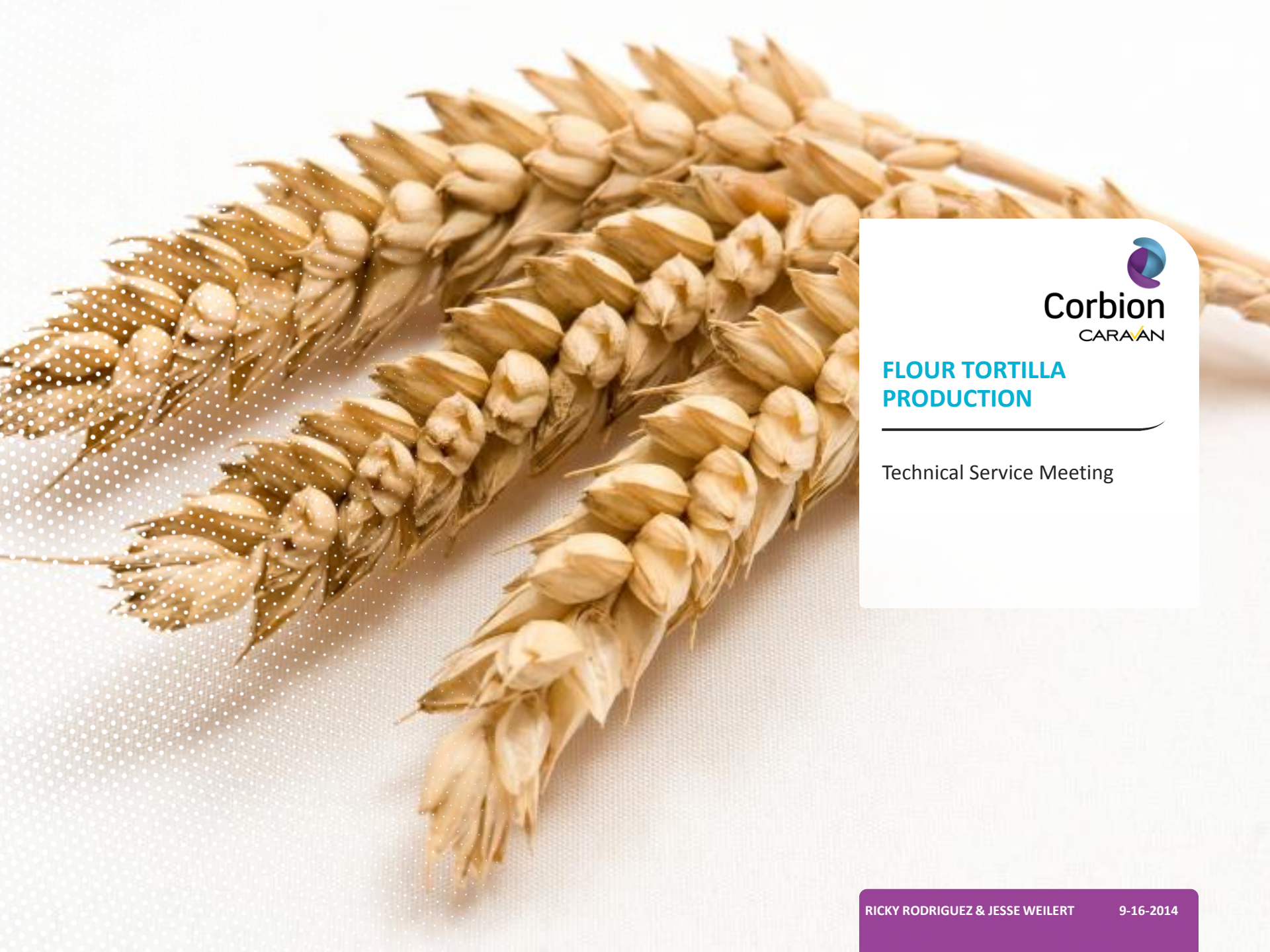


Corbion
CARAVAN

FLOUR TORTILLA PRODUCTION

Technical Service Meeting

RICKY RODRIGUEZ & JESSE WEILERT 9-16-2014

Contents

- Tortilla History and Facts
- Consumer Expectations
- Ingredients and Formulation
- Industry Challenges
- Caravan Tortilla Products
- Tortilla Processing
- Troubleshooting
- Sensory
- Corn Tortilla Basics
- Glossary:
  - Flour Tortilla Terminology

A little bit of Tortilla History…

- **According to Mayan legend, tortillas were invented by a peasant for his hungry king in ancient times.**
- **10,000 BC, the first tortillas were made from the dried kernel of native corn.**
  - **"Masa"** means dough in Spanish.
- **3000 BC, people of the Sierra Madre mountains in Mexico hybridized wild grasses to produce the large nutritious kernels we know as modern corn.**
- **1542, the Spaniards introduced the planting of wheat in America.**
- **US/Mexico border was settled by conversos (people of Jewish descent from Spain and Portugal) during the colonial period.**
  - They first came up with the **flour tortilla**.
- **1849, The flour tortilla appears in the northern states of Mexico and Texas in a dish made from flour tortillas filled with meat. The burrito is born.**
  - In Spanish it means **"little donkey"**.
- **1983, self-service shops in the country begin selling flour tortillas. They also arrive in Europe. Being first commercialized in England.**
- **1993, China starts manufacturing the Mexican flour tortilla.**

… and some little known facts

- Tortillas got their name from the Spaniards. In Spain "torta" means “round cake”, so tortilla literally means “little tort” in Spanish.
- In Spain and the Spanish speaking Caribbean, “tortilla” often refers to an open-faced omelet.
- NASA used flour tortillas on the space shuttle. The humble tortilla defeated one of the greatest eating threats in space stations: food crumbs floating around and affecting sensitive instruments.
- Tortillas are not just for eating. There is a type of art that is called "tortilla art“ that uses tortillas as the canvas. The tortillas are baked, covered with acrylic and then painted. Tortilla art is made to represent the culture of Latino artists.

La Virgen de Guadalupe
René Yanez

The Great Tortilla Conspiracy 01
René Yanez

Consumer Expectations

Consumer Expectations

- Flavor
- Softness
- Color
- Toast Points
- Opacity
- Strength
- No Breaks
- No Mold
- Nutrition
- No Sticking

Tortilla Ingredients

Ingredients & Formulation

- **Wheat Flour**
- **Water**
- **Salt**
- **Fat**
- **Leavening (Chemical)**
- **pH Control & Mold Inhibitors**
- **Dough Conditioners**
  - Reducing Agents, Emulsifiers, Gums,…
- **Extras**
  - Sugar, Enzymes,…

Bakers Percent

- When all the ingredients in a formulation are based as a % of the weight of flour.
- Used to calculate and compare formulations.
- Weight of flour always equals 100%.

$$Bakers\,\% = \frac{Ingredient\,Weight}{Flour\,Weight} * 100$$

Example:

$$\frac{8\,pounds\,salt}{400\,pounds\,flour} * 100 = 2\%\ \text{based on Flour}$$

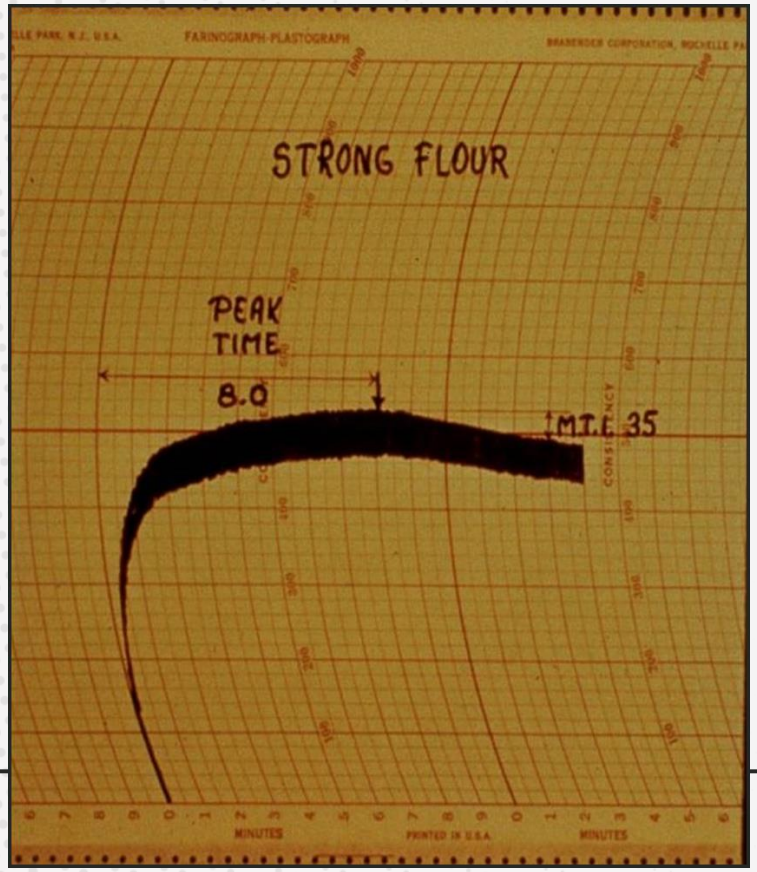
Flour

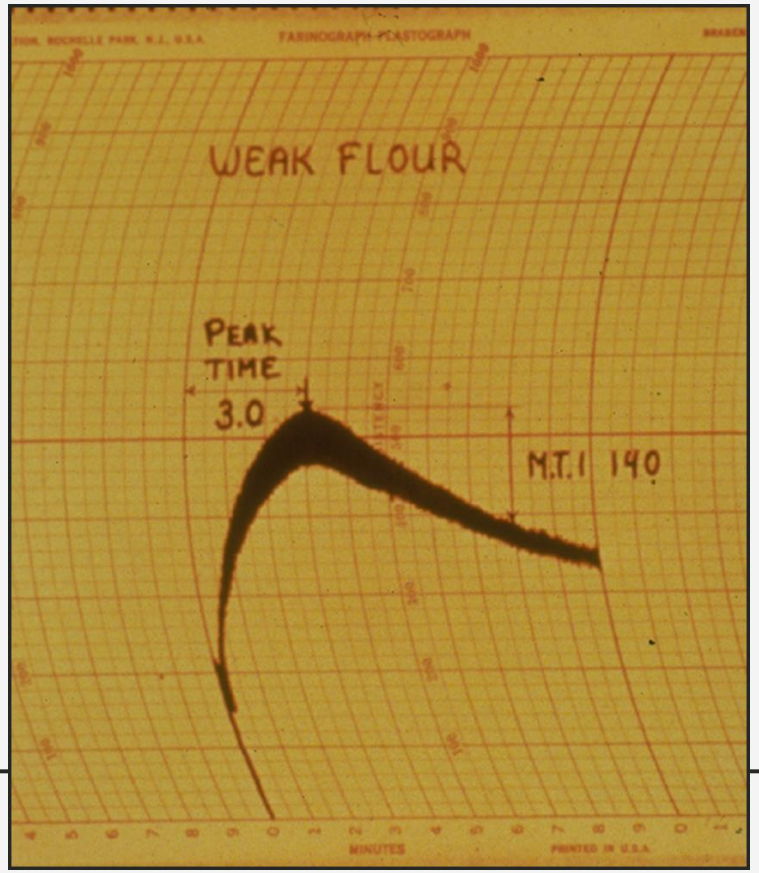
Most Common Flour Used for Hot Press Tortillas:

- **Bread-type Flours**
  - Hard Wheat Flours of moderate protein.
  - Protein typically **10.5 – 11.5%**
  - Ash typically 0.45 – 0.52
  - Abs 60-64%
  - Malt, enrichment, and bleach (benzoyl peroxide) are also options used in flour for tortillas.
  - MTI of 30 – 40 desirable

MTI = Mixing Tolerance Index

- Measured on a Farinograph
- Indicates how fast a flour will breakdown after it has reached full development.
- Low MTI indicates a strong flour
- High MTI indicates a weak flour





Water

- **Second most predominate ingredient (after flour).**
  - **45 – 55%** based on flour.
- **Main function is hydration. Is the key that unlocks the power of minor ingredients.**
- **Functions to help control temperature.**
  - Warmer Doughs: **80-90ºF**
- **Absorption impacts:**
  - Mixing, Make-up, Baking, and Shelf-life.

Water

- **Over Absorption:**
  - **Sticky dough, poor processing, irregular shapes (flowers), pillowing, sticking, mold,…**
- **Under Absorption:**
  - **Poor scaling, poor processing, irregular shapes, poor shelf-life quality,…**

Salt

- **1.7 – 2.0% in typical tortilla formulas**
- **Primary purpose**
  - Flavor
  - Also: Toughens gluten, strengthening internal cells and improving gas retention.
- **Sodium in Tortillas – NaCl + Leavening (+ Verdad)**
- **Delayed salt method sometimes used to reduce mixing time and aid dough temperature control.**
- **High levels of salt can cause excessive pullback/shrinkage by strengthening the protein.**

Fat

- **Typically All Purpose or Emulsified Shortening (more opaque).**
  - **5 – 7%** based on flour in low fat tortillas.
  - **8 – 15%** based on flour in regular tortillas.
- **Primary purpose**
  - Lubrication
    - Dough – Eases processing and handling
    - Tortilla – Improves shelf-life, softness, pliability, flavor…
- **Oil also becoming more popular with TFF movement.**
  - Liquid oil can increase translucency and sticking…

Leavening

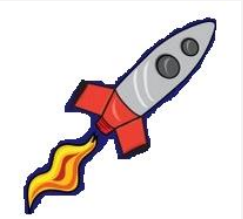
- Biological, Mechanical, Water, and... **Chemical**

- Key is to formulate leavening to occur at proper time
  - Press and Oven
- Premature reaction results in translucent tortillas and is a waste of **$**.
- Proper leavening imparts
  - Opacity
  - Tenderness
  - Flavor
  - Texture / Volume
  - Impacts Toast Points / Color

Chemical Leavening

AKA: Baking Powder

- **1-3% in Tortillas**



THE ROCKET SCIENCE

Base + Acid Salt (water/heat) = $CO_{2\ gas}$ + Residual Salts + Water

- Gas = Bubbles
- Trapped Bubbles = Desired Effect…

“Base” - Bicarbonate

Type:

- Sodium ($NaHCO_3$), Potassium, Ammonium
- **Function:**
  - Provides Carbon Dioxide
  - Different Grades

“Base” - Bicarbonate

Grades:

- Type 1 Powder, TFF
- Type 2 Fine Granular
- Type 4
- Type 5

Leavening – Neutralizing Value

- The amount of **base** that will be **neutralized** (fully gassed) by the **acid.**

$$NV = \frac{Pounds\ Bicarbonate}{Pounds\ Acid} \times 100$$

- **Larger NV = Less acid** to get the same gas out of an equal amount of soda.
- Tortillas typically designed with a **balanced system**.

