: Sodium Aluminum Phosphate

Reference: Heidolph, 1996; Brose and Becker, 2001

MINOR INGREDIENTS: PRESERVATIVES & ACIDULANTS

Preservatives	Salts	Effective pH	Effective on microbes
Propionic Acid	Calcium Propionate/Sodium Propionate	pH< 5.5	Yeast, Mold
Sorbic Acid	Potassium Sorbate	pH<6.5	Yeast, Mold
Benzoic Acid	Sodium Benzoate	*pH<4.5*	Yeast, Mold, Bacteria
Parabens	*Methyl Paraben/Propyl Paraben*	*pH: 4-8*	Yeast, Mold, Bacteria

Reference: Smith et al, 2004

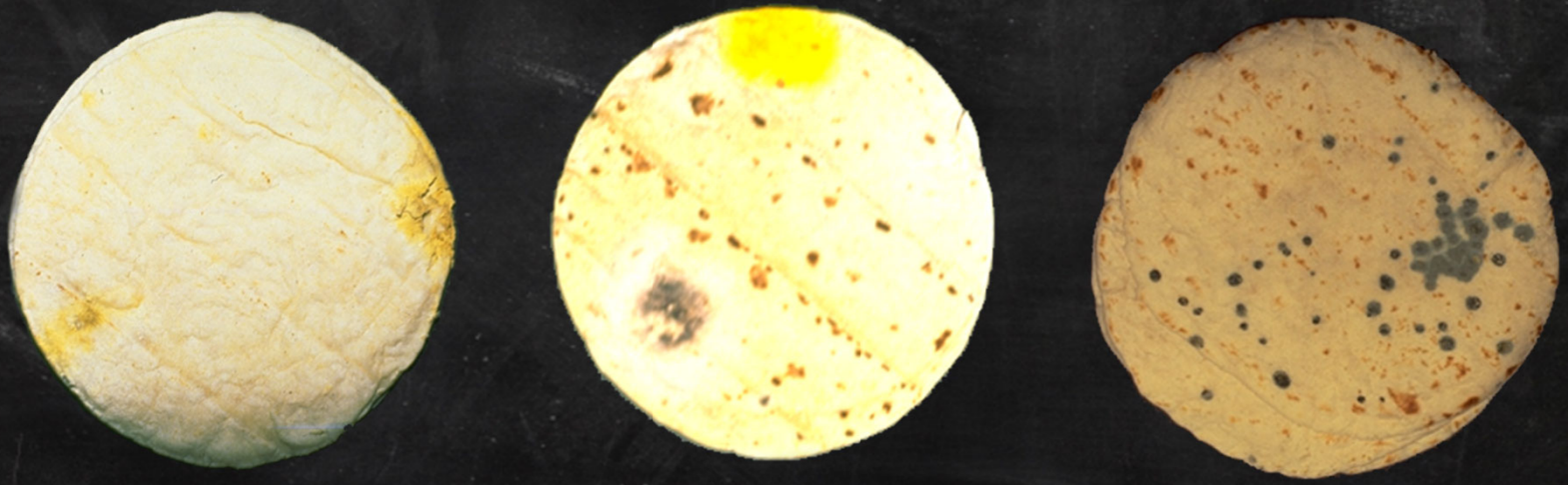
TYPES OF MICROBIAL SPOILAGE

Mold
Most Common

Yeast
Chalky Spots

Bacteria
Precedes Mold Growth (A_w above 0.86)

MINOR INGREDIENTS: TYPICAL MICROBIAL SPOILAGE



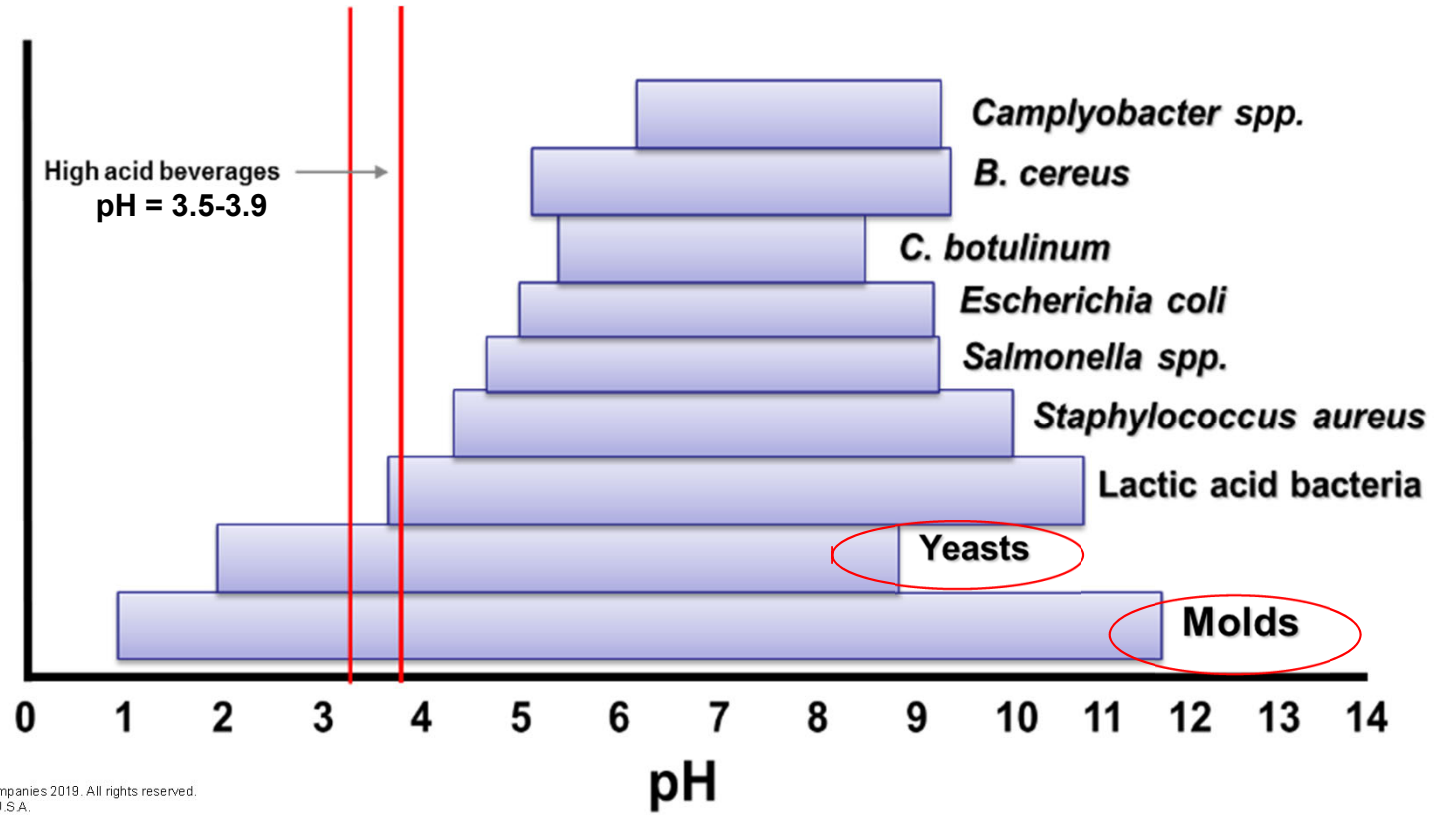
Aspergillus ***Rhizopus*** ***Penicillium***