Leavening - Acids

Acid "Drives" the Function

- Most Common Leavening Acids:
  - MCP / AMCP (NV = 80/83)
  - SAPP (10, 28, 40,…) (NV = 72)
  - SALP (NV = 100)
  - SAS (NV = 104)
  - Others: CAPP (55-69), DCP (33), Encap,…

Leavening - Acids

Selection based on:

- Finished Product Characteristics
- Desired Rate of Reaction
  - Product / Process
- Regulations
- Health
- $
- Other Ingredients,….

Sugar / Sweeteners

- **Sucrose (Granulated), Syrups, Dextrose, …**
- **Not always used in tortillas.**
  - 0 – 2% based on Flour.
- **Primary purpose:**
  - Flavor
  - Color - Toast Points (if reducing sugars)
  - Shelf-life
- **Can increase risk of tortilla stickiness.**

Dairy

- **1.0 – 2.0% in formulations.**
- **Not always used in tortillas – allergen.**
- **Main functions:**
  - Color (protein & lactose) = Toast Points
  - Nutrition
  - Flavor
  - Buffering

Dough Conditioners

Reducing Agents

- Sulfites
  - Usage: 0 – 45ppm
- L-Cysteine
  - Usage: 0 – 75ppm (90ppm max)
- Inactive Yeast
- Protease
  - Variable due to concentration.
  - Can be risky to use due to activity.
    - **Caravan Arco Pro Relaxer**

Dough Conditioners

Emulsifiers

- Mono and Diglycerides
  - Improves crumb softness / shelf-life
  - Hydrated
    - **GMS 90 SS**
    - Usage: Up to 2%
    - ZTF
  - Dispersible
    - **BFP 800 / Starplex 90**
    - Usage: Up to 1%

Dough Conditioners

- Calcium Stearoyl-2-Lactylate (CSL / **Verv**)
- Sodium Stearoyl Lactylate (SSL / **Emplex**)
  - Improves machinability and shelf-life. Also reduce tortilla "edge fraying"
  - Usage: 0 – 0.5%
- Diacetyl tartaric acid esters of mono and diglycerides (DATEM)
  - Usage: 0 – 0.5%

Dough Conditioners

Gums

- Holds water / improves shelf-life and product stability
- Guar, CMC, Xanthan, …
- **Past Issues: $ & Supply**

Enzymes

- Flour conditioning
- Improved machinability / processing
- **Extended shelf-life**

Top Industry Challenges for Flour Tortillas

Top Three Challenges for Flour Tortillas

Staling:
- Becoming firm and dry
- Loss of flexibility and rollability

Stickiness:
- Result in tearing and peeling

Mold Growth

Tortilla Mold Free Shelf-Life

Preservatives

Sources of Mold Contamination

- Ingredients
- Air: atmospheric or compressed
- Equipment
- Packaging
- Returned products
- Trash containers
- People
- “Dead” spots within building

Control of Mold in Tortillas

- Minimize contamination of product with mold.
- Establish clear expected shelf life.
- Control factors that enhance mold growth.
- Usage of **mold inhibitors**, **pH** and **water activity** control.

Establishing Shelf Life

- **Be realistic!**
- If sure product will be consumed within **48 hours**, do not use a mold inhibitor.
- Refrigerated or frozen storage extends mold-free shelf life.
- Establishing a very long shelf life may affect the **taste** and **eating qualities** of product.

pH Reduction

Function

- Microorganism control (Mold)
  - Resistance of most living organisms to heat is less at **lower pH**.
  - Most bacteria, yeast, and fungi **cannot** be inhibited by an acidic pH alone.
    - Preservatives are needed.

pH Reduction

Sources - Acids

- **Fumaric** – most common in tortillas / encapsulated available. Usage: 0.0 – 0.5%.
  - NV = 145 **(Caution » Leavening)**
- **Citric** – Very water soluble and sharp flavor – not as common in USA. Encapsulated common in Europe.
  - NV = 159
- **Vinegar** – Liquid and powder forms – widespread use in baking, but not much in tortillas.
- Sorbic, Malic, Lactic, Propionic, Phosphoric, Flavors (Lemon, Orange,…)

Preservatives

Artificial

- **Calcium and Sodium Propionate**
  - Usage: **0.0 – 1.0%**
  - Upper pH for function is 5.5
  - Will have an impact on flavor and aroma.
- **Potassium Sorbate / Sorbic Acid**
  - Usage: **0.0 - 0.5%**
  - Upper pH for function is 6.5 – larger functioning range than Propionates
  - Very detrimental to yeast – not an issue with tortillas.
  - More expensive than Propionates
  - Will have an impact on flavor and aroma.

Preservatives

Natural

- Vinegar, raisin juice concentrate, fermented whey and flour products (% varies)
  - Usage depends on shelf-life requirements, climate & labeling restrictions.
- **Verdad** – Natural Culture

Other Options

- Oxygen Scavengers
- Controlled atmosphere packaging
- Heat sterilization
- UV light

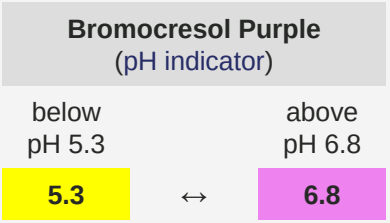
Quality Standards

pH

- Grind uniform sample and test
  - Day 1 and **Day 3**
  - 5.5 max for preservative functionality / **< 5.3 ideal**

pH Stain Indicators

- **Bromocresol Purple** (0.04% Aqueous Solution)
  - pH range **5.3** to **6.8** (Yellow to Purple)
  - Best indicator for tortilla surface studies.



Moisture Content

- **31 – 32%** (variable)

Water Activity

- **0.92 – 0.95**

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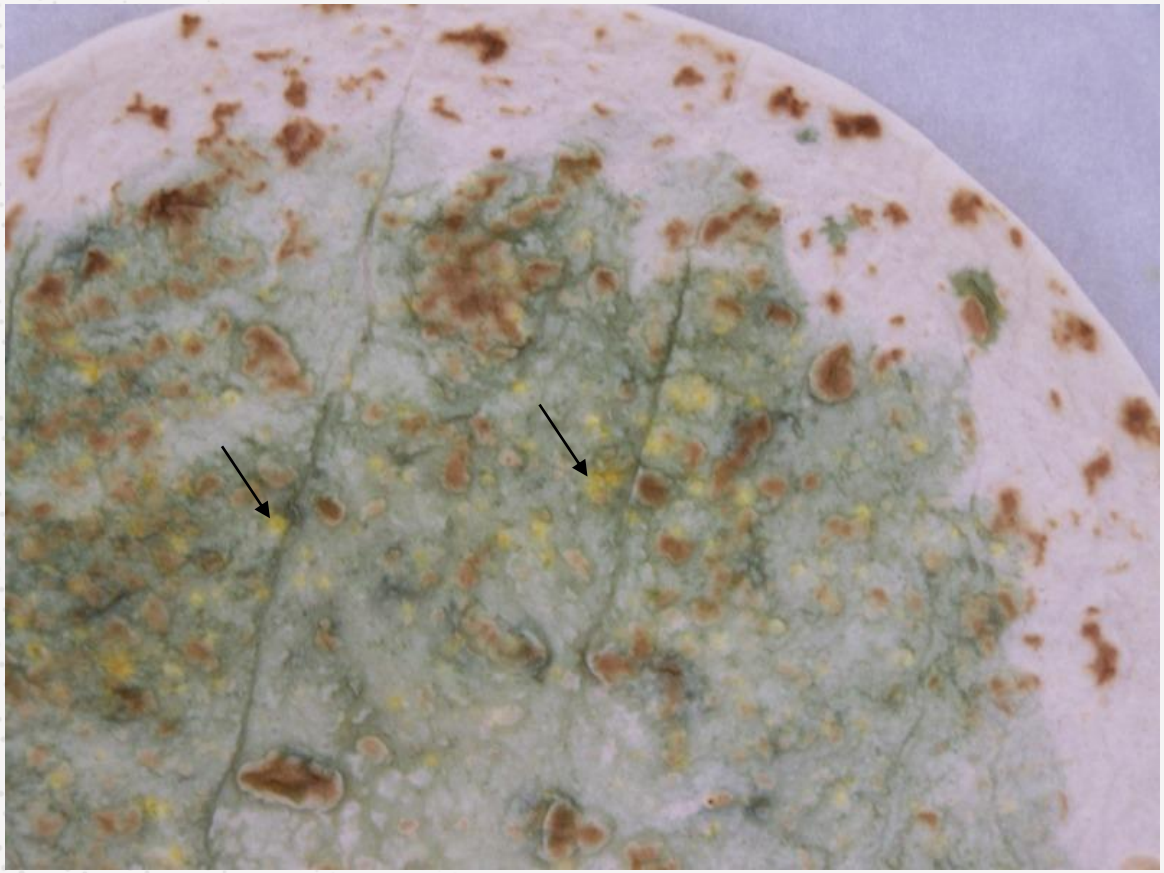
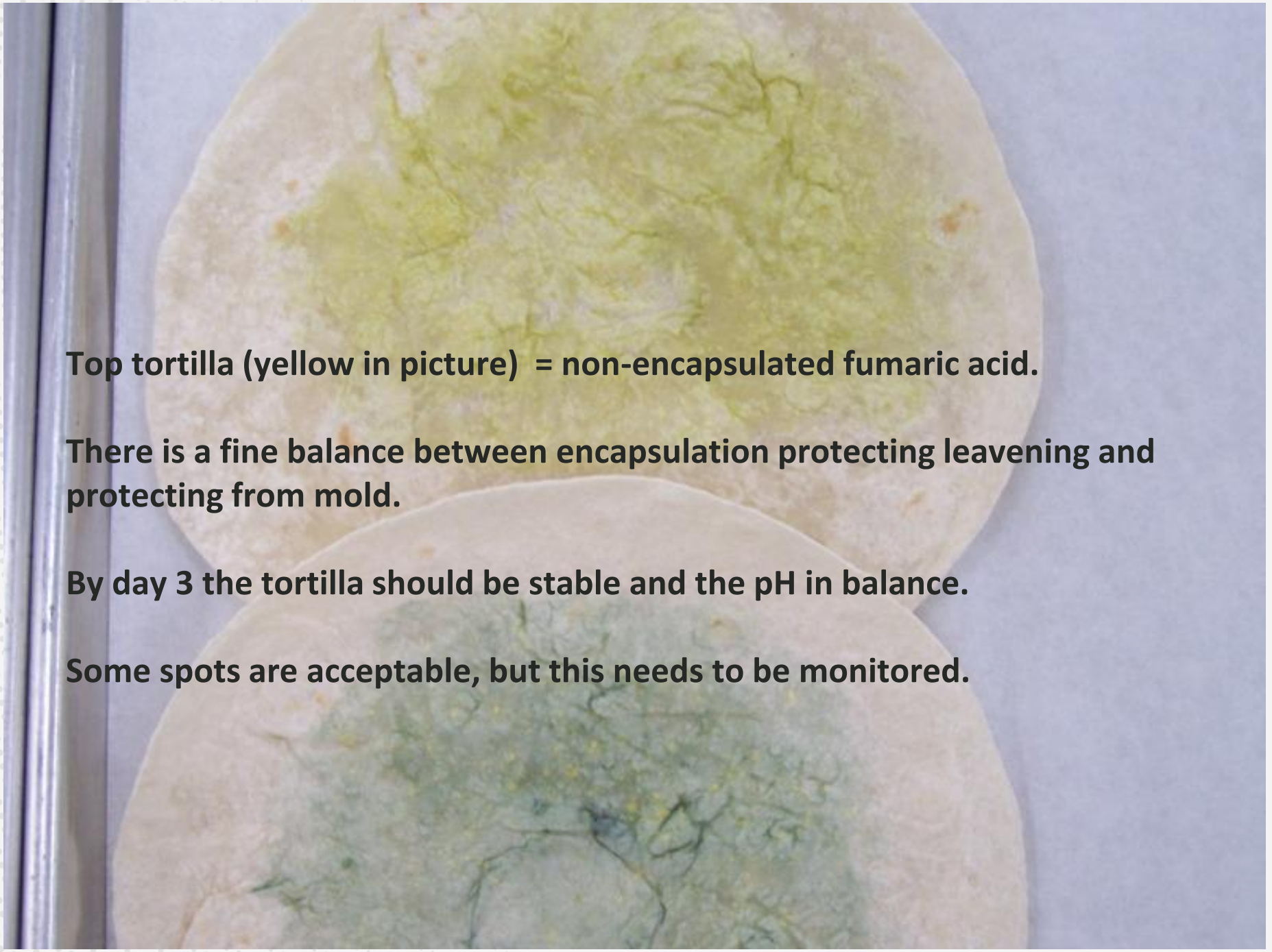
Tortilla Surface Evaluations

- Bromocresol Purple Aqueous pH Indicator
- pH range: Yellow (pH=5.3) to Purple (pH=6.8).
- As can be seen from the yellow spots, the poorly encapsulated Fumaric is not providing uniform pH adjustment.





Top tortilla (yellow in picture) = non-encapsulated fumaric acid.

There is a fine balance between encapsulation protecting leavening and protecting from mold.

By day 3 the tortilla should be stable and the pH in balance.

Some spots are acceptable, but this needs to be monitored.