MINOR INGREDIENTS: BATCH PACK

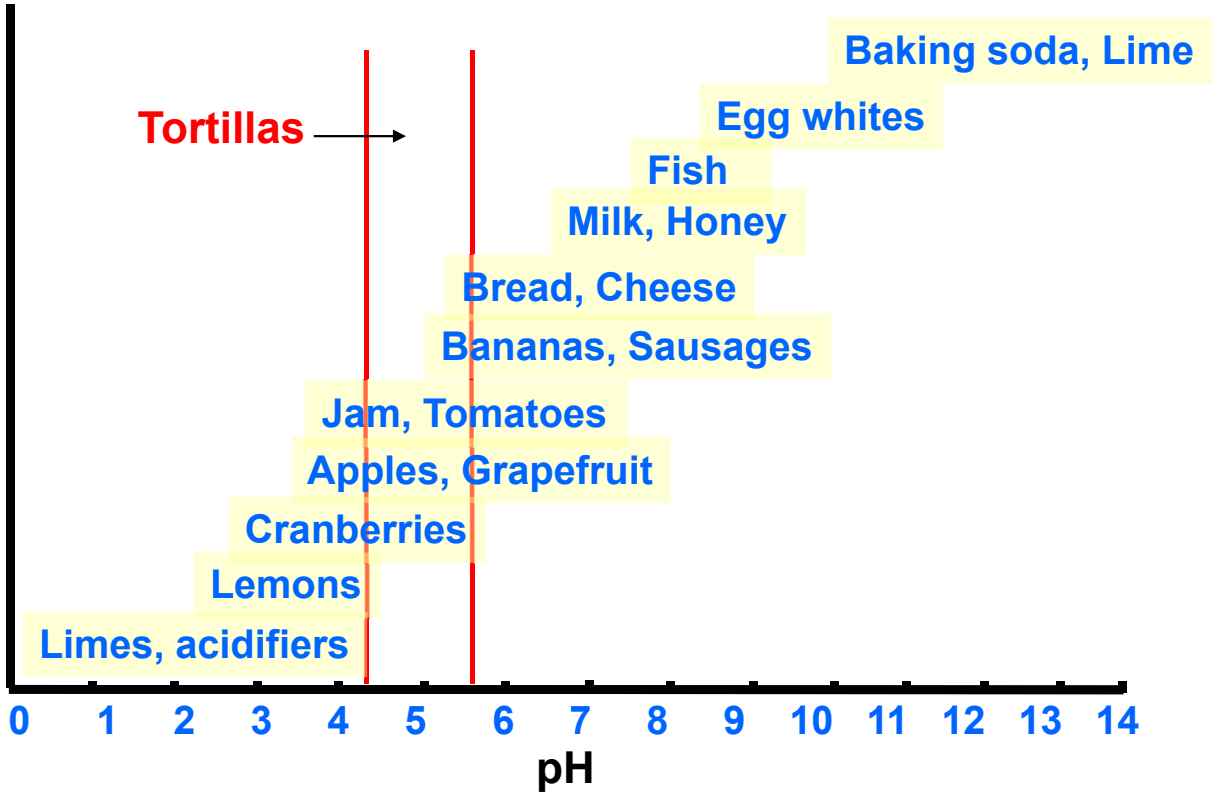
Preservatives/Acidulants – pH control

- pH control is critical for antimicrobial agents to function effectively
- Fumaric acid is the pH modifier most commonly used
- Fast dissolving acids (e.g. citric acid, malic acid) will interfere with baking action
- In White Tortilla: CO_2 gets released at hot press/baking stage
  - CO_2 should be retained for tortilla to be opaque and puffy
  - Thus the need to use fumaric acid

PH REQUIREMENTS FOR FOOD MICROBES



PH OF SELECTED FOODS



MINOR INGREDIENTS: BATCH PACK

Emulsifiers

- Primarily used to improve dough softness and extensibility, uniform outside edge
- Emulsifiers are complex molecules with water and fat soluble end
- DATEM/SSL improves machinability by interacting with gluten and starch
- Mono-Diglycerides complexes with amylose reduce stickiness and staling

SSL: Sodium Stearoyl-2- Lactylate,
DATEM: Diacetyl Tartaric Acid Ester of Mono- and Diglyceride