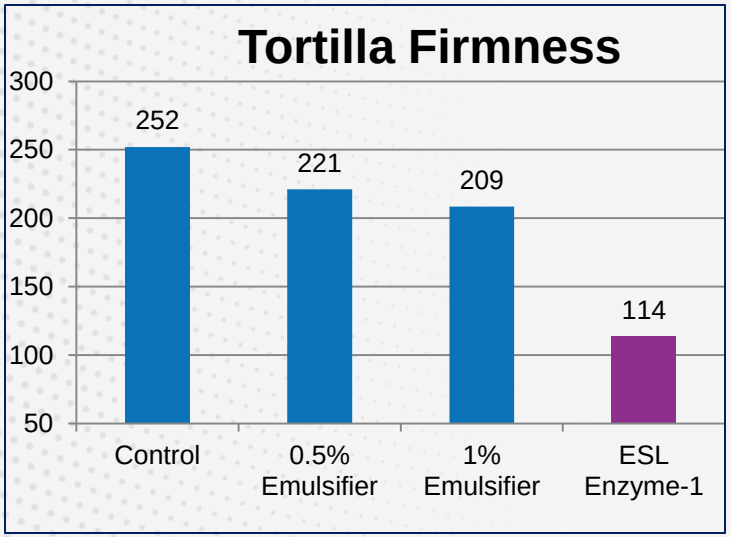
Tortilla Softness

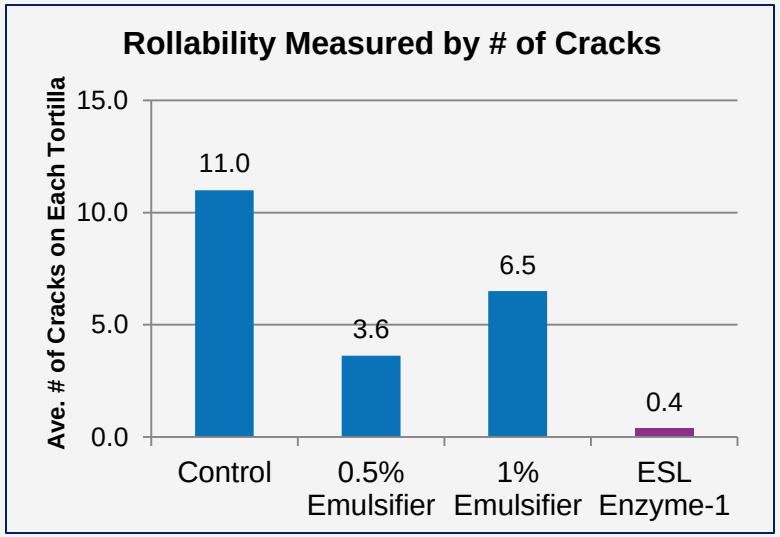
Unique Challenges for Tortilla ESL Enzymes

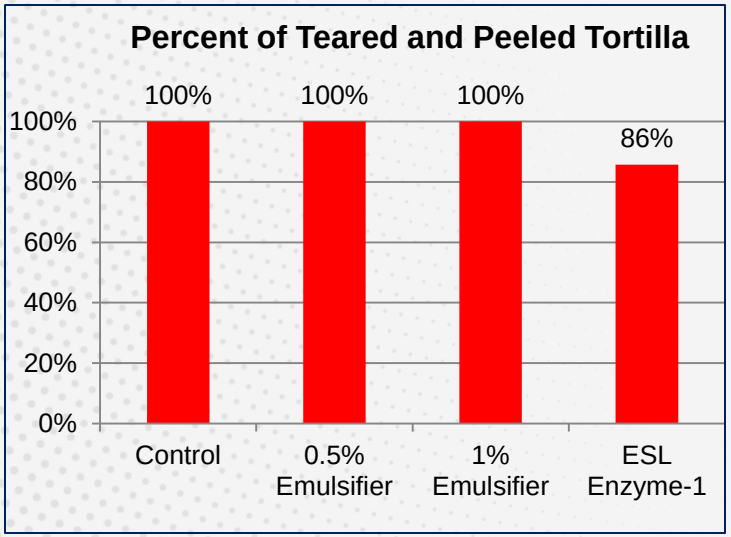
Extremely short baking time, leaving very short time for ESL enzymes to do their job.

Extending tortilla shelf life worsens the stickiness problem.

The Anti-Staling Effect of Emulsifiers in Tortilla







1. Emulsifier had marginal effect in improving tortilla softness / rollability.
2. ESL enzymes showed more significant impact than emulsifiers.
3. Both softening emulsifiers and ESL enzymes failed to reduce tortilla stickiness.

Ultra Fresh Premium 225 (BakeSoft Tortilla 500)

- Item # 136217
- 0.25% – 0.5% usage
- Wheat Flour and 2% or Less of Each of the Following: Salt, Enzyme (Wheat).
- Add on to ANY existing tortilla formula.
- GMO at this time.

Practical View – Tortilla Anti-Staling

- Aged Product
  - Tortilla shelf-life studies have retained samples in the lab that are 365+ days old.
- "Softening" emulsifiers have been reduced/removed with success
- Gums have been reduced/removed with success
- Rolability, Foldability, and Overall Quality greatly extended.
- Freshness/Flavor benefit (formula dependent)
- The potential for damage from sticking is increased!

Tortilla Anti-Sticking Technology

Sticking Issues in the Industry & Traditional Fixes?

- **Formula**
  - Cut **Water**, Reduce **Sugar**, Reduce **Leavening** (pillowing), Less **Reducing Agents**,…
  - Addition of **Gluten** to reduce tearing, **Gums** to manage moisture,…
  - Standard **Emulsifiers** as conditioners.
  - **Trans-Free** shortening/oils can have a liquid-solid phase, which can lead to increased sticking in the bag.

- **Bake, Bake, Bake,…**final MC **≈ 30-32%**.
- **Cool, Cool, Cool,…**temperature suggested at **+/- 10° F** package room.

- Reduce **Humidity** in cooling area… **<70%...Cooling rooms that rain!!**

- Don't stack as high in the box.
- Use a **cardboard shelf** in the box…**Flip boxes over / re-pallet!!**
- Use a **pallet configuration** that distributes weight better.

- **"Temper"** the product before going into refrigeration or freezing.
- **Warehouse & Transportation** temperature… **Minimize temperature shifts**

Process & Formulation

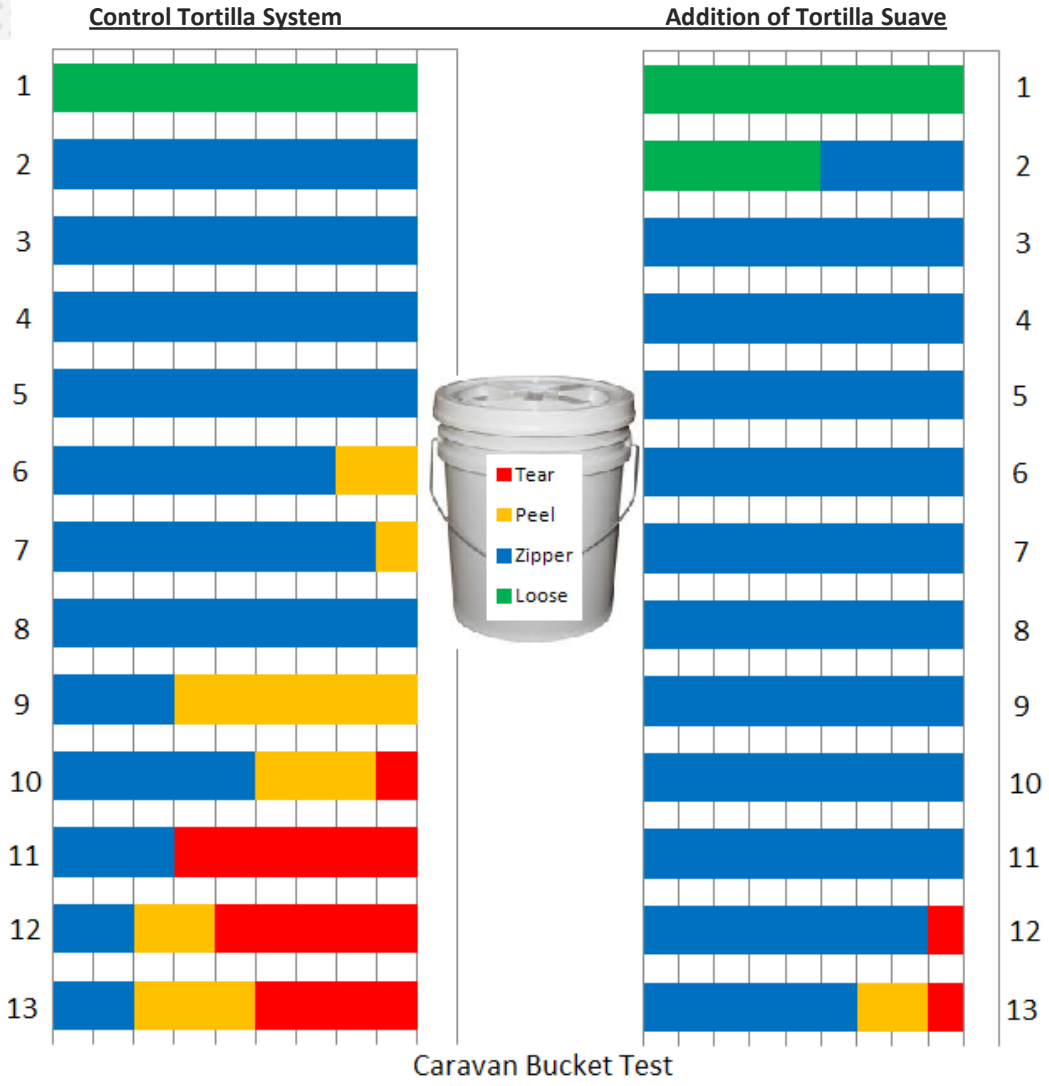
The options go on and on, but traditional fixes are illusive…

Stickiness Measurement

“Quantitative” Numbers are a Challenge

Direct TA measurement of the force or energy that is needed to separate two tortilla seems very logical.

Tortilla “Bucket Test”



Caravan Bucket Test

This test involves the storage of tortilla packages in deep stacks and then evaluating them from the top down, recording differences in sticking.

Grades are based on:

- “Loose tortillas”
- Tortillas that make a “zippering sound” when separated, but no damage occurs.
- Tortillas that suffer from surface “peels.”
- Tortillas that “tear” and are considered unusable.

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Bucket Test

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Current Anti-Stick Offerings

- Trancendim Product Line
  - Beaded Hi Diglyceride
  - MP: 55-70°C (131-158°F)**
  - Very Low/No Trans (IV ≈ 3)
  - Fat Structuring
- Trancendim 110, 130 & 180
- Trancendim Non-GM

TRANCENDIM™

Current Anti-Stick Offerings

- Value Added Blends:
  - Scaling, Handling, Increased Functionality,…
- Tortilla Stick No Mas
- Tortilla Stick No Mas Non-GM
- Tortilla Suave = Anti-Stick + Softeners

Tortilla Stick No Mas

- Item #s 135212 & 136544(GR)
- 1 – 2% usage
- Hydrogenated Cottonseed Oil, Corn Starch, Mono- and Diglycerides, Guar Gum and 2% or Less of Each of the Following: Soybean Oil, Silicon Dioxide (Flow Aid).

- Add on to ANY existing tortilla formula.

Tortilla Stick No Mas Non-GM

- Item # 136546
- 1 – 2% usage
- Mono- and Diglycerides, Wheat Starch, Xanthan Gum, Calcium Sulfate and 2% or Less of Each of the Following: Sunflower Oil, Silicon Dioxide (Flow Aid).
- All Non-GMO Ingredients

- Add on to ANY existing tortilla formula.

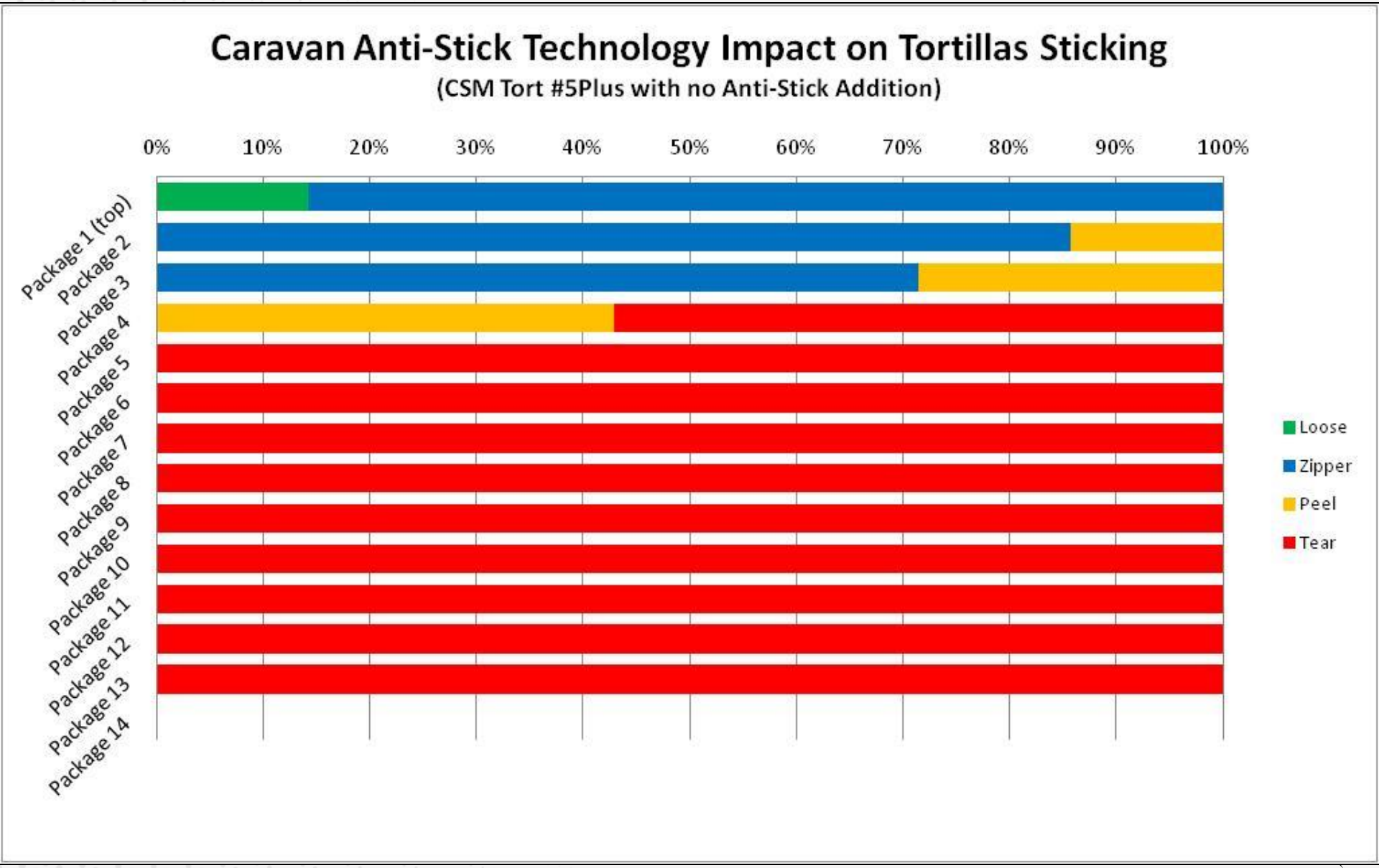
Tortilla Suave

- Item #s 135093 & 136477 (GR)
- 1 – 2% usage
- Mono- and Diglycerides, Corn Starch, Wheat Flour, Guar Gum and 2% or Less of Each of the Following: Soybean Oil, Silicon Dioxide (Flow Aid), Enzyme (Wheat), Salt.
- Superior ANTI-STICK & SOFTNESS
- Add on to ANY existing tortilla formula.

Tortilla Suave

- **Specially formulated blend of enzymes, emulsifiers, gums and starches leaves tortillas:**
- **Soft and Pliable.**
  - Lab studies have shown tortillas **over a year old** with fresh qualities related to rollability, foldability and softness.
- **Resistant to sticking to one another in the package.**
  - Lab studies have shown tortillas treated with Tortilla Suave can withstand significant abuse and compaction before sticking to one another.

No Mas / No Mas Non-GM



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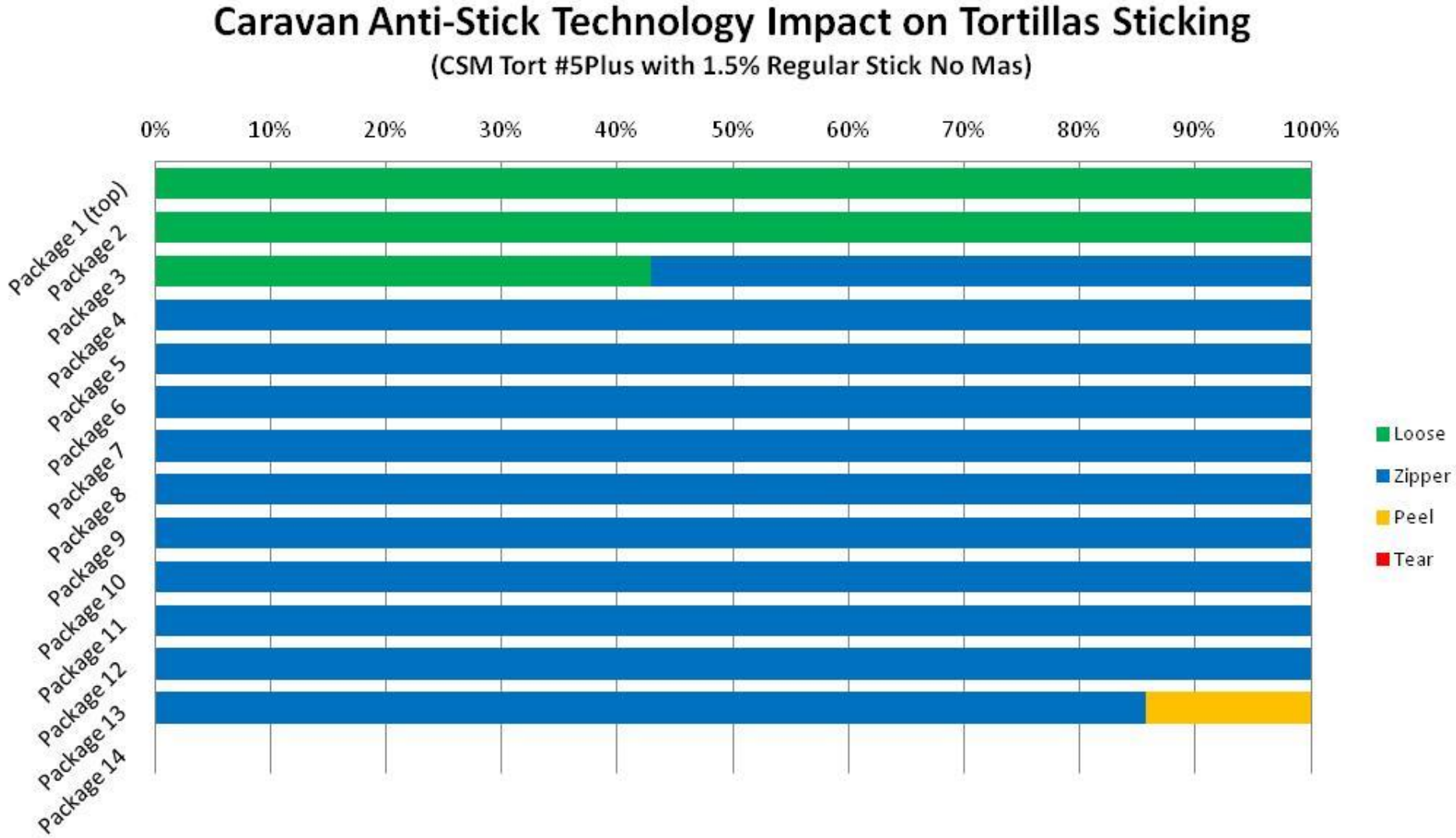
No Mas / No Mas Non-GM



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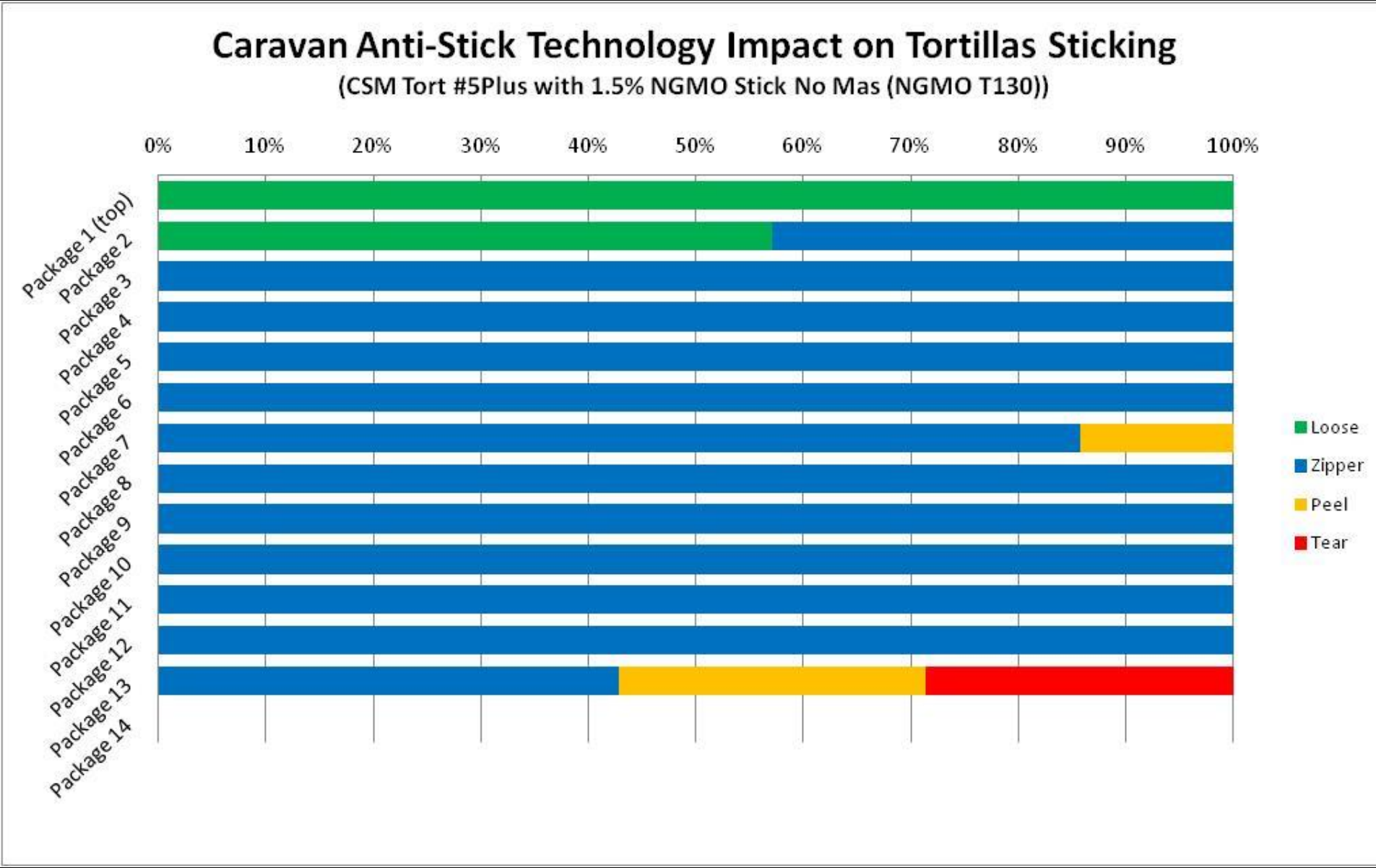
No Mas / No Mas Non-GM



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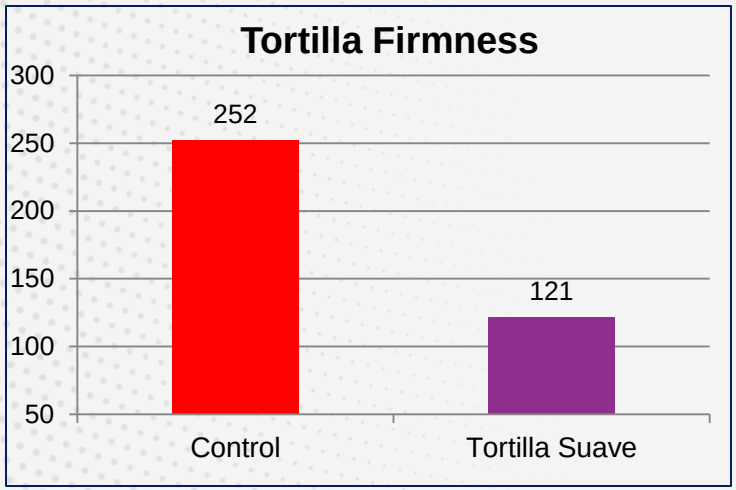
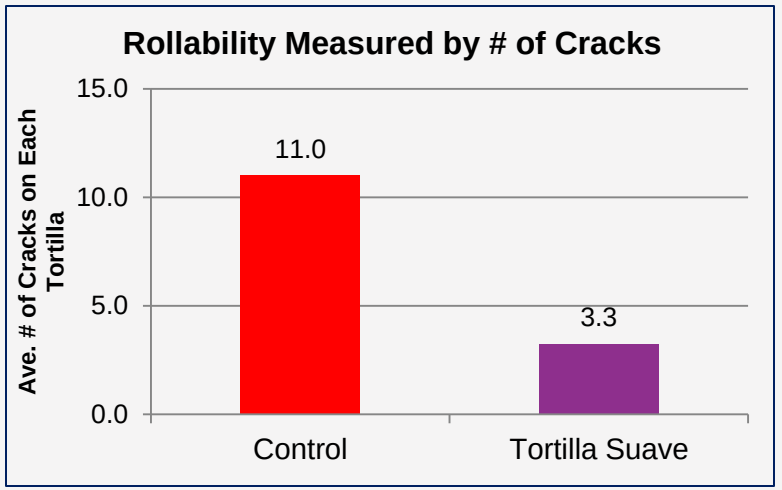
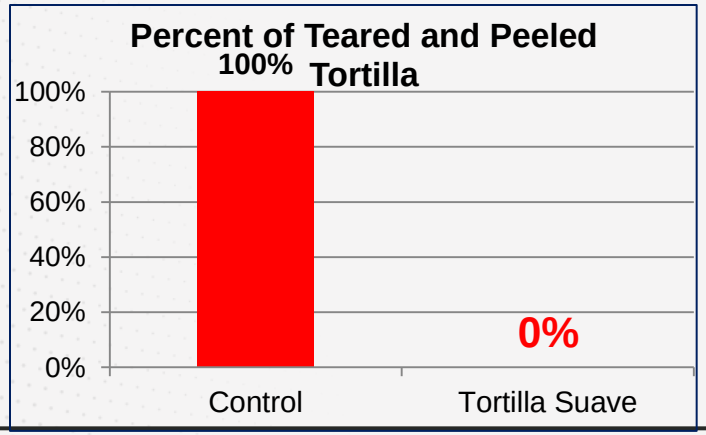
Effects of Tortilla Suave on Tortilla Quality and Shelf Life

Tortilla Suave significantly improves the softness and flexibility of the tortilla.

Tortilla Suave also significantly reduced the tortilla stickiness.







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Effect of Anti-Stick Technology on Surface Energy (Wetability)

Corbion anti-stick technology reduces the tortilla surface wetability.

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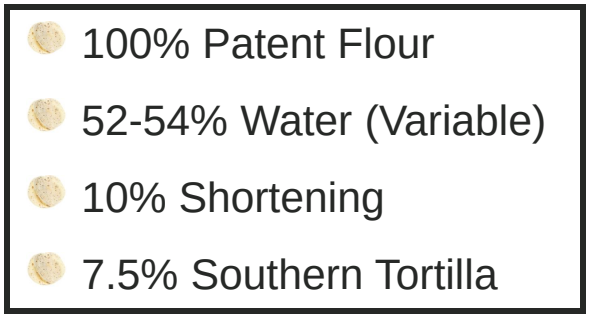
Caravan Tortilla Products

Pre-blends, Batch Packs & Bases

- **Utilized by many small and large producers.**
  - All the minor ingredients needed to produce tortillas.
    - **Acidulants, preservatives, conditioners,…**
    - With or without leavening and salt.
  - Ensures **consistency** from batch to batch.
  - Ensures critical **shelf-life ingredients** are added to every batch.
  - Typical usage levels range from **3% to 16%**.
  - Depending on the need the products can be **customized**.