Reference: Serna-Saldivar, et al, 1988

MINOR INGREDIENTS: BATCH PACK

Hydrocolloids

- Improve shelf-life by retaining more moisture
- Increase water absorption of dough
- Make it more stable for overmixing.
- Improve gluten development
- Most commonly used gums: Guargum, Carboxymethyl cellulose, Xanthan Gum, etc

Reference: Friend et al 1993

MINOR INGREDIENTS: BATCH PACK

Dough Conditioners

- Reducing agents
  - Weaken the gluten matrix
  - Reduce dough elasticity
  - Reduce mixing time
  - e.g., L Cysteine, Sodium metabisulfite, enzymes, yeast
- Oxidizing agents:
  - Strengthen the gluten structure hold the CO_2
  - e.g., ascorbic acid, enzymes

Reference: Serna-Saldivar, et al, 1988

SPECIAL INGREDIENTS: ENZYMES

Enzyme Type	Function in Tortilla
Amylases	Modification of gelatinized starch to prevent or delay crystallization
Oxidases	Modification of gluten protein to improve gluten strength
Proteases	Modification of gluten to prevent strong gluten network; improves machinability
Pentosanases (Xylanses)	Breakdown polysaccharides to release water and generate structures that bind more water
Lipases	Modification of fat to generate emulsifier like structure

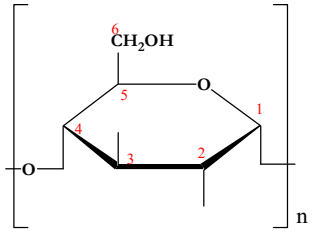
Reference: Miguel et al, 2013

SPECIAL INGREDIENTS: WHEAT FLOUR

Wheat flour contains 65-70% starch

Starch has two components:

1. Amylose-linear glucose polymer (20-25%)
2. Amylopectin: Branched glucose polymer (75-80%)

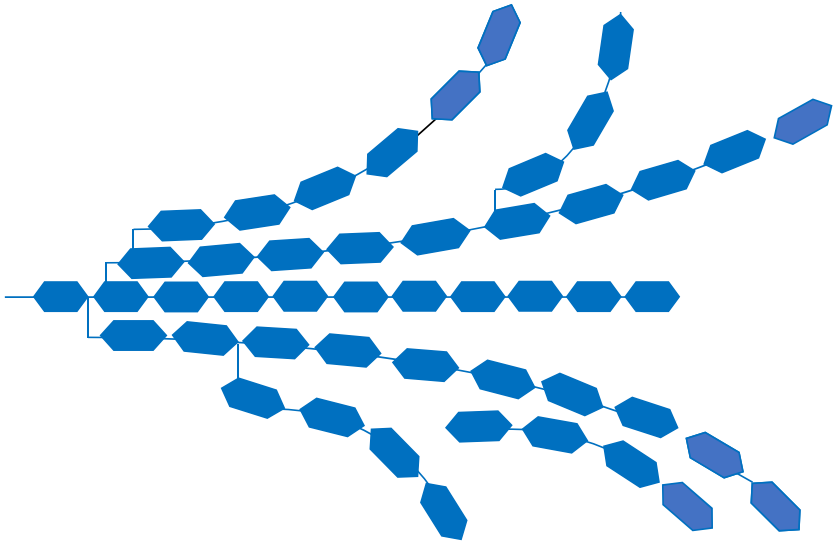


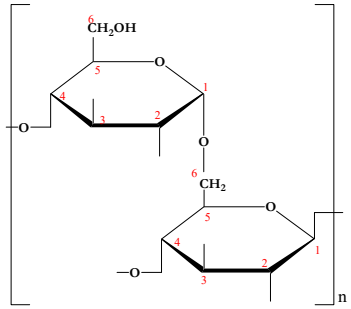
Amylose: α-linked glucose units (Glucan) α, 1→4 linkage