Southern Tortilla Base

- MTS
- Item # 135255 & 136515 (GR)
- **7.5%** usage
- Powder Base



- White (opaque) Fluffy Tortillas / ESL & Anti-Stick Included
- Salt, Baking Soda, Mono- and Diglycerides, Sodium Aluminum Phosphate, Sodium Aluminum Sulfate, Calcium Propionate, Fumaric Acid, Corn Starch, Wheat Flour, Potassium Sorbate, Calcium Sulfate and 2% or Less of Each of the Following: Guar Gum, Soybean Oil, Monocalcium Phosphate, Hydrogenated Soybean Oil, Enzymes, Sodium Metabisulfite (Sulfites).

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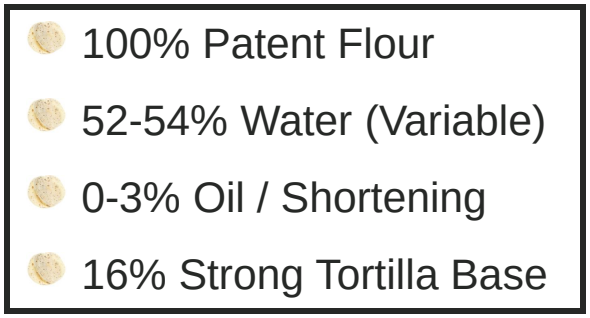
Strong Tortilla Flow ZTF

- MTS
- Item # 134300
- 16% usage
- Plastic Base



- Strength for Cold-Rollability / Translucent Tortilla / Anti-Stick.
- Soybean Oil, Wheat Gluten, Mono- and Diglycerides, Salt, Sugar, Baking Soda, Sodium Acid Pyrophosphate, Calcium Propionate (for Freshness), Sodium Aluminum Sulfate, Fumaric Acid and 2% or Less of Each of the Following: Potassium Sorbate (For Freshness), Sodium Stearoyl Lactylate (SSL), Guar Gum, Wheat Flour, Enzymes (Wheat), Sodium Metabisulfite (Sulfites).

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Viva Tortilla Base

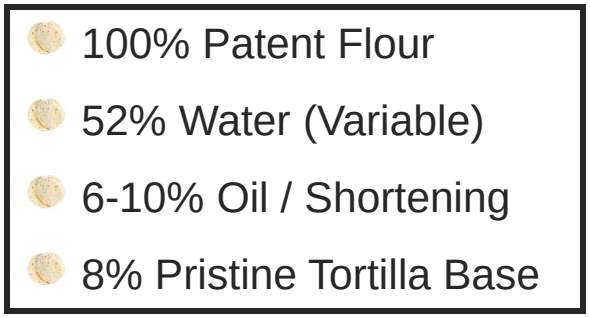
- MTS
- Item # 125867
- 8% usage
- Powder Base

- 100% Patent Flour
- 54-56% Water (Variable)
- 10-15% Shortening
- 8% Viva Tortilla Base

- Old style traditional tortilla with minimal shelf life / Slightly Translucent Tortilla / Contains Whey
- Whey (Milk), Calcium Sulfate, Salt, Sodium Aluminum Phosphate, Sodium Bicarbonate, Mono- and Diglycerides and 2% or Less of Each of the Following: Sodium Metabisulfite.
- No Shelf-Life Extension Ingredients

Pristine Tortilla Base

- MTO (made to order)
- Item # 134273
- 8% usage
- Powder Base
- Cleaner Label
- Unbleached Wheat Flour (Contains Barley Malt Flour), Salt, Sodium Acid Pyrophosphate, Sugar, Sodium Bicarbonate, Soy Lecithin, Inactive Yeast and Enzymes
- No Shelf-Life Extension



PRODUCT	% USAGE	DEFINING CHARACTERISTICS
Southern Tortilla & GR **Item # 135255 & 136515**	7.5 %	**Powder / White Fluffy Tortillas / Anti-Stick & ESL / First choice**
Southern Tortilla Advanced **Item # 136903**	7.5 %	**Powder / White Fluffy Tortillas / Additional Anti-Stick Technology**
Tortilla Supreme & GR **Item # 128207 & Item # 136676**	8.5 %	**Powdered / Translucent Tortillas / Anti-Stick / No Enzyme ESL**
Strong Tortilla Flow ZTF Item # 134300	16 %	**Plastic / Ideal for large diameters (wraps) / Ensures cold roll-ability. Excellent product for Delis and Sandwich shops. Translucent Tortilla / Anti-Stick.**
Flexi Tortilla Item # 127652	14 %	**Powdered / Formulated with tolerance to stretch, rolling, and folding / No Anti-Stick or Enzyme ESL**
Viva Tortilla Item # 125867	8 %	**Powdered / Old style traditional tortilla with minimal shelf life / Slightly Translucent Tortilla / Contains Whey**
Viva Plus 9 Item # 134233	9 %	**Powdered / Extended shelf life and ant-stick technology incorporated / No ESL Enzymes**

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PRODUCT	% USAGE	DEFINING CHARACTERISTICS
Trim Carb Tortilla EXT Item # 128023	80% Base / 20% Flour	**Powder base for the production of low carbohydrate tortillas and wraps.**
Pristine Tortilla Base Item # 134273	8%	**Powder base for the production of clean label tortillas / Does not contain preservatives.**
CaraSalt Tortilla Base Item # 135666	7%	**Powder base for the production of reduced sodium tortillas.**
Basic Tortilla 3 Item # 135388	3%	**Concentrated tortilla base / Does not contain leavening**
SS Grains / Meisters / ...	Add Ons	

Corbion

Tortilla Processing

Tortillas Processing

- Mixing and Temperature
- Transferring and Floor Time
- Dividing
- Rounding - Intermediate Proof
- Forming / Pressing
- Baking
- Cooling / Packaging

Process - Defined

- Process is a series of steps necessary to obtain a finished end product.
- Model T Ford first industrial in-line process.

- Tortilla Industry is established on the same principal.
- Each downstream step is an internal customer of the process that precedes it.
  - Domino Effect

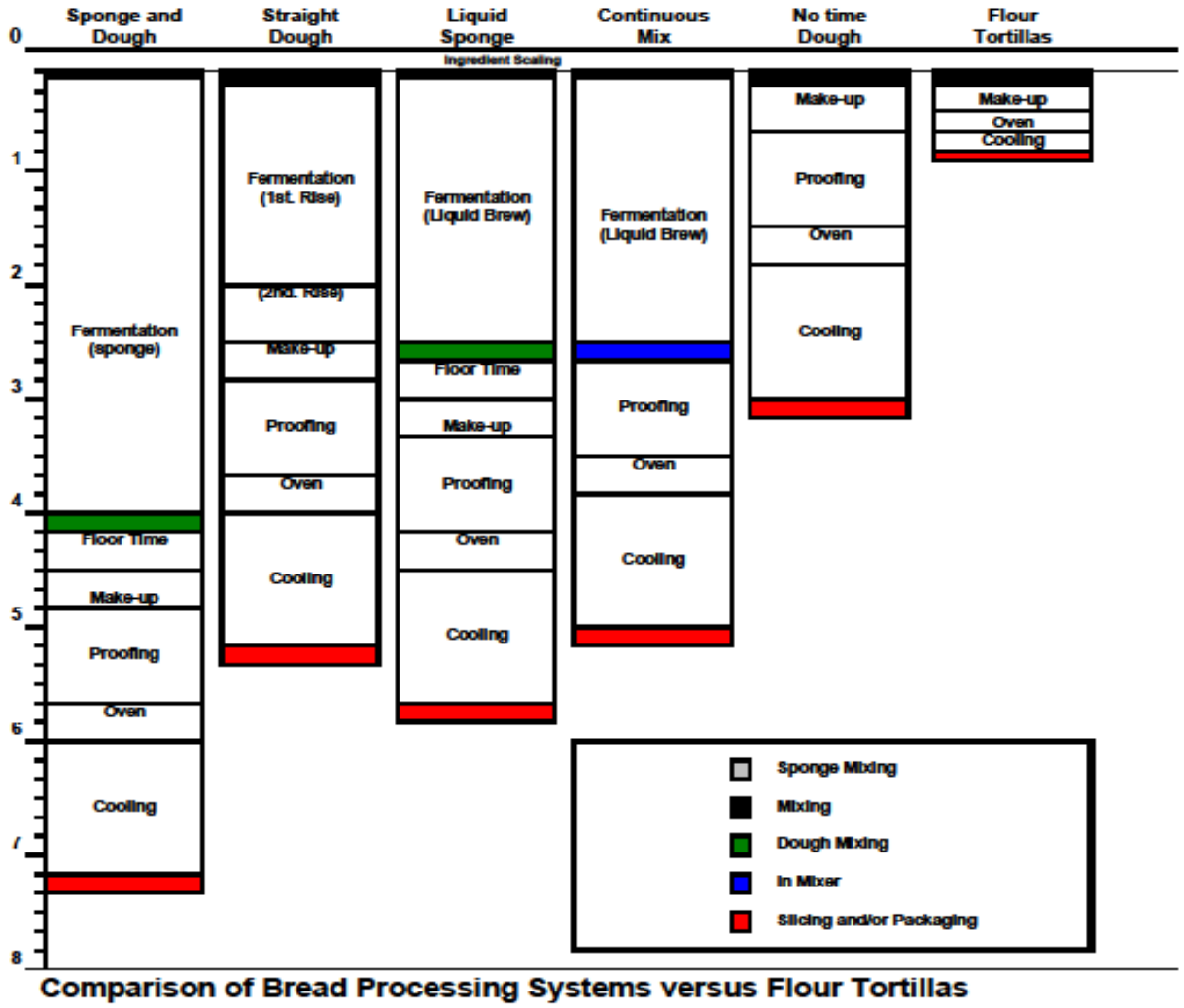
Quality Control

- **Direct result of supervisors following through with their people to ensure each step is carried out in the prescribed manner.**
  - Good consistent quality will only be achieved when all people involved are working towards the same goal.
  - Management has determined the % of each ingredient.
  - Imperative that ingredient scalers and mixing personnel follow the formulations exactly.
  - Any changes in amount of ingredients in the formula must only be made by management.

Tortilla Processing - Uniqueness

- **Very fast turnaround**
  - Under **45 minutes** from flour to bag
- **Warmer Doughs**
  - 80-90ºF
- **Stressful Processing**
  - Hot Press / Die Cut / Hand Stretched
- **Fast Fast Fast…Griddle 20-40 sec**
- **One becomes Many: Stacking = Sticking**

Bread vs. Tortilla Process



Comparison of Bread Processing Systems versus Flour Tortillas

Mixing

- **Mixing is the foundation of a good or bad tortilla.**
  - Mixing must achieve the blending of ingredients in the correct order, to the correct mixing **time and temperature**, so as to properly develop the dough to its optimum for machinability and gas retention.

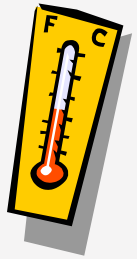
- **Aim of Mixing in Tortilla processing:**

"...Getting the dough out of the mixer in its driest condition, with as high an absorption as possible, and at the same time of proper consistency so it will machine well." ERNIE PYLER

Mixing - Objectives

- **Uniformly incorporate ingredients**
- **Hydrate all dry materials completely**
- **Develop the gluten for proper handling quality and gas retention**
- **Development and temperature of the dough is established.**
  - The Mixing Area is the **HEART** of the bakery. Why?
  - **CONSISTENCY**

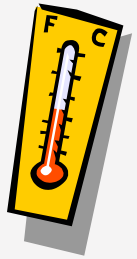
Time & Temperature



Factors Involved:

- Temperature of Ingredients.
- Size and type of mixing equipment.
- Batch size.
- Mixing procedures: Time, speed.
- Seasonal Temperature: summer / winter.

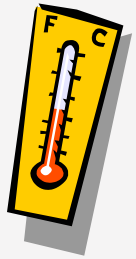
Time & Temperature



Why Is Temperature Control Important?

- Controls the consistency of the final product.
- Controls the rate of fermentation (faster, slower).

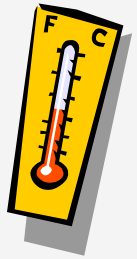
Time & Temperature



Definition of Friction Factor

The value which is used to represent the heat increase (temperature rise) of the dough during the mixing process due to friction.

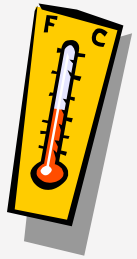
Time & Temperature



Temperature changes that occur during the mixing of dough are caused by:

- **Heat generated by friction.**
- **The heat of hydrating flour.**

Time & Temperature



Removing the heat generated by mixing can be achieved by:

- **Use of Chilled Water**
- **Use of Ice**
- **Mechanical refrigeration**

Mixing

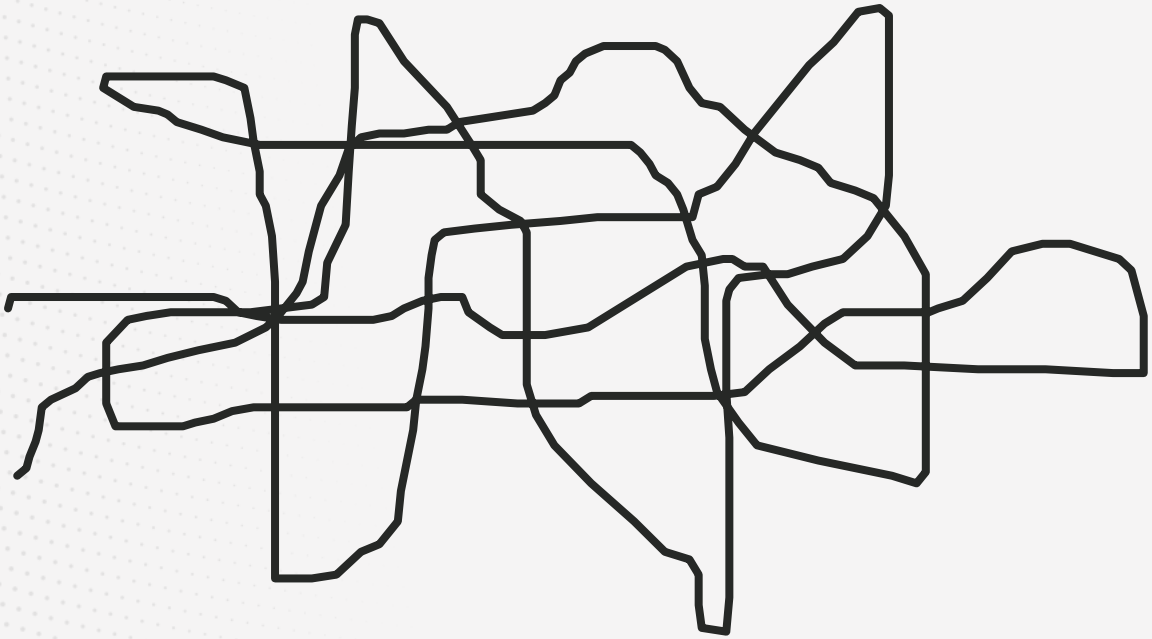
- **Types of Mixers used in Tortilla manufacturing:**
  - Large Operations – Horizontal
  - Small Operations – Spiral or Vertical