Reference: Buelon et al, 1998

SPECIAL INGREDIENTS: WHEAT FLOUR

Amylopectin: Branched glucose polymer





Amylopectin: α, 1→4 and α, 1→6 linked glucose units (Glucan)

Reference: Buelon et al, 1998

SPECIAL INGREDIENTS

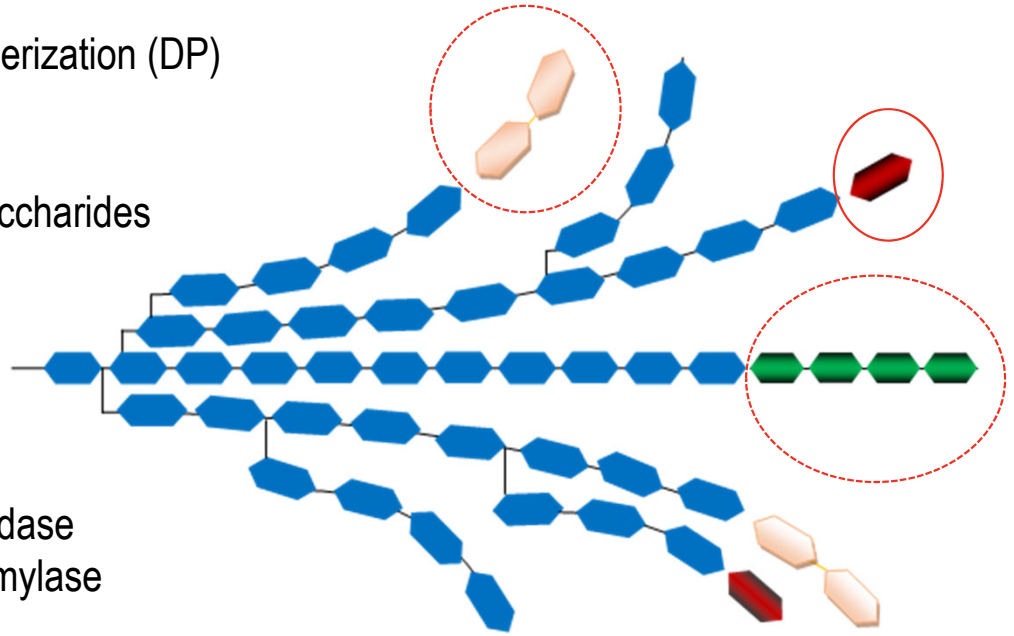
Starch Water Interaction During Mixing

- Gelatinization: In the presence of water and heat starch absorb water and swells up; loses its crystalline structure, viscosity increases
- Retrogradation: After gelatinization starch tend to regain its crystalline structure
- Staling of tortilla: Loss of freshness of tortilla due to retrogradation, tortilla become harder and loses its foldability

SPECIAL INGREDIENTS

Activity of various amylase

Degree of Polymerization (DP)
DP1: Glucose
DP2: Maltose
DP3-12: Oligosaccharides



- α-amylase
- Amyloglucosidase
- Maltogenic amylase

Reference: Oart, M. V., 2010

Tortilla Trends

- Clean Label/ Familiar Label
- Low Carb or Reduced Carb
- Low Sodium
- Freeze-Thaw Style
- Gluten Free
- High Vegetable Protein

All variants are either Burrito style or Gordita Style

TORTILLA VARIANTS

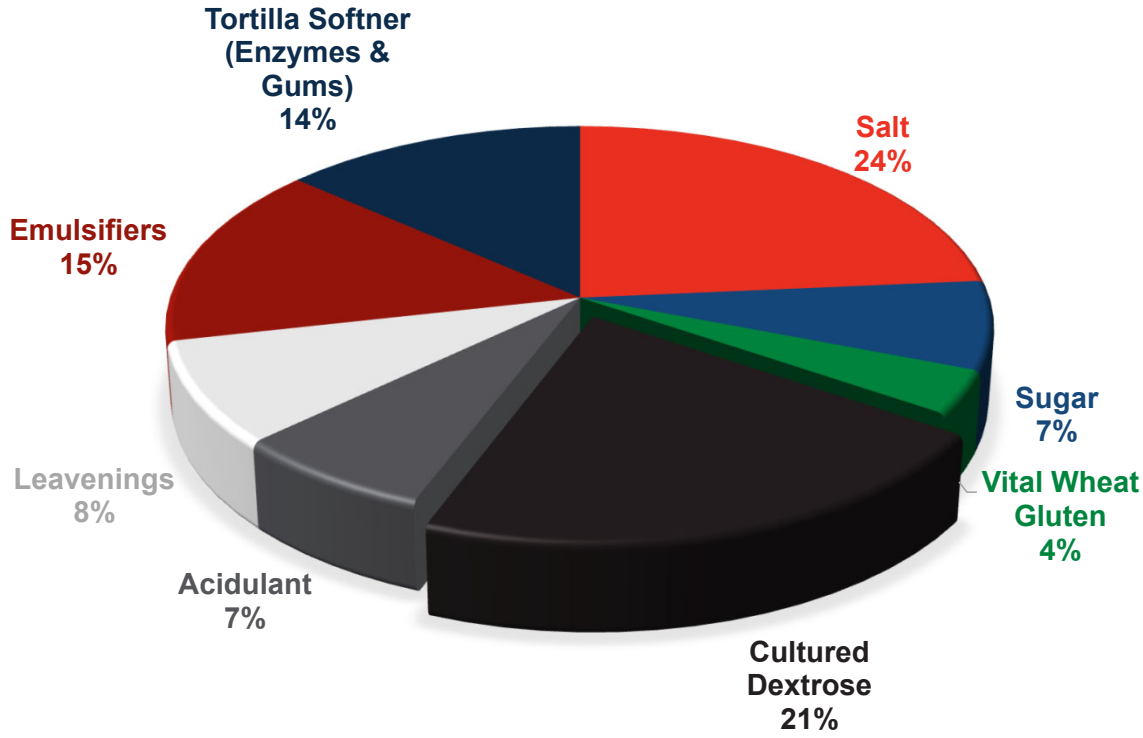
Translucent: Foodservice/Burrito Style

- Flexible, stretchy
- With and without gluten
- Low priced
- Not much variation in formula form customer to customer
- Mostly used for Burritos

White and Puffy: Gordita/Casera Style

- Thick and puffy
- Toast points vary form brown to black
- High in leavening content, puffy
- Customers are very picky in this variant, specific toast points, puffiness, thickness, etc.
- High priced
- Very customer specific
- Mostly used as table tortilla, fajita, tacos, Quesadilla

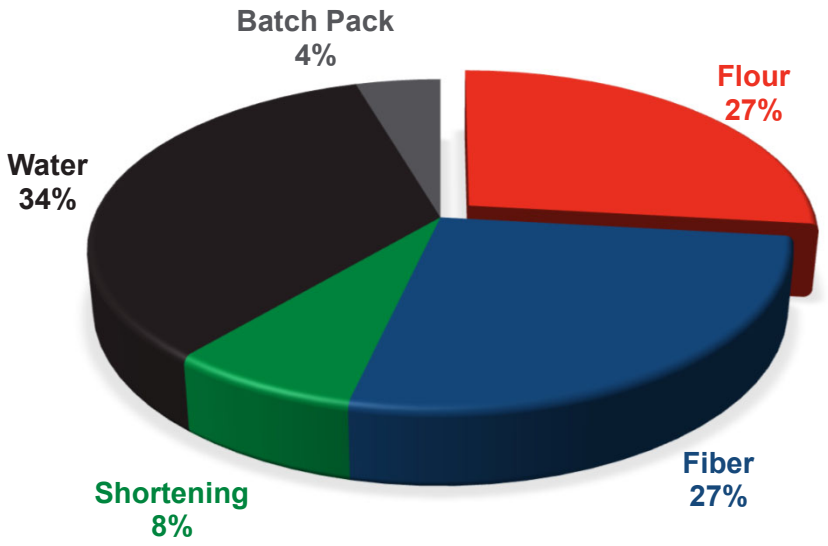
TORTILLA TRENDS: CLEAN LABEL



TORTILLA TRENDS: LOW CARB / HIGH FIBER

- Wheat Flour will be replaced by fibers & Gluten
- Water absorption will increase