← **Spiral**

← **Horizontal**

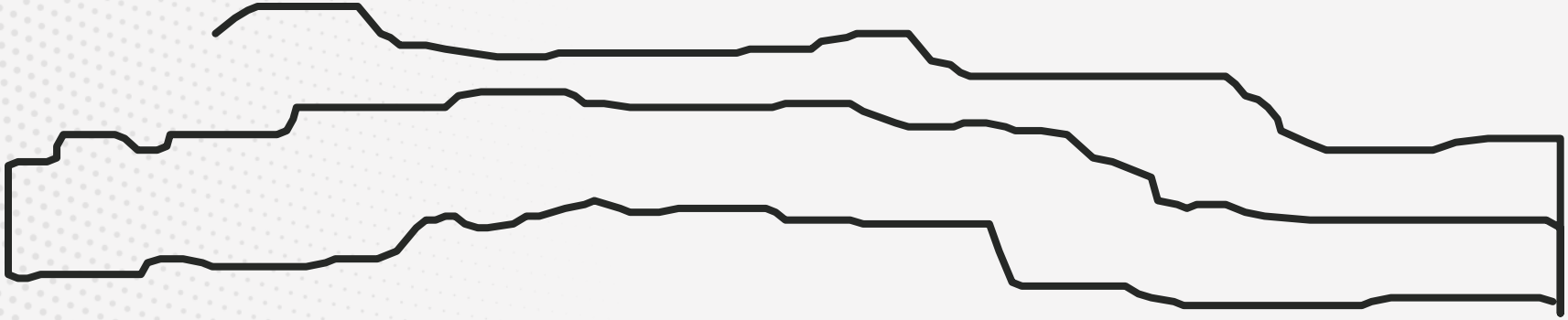
- **<u>Dry blending</u> is recommended to uniformly distribute minor ingredients within the flour before the water and shortening are added.**
  - This helps with consistency as well as protection of minor ingredients.

Mixing action on the gluten



Undeveloped gluten

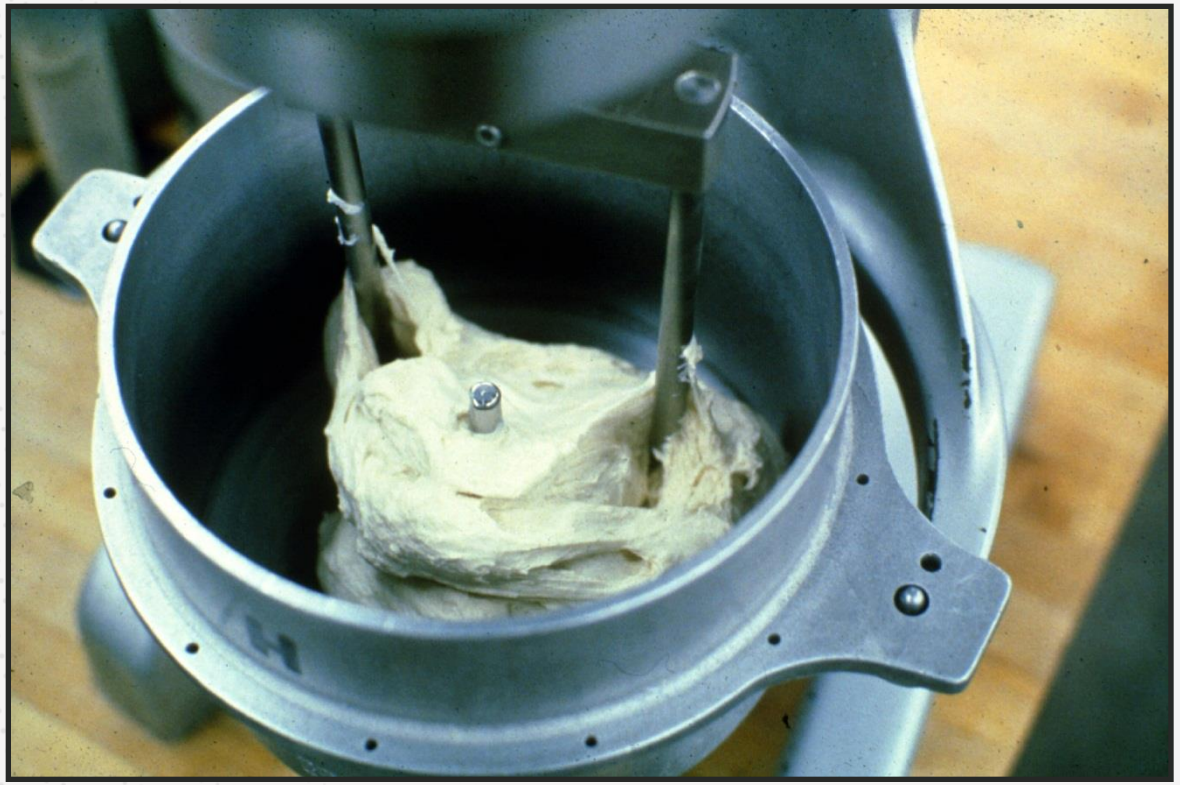
Mixing action on the gluten



Developed gluten

Mixing - Stages

- **Pick-up:** Dough is sticky, cold and lumpy.

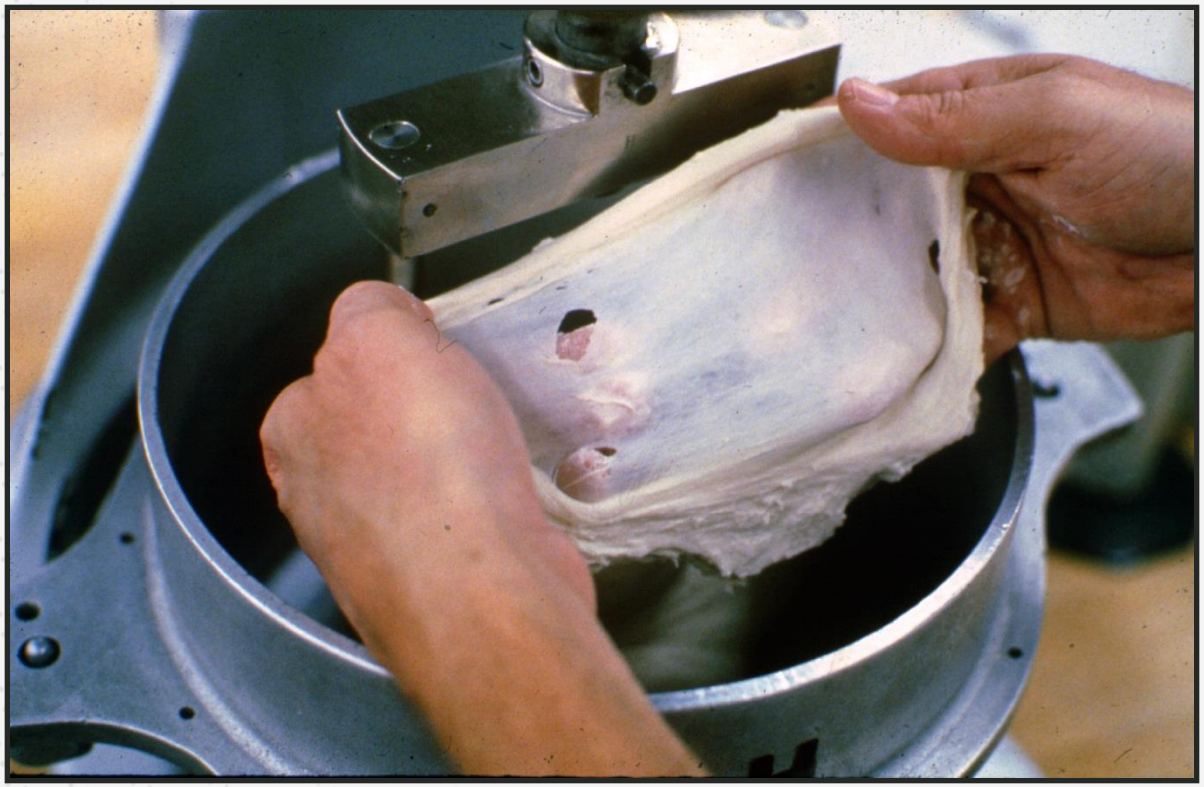


Mixing - Stages

- **Initial Development:** Dough becomes warmer, softer and drier.

Mixing - Stages

Clean-up: Dough is at it's maximum consistency. Dough will slap mixing bowl walls and pick-up as one piece.



Mixing - Stages

- **Final Development:** Dough is at optimum temperature and handling. A thin gluten film is visible.

Mixing - Stages

Letdown: Dough is too warm and sticky. Lacks elasticity and has excess flow.

Mixing - Stages

- **Breakdown:** Dough starts to liquefy.

Mixing

- **Mixing time is directly related to the efficiency of the mixer and the desired finished dough characteristics.**
- **Consistent dough development and temperature are critical.**
- **Tortilla doughs are typically slightly underdeveloped.**
  - This is a point of argument within the industry.
- **From bakery to bakery final dough temperature can range from as low as 75 ºF to as high as 100 ºF.**
  - Over 90°F you can start to lose a large amount of your leavening.
  - **80 – 90ºF** usually being the target.
- **If mixed properly, the dough should come out of the mixer cleanly (only minor sticking to the bowl).**

Equipment Options are Plenty!

Corbion Caravan Tortilla Equipment

Corbion

Flour Tortilla Dough Transferring

Methods of getting the dough from mixer to divider:

- **Hand Transfer**
  - Low Efficiency / Low Damage

- **Trough w/hoist**
  - Medium Efficiency / Low Damage

Flour Tortilla Dough Transferring

- **Chunker**
  - Medium Efficiency / Low Damage

- **Pump**
  - High Efficiency / High Damage
  - Energy / Heat
  - Damage dough structure – Requires different dough development at mixer.

Floor Time

- **Rest time after mixing and before dividing improves the quality of the dough and will improve dividing and rounding.**
  - **Too little floor time**
    - Dough can be **sticky** and hard to divide / round.
  - **5-10 minutes floor time**
    - Dough has a chance to recover, become extensible, and drier.
  - **Excess floor time**
    - Result in poor make-up, scaling weights, and rounding.
    - Dough can become **bucky** and **excessively elastic**.
      - Not as severe as bread doughs due to lack of yeast.

Dividing

- **Piston**
  - Dough is forced into the evacuated area of the manifold as the piston is pulled into the drum. The drum rotates and the dough is pushed out as the piston is pushed out of the drum.
  - Less abusive than other methods of dividing.
  - Most models are accurate.
  - Stiff dough tend to have scaling weight issues

Dividing

Knife and Extruder

- Dough is extruded by a series of augers into a uniform stream and is cut off by a blade.
- Dough weights regulated by speed of extruders and the speed of the knife cuts.
- Abusive to the dough due the mixing action of the augers.

Dividing – Small Wholesale

← Union Divider

Worm Ball →

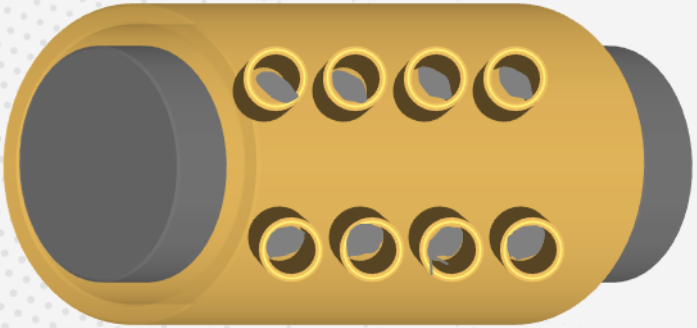
Rounding

Method to get the dough into a symmetrical form (a dough ball) for consistent processing

- **Rounder bars**
  - Constant belt motion forces dough ball against an angled rounding bar

Rounding

- **Sleeve and Drum**
  - Dough is deposited into a reciprocating drum onto which is placed a stationary sleeve that contains cup sizes proportional to the required weights
  - Excessively cold doughs will not round properly. This will lead to misshaped tortillas.