TORTILLA: HIGH FIBER INGREDIENTS

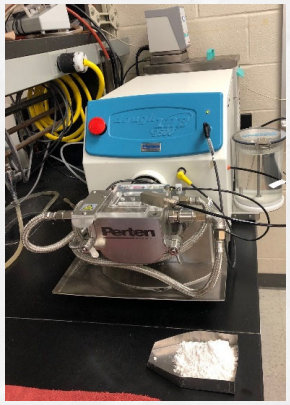


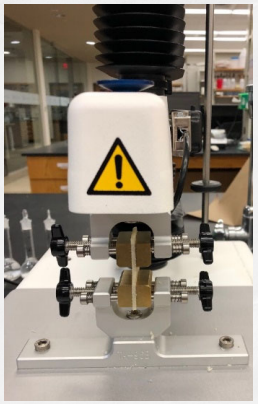
MINOR INGREDIENTS: BATCH PACK

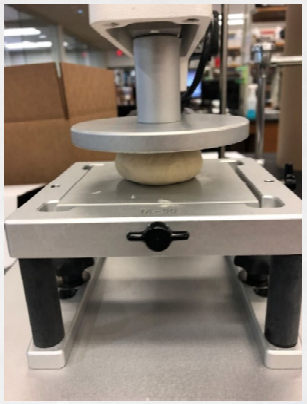
- Increased demand of tortilla variants
- Increased complexity of ingredients/innovation
- Update with functionality and regulatory status
- Strong technical support
- Reduced cost (inventory and labor)
- Tortilla manufacturer has to focus on productivity, line efficiency and evolve with market trend in finished product tortilla.

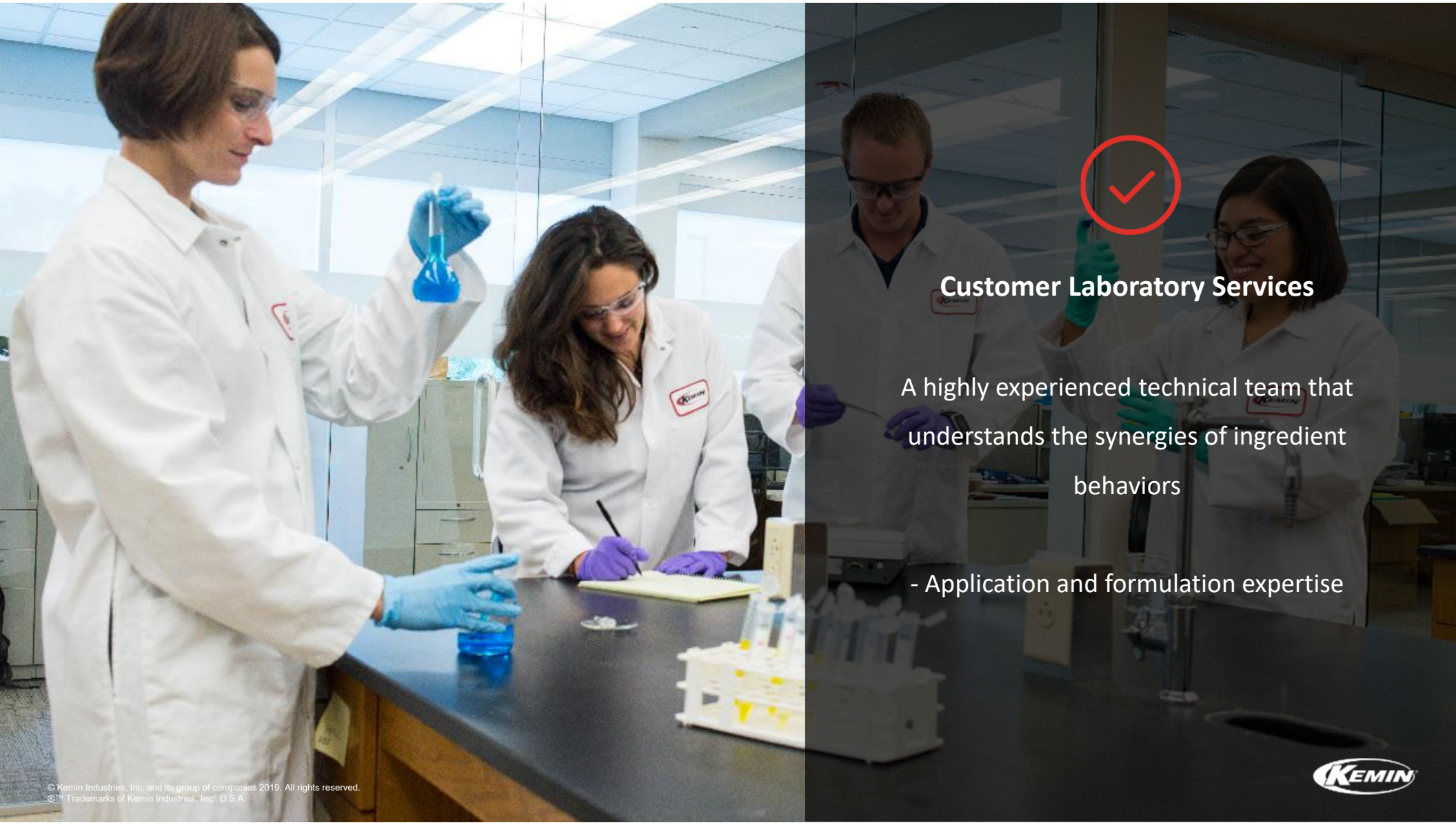
TORTILLAS: KEMIN DIFFERENTIATION

- Ingredient evaluation (e.g. flour, shortening)
- Consistency in product, every batch is analyzed for actives using advanced instrumentation









Customer Laboratory Services

A highly experienced technical team that understands the synergies of ingredient behaviors

- Application and formulation expertise

SHIELD® BAKERY PRESERVATIVE

Actives	Shield Product	Handling
Propionate / parabens	SHIELD CT	Buffered
Propionic / phosphoric/ parabens	SHIELD NXT	Corrosive
Propionate / benzoate	SHIELD CT B	Buffered
Propionic/ phosphoric	SHIELD T	Corrosive
Propionate / sorbate	SHIELD FL	Buffered
Propionate	SHIELD NCD/NA/CA	Buffered

Product Application Department

We offer application technology, expertise and services to maximize our product value

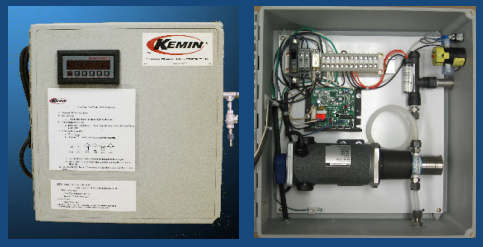
- Dry & liquid product applicators
- Monitoring services
- Application workshops

APPLICATION EQUIPMENT

- Automatically injects preservative into water line – ideal dispersion & effectiveness
- Controlled by impulse from water meter or grinder motor
- Accurate: +/- 1%
- Fail-Safe: Flow sensors, empty drum indicators, check valves
- Totalizer allows enumeration of how much added over time – quality and inventory measurement or remote printout

Central Application System

Batch Applicator



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