Scaling Weights

- **The diameter of the tortilla directly relates to the size of the dough ball.**
- **A general rule of thumb:**
  - A tortilla has 1 gram of mass per square inch.
  - For a tortilla: **Area = πr^2**
  - **π = 3.14**
  - r = Radius = ½ diameter
- **Example:**
  - With an **8 inch tortilla** the formula looks like this:

    $\pi \times (\text{radius} \times \text{radius}) = \text{square inches (or gram cut size)}$

    $3.14 \times (4 \times 4) = 3.14 \times 16 = 50.2$ square inches (or grams needed)

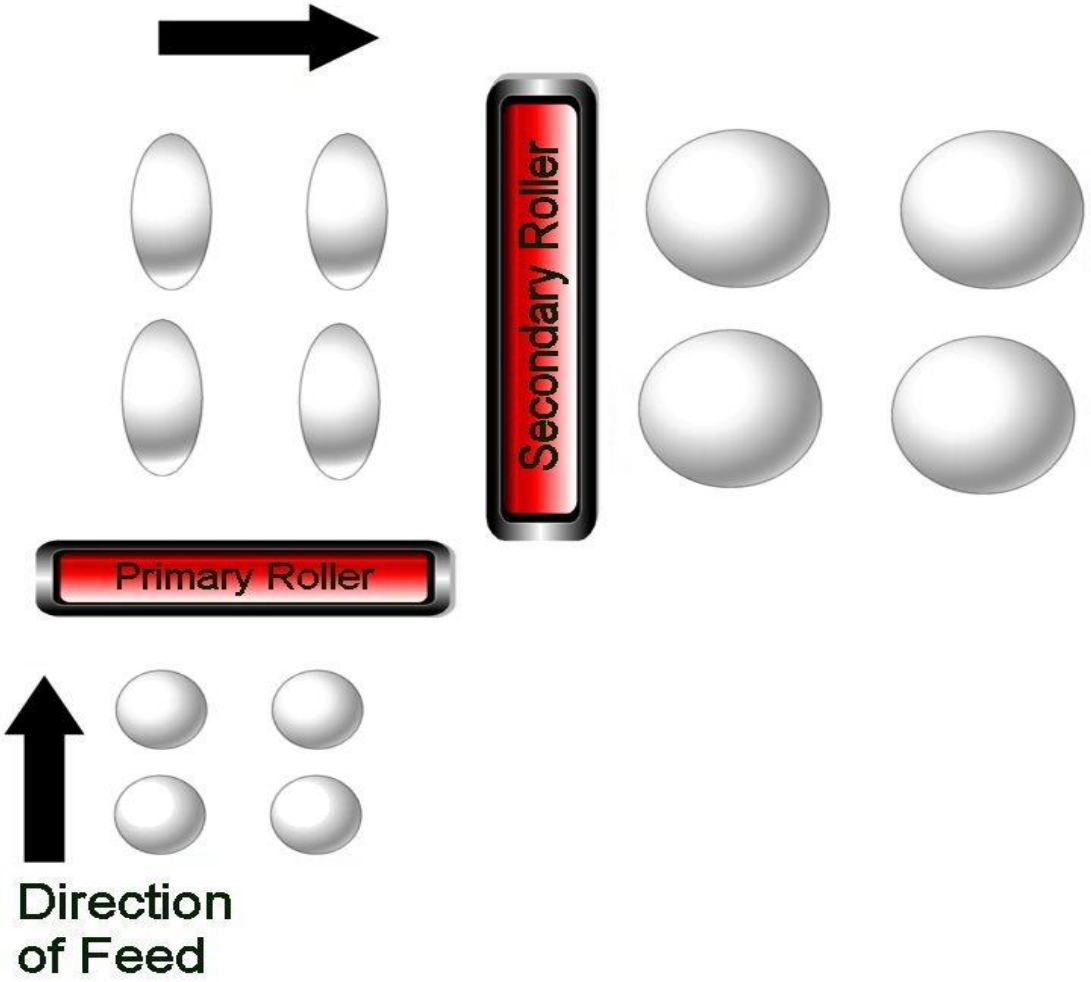
Overhead or Intermediate Proofer - Rest

- Tortillas are not typically yeast leavened so the term “proof” is not used in the same sense as a yeast leavened bread dough.
- For tortillas, proofing is a **rest time** in which the dough balls recover from processing.
  - Allows the dough time to hydrate, relax (become more extensible), and become less sticky.
- Typically “proof” times range from **8 to 12** minutes.
- Conditions are normally warm (**80 ºF – 90 ºF**), not hot, and just humid enough to keep the dough ball from crusting over (**55 – 70%** Relative Humidity).
  - Excessively hot or wet conditions will result in stickiness.

Forming: Hand Stretched Method

- After dividing and rounding, the dough piece is given a short relaxation period.
- It is cross sheeted and manually processed over a hot plate for the purpose of reshaping the tortilla.
- This reshaping is termed “hand stretched” and the resulting tortillas are referred to by this name.

Hand Stretch Process



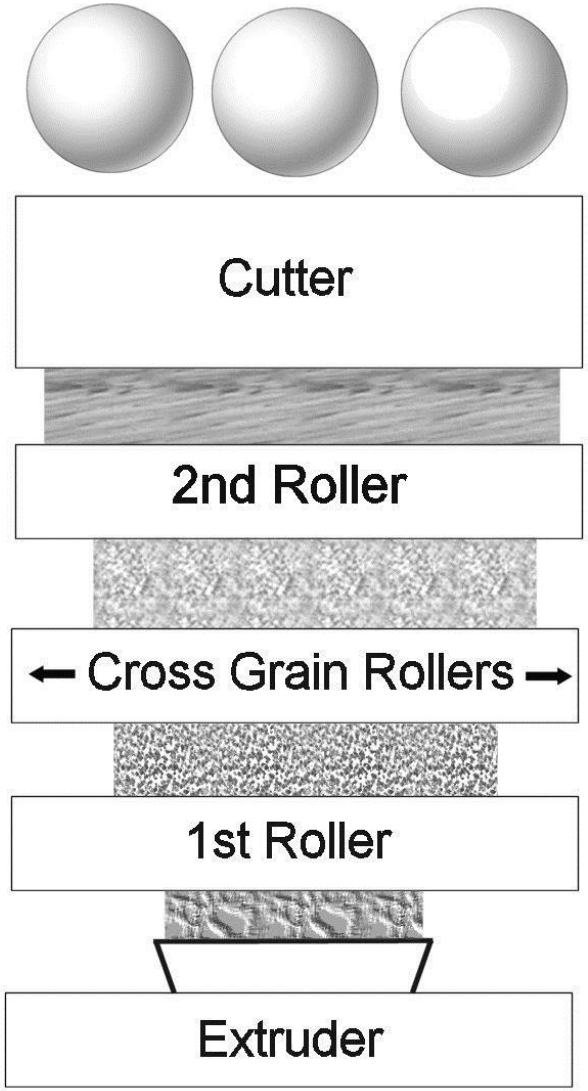
Hand Stretched Method

Characteristics & Applications

- Generally have a dull appearance.
- Dry, powdery feel caused by residual dusting from manufacturing process.
- Tender bite and dense with little layering or flake.
- Favored for table tortillas.

Forming: Die Cut Method

- Similar to automated yeast raised donut or sweet dough line.
- The dough is processed through a series of straight and cross grain rollers to achieve the proper thickness (about 1/8 inch) and flexibility.
- It is then finished under a rotary die cutter. This is where the product is cut into shape, separated and scrap dough is removed for further use.
- It is then transferred, ungelatinized into the oven for baking.



Die Cut Process

Die Cut Method

Characteristics & Applications

- Dry, powdery feel caused by residual dusting from manufacturing process.
- Generally tough, chewy and very dense with no flakes or layers.
- Favored for frying as edible salad bowls and in entrée preparation for food service and frozen foods.

Forming: Hot Press Method

- The most common system to date for standard tortillas.
- Shapes the dough ball into a flat round disk.
- Seals the outside walls.
- Starts starch gelatinization.
- Accelerates leavening.
- Starts the cooking process.

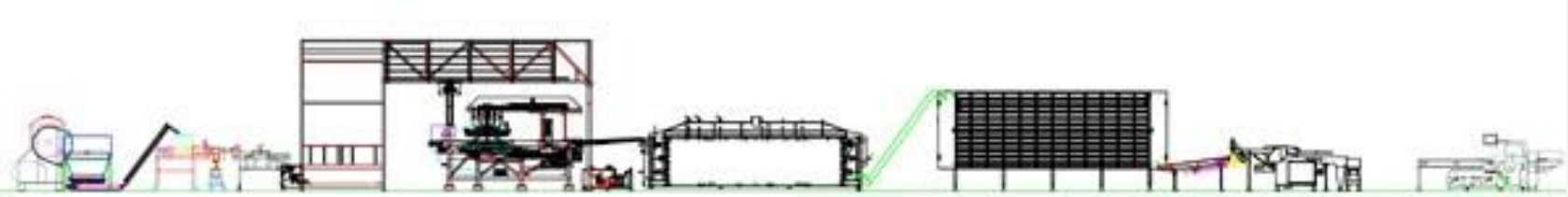
Forming: Hot Press Method

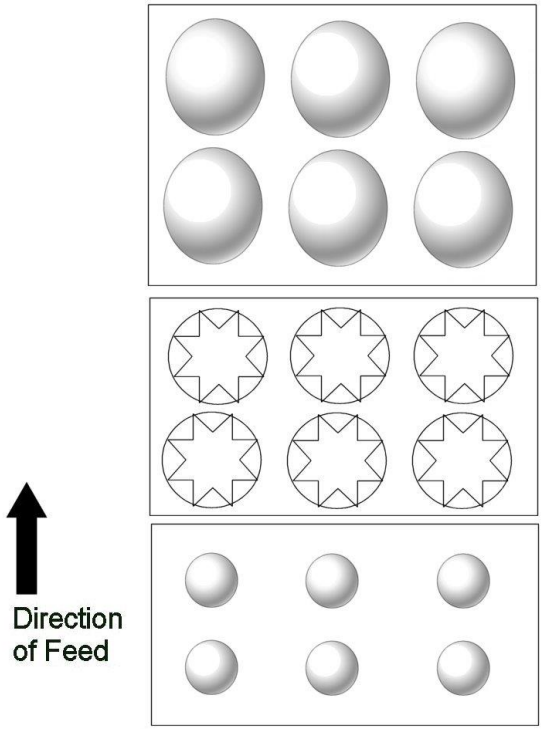
- **A dough ball is indexed onto a transfer belt after proofing.**
- **Transferred into the hot press.**
  - Top platen of the press is heated from **380 – 450ºF (194 - 232ºC)**
  - Bottom platen typically **10-20°F** cooler than the top.
  - Top a little warmer helps with release.
  - The tortilla will curl towards the hotter plate if the temperature difference between the platens becomes too excessive.
- **The Pressure is typically 600-1200psi.**
  - Lower pressures are better for the equipment and tortilla quality.
  - Use the lowest pressure possible to get the desired tortilla size.

Forming: Hot Press Method

- **The press time or dwell time is between ½ to 1½ seconds**
  - Surface gelatinization
  - Final shape
- **Excessive pressure/time**
  - Reduced tortilla quality
  - Increased translucency
  - Ragged edges
- **It is then baked/griddled immediately after pressing.**

Forming: Hot Press Method





Corbion

Hot Pressed Method

Characteristics & Applications

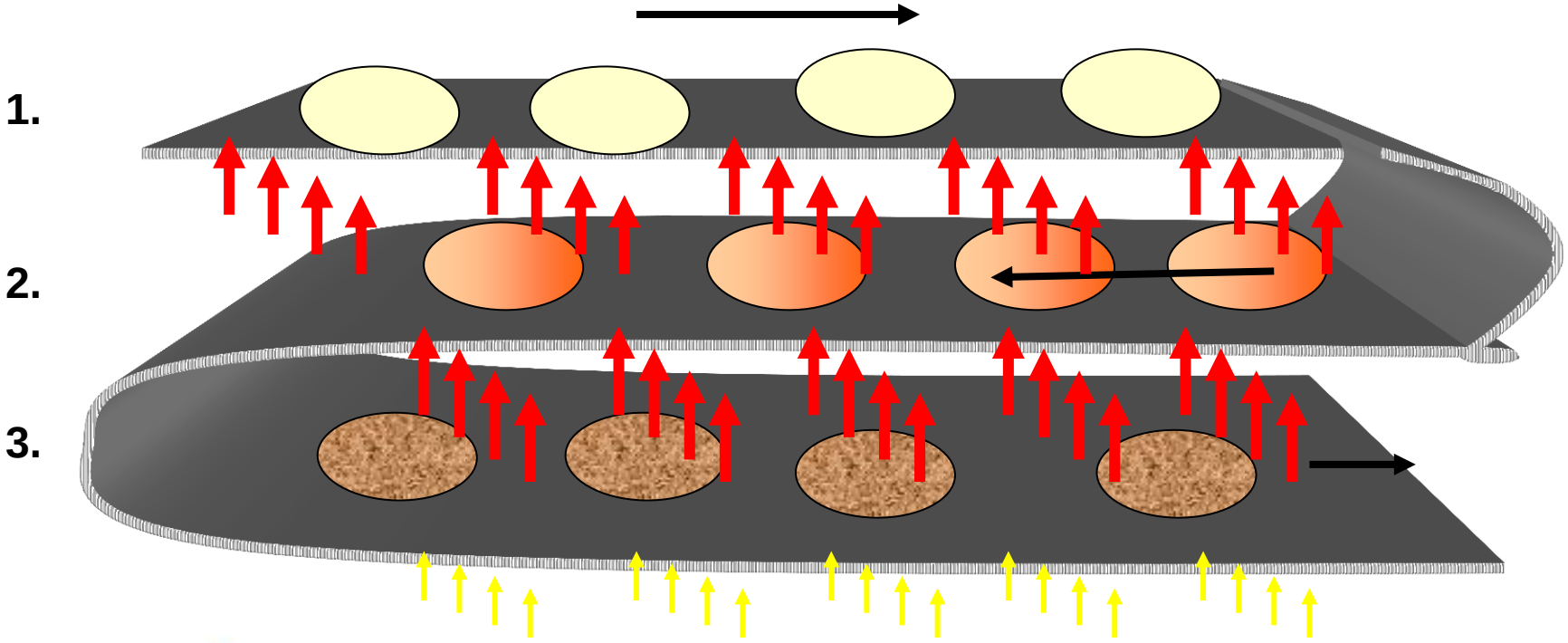
- Smooth and lightly shiny in appearance.
- Tend to be pliable and slightly elastic.
- Usually easy to roll or fold without tearing.
- Texture and crumb are usually light and fluffy (opaque) with pronounced layering and flake.
- Favored for table tortillas.

Baking / Griddling

- **Three pass tortilla ovens are designed to impart a great amount of heat in a very short period of time.**
- **Heat is transferred through conduction (contact heat).**
  - Bands / belts heated by direct gas flame.
  - More closely resembles a **griddle** than an oven.
- **Typically temperature settings are 350 - 550ºF.**
- **Bake times will vary, but normally between 20 and 40 seconds.**

Baking

1. **Bottom (Back) of tortilla is baked first – Texture and blisters begin.**
2. **Top (Face) of tortilla is baked second - Texture and blister pattern are set.**
2. **The finished texture and color is completed on the final pass, pillowing will occur if temperature is too high**



Baking

- During baking the final tortilla structure is established. As internal temperatures rise, the starches swell and the proteins denature.
- Gas pressure inside the tortilla increases causing leavening.
- Crust and Blister colors are formed along with moisture being bake out.
- Time / temperature adjustments influence pillowing, toast points, and finished moisture content.

Cooling

- Allows the product temperature to lower for proper packaging.
- Tortillas cool extremely rapidly. Under 5 minutes.
- Should target a packaging temperature +/- 10ºF of room conditions to prevent condensation.
- Cooling time too short:
  - Moisture will form inside bag accelerating mold growth and increasing sticking.
- Cooling time too long:
  - Product looses too much moisture.
  - Tougher texture and reduced roll / fold shelf-life.

Packaging

- Manual
- Semi-Automatic
- Plastic bags
- “Non-breathing” Materials
- “Oxygen scavengers”
- Vacuum

Tortilla Troubleshooting

Troubleshooting

- Mixing
- Processing
- Sticking

Troubleshooting

Mixing - Undermixed dough

Troubleshooting

Mixing - Undermixed dough

Troubleshooting

Mixing - Overmixed dough

Troubleshooting

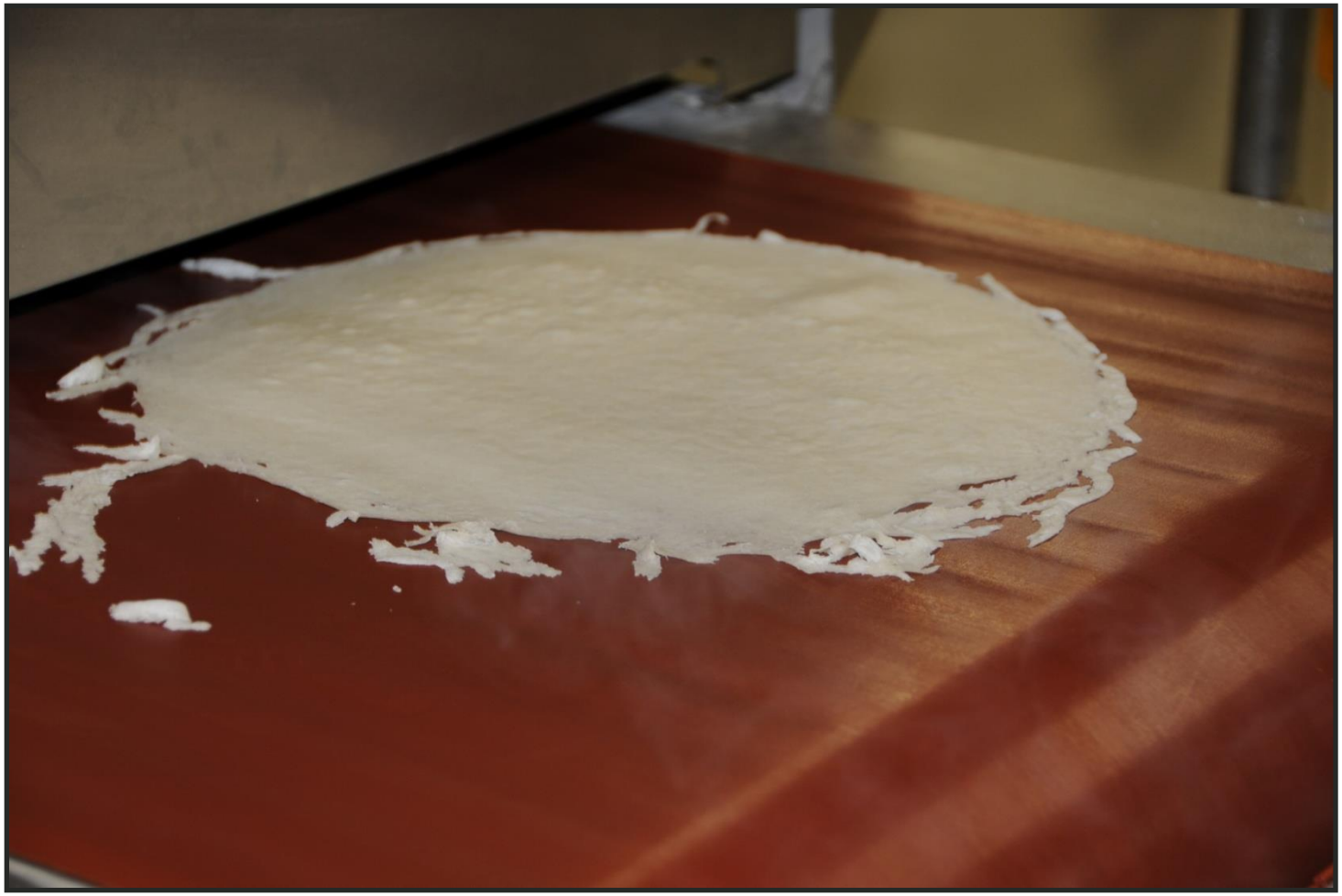
Overmixed

Undermixed

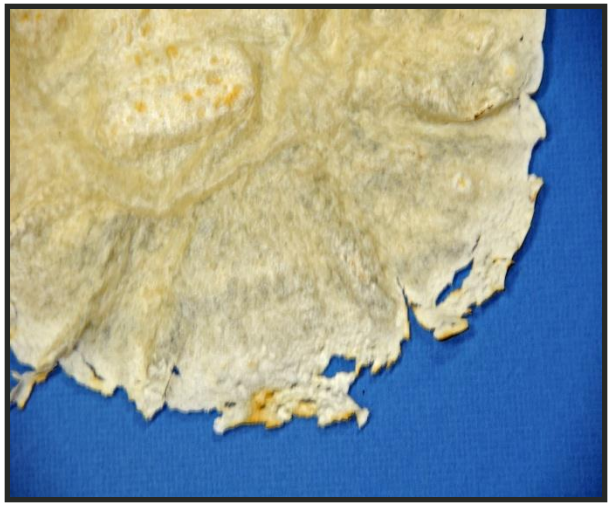
Proper Development

Troubleshooting

Press Blowout



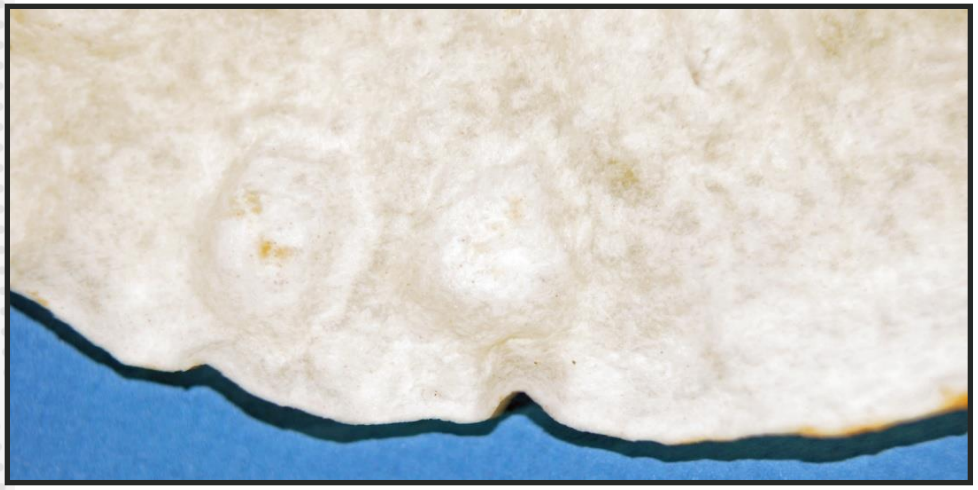
Troubleshooting



Press Blowouts Causes

- Press too Hot
- Too long of Dwell Time
- Pressure too High
- Dough Overdeveloped
- Dough Underdeveloped

Troubleshooting



Sawtooth Edges

- Dough Undermixed
- Dough Underhydrated
- Dough Dried after Mixing
- Dwell Time too Long
- Press Temperature too Hot
- Press Pressure too High

Troubleshooting

What Leads to Translucency

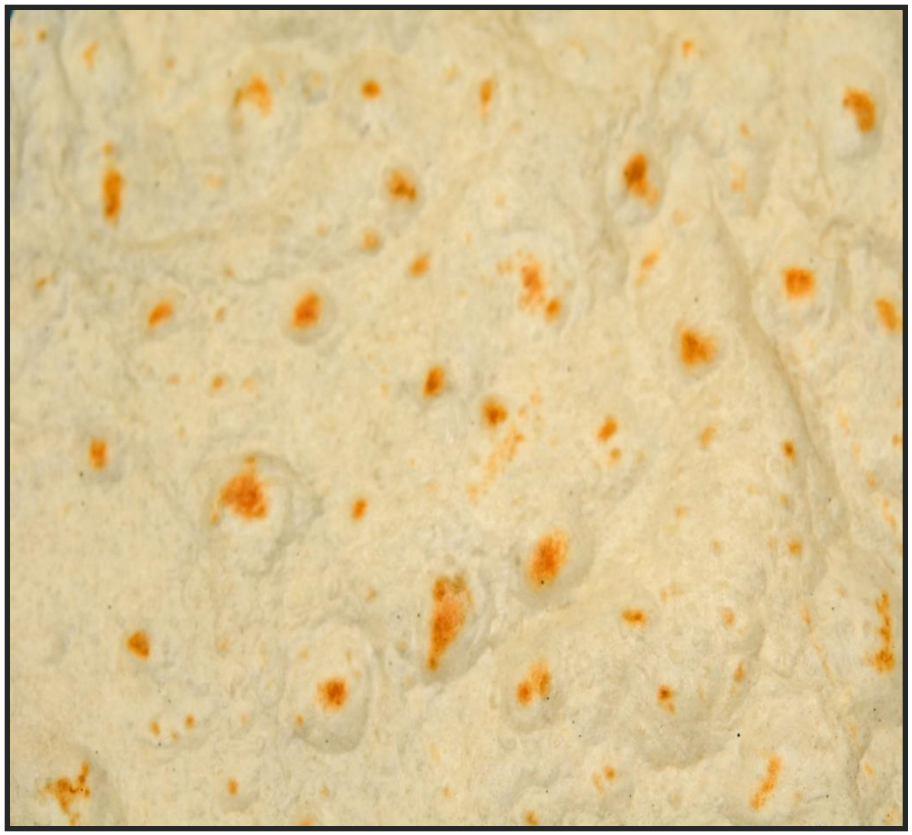
- Dough too Warm
- Dough Overmixed
- Formulation
  - Leavening
  - Too much Reducing Agents
  - Fat % too high / type of Fat
- Dwell Time too Long
- Press Temperature too Hot
- Press Pressure too High

Troubleshooting

Opacity & Translucency

Troubleshooting

Toast Points



Toast Points – Term used to describe the baked points on the blisters. Can be found on both top and bottom of the tortilla. Should be an even spread on the tortilla.

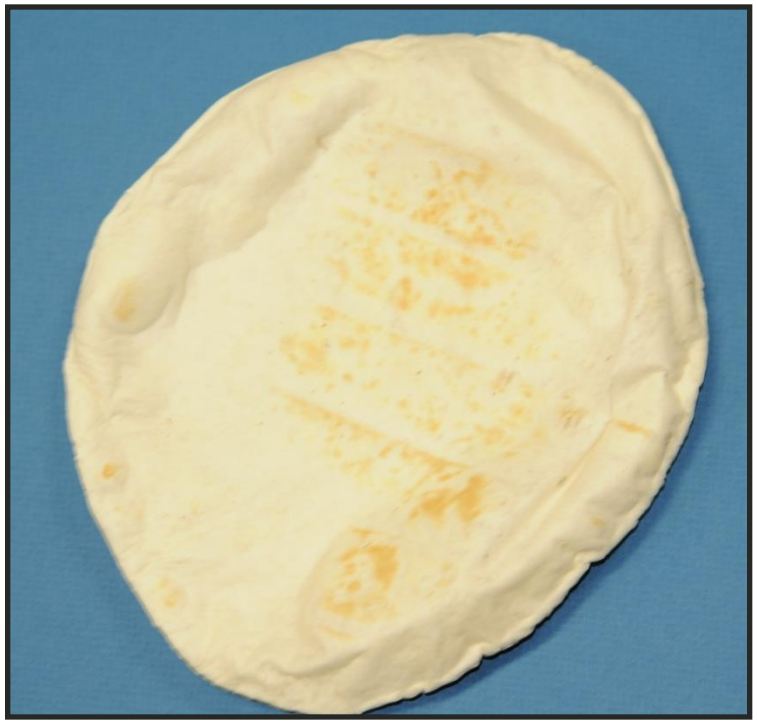
Troubleshooting

Pillowing

Troubleshooting

Pillowing

Troubleshooting



What Leads to Pillowing

- Bake Temperature
- Too much Leavening
- Oven setup

Troubleshooting

Sticking - Defined

- The Tortilla adhering to the press during the press process.

or

- Two or more tortillas that will not separate after being packaged for any period of time.

Troubleshooting

Main causes for Sticking to the Press:

- Bottom Platen hotter then the top.
- One of the heating elements in the Platen not working
- Over Mixed dough
- Absorption too high
- Formulation

Tortilla Sensory

Sensory / Product Evaluation

- **Quality**
  - Appearance
    - Size / Shape / Height
    - Toast Points / Blisters
    - Translucency
  - Sticking
  - Rollability
    - Wood Rod
  - Foldability
  - Strength
  - Flavor / Aroma
  - Mouth feel
  - Purchase Quality
    - Would you buy??

Corn Tortillas

Corn Tortillas – Just the Basics

- **Cooked Corn (Nixtamialization Process)**
  - Corn, Water, Lime (Calcium oxide, not the fruit!)
  - Cook – Wash – Steep - Mill
  - Basic (high pH) Solution - Softens tough pericarp, enhances water absorption, improves gelatinization capabilities, influences flavor & texture
- **On-Site vs. Masa Flour**
- **Formula: Corn and Water**
  - Preservatives, gums, emulsifiers, enzymes **(Emplex, Verv, UFP 1650)**
  - Whole Grain, Low in Fat, Low in Sodium, Gluten Free,…
- **Sigma Blade Mixer**
  - Not “dough” as with wheat flour – Very little development.
- **Sheeted / Rotary Cut**
- **Baked / Cooled / Packaged (or use for fried chips/shells)**

Thank You For Your Time

Corbion

Tortilla Glossary

Glossary of Flour Tortilla Terminology

- **Pillowing – The result of steam and gas production from bake and leavening action. This will make the tortilla swell completely, and is not considered a positive in the eyes of most manufacturers.**
- **Toast Points – Term used to describe the baked points on the blisters. Can be found on both top and bottom of the tortilla. Should be an even spread on the tortilla.**
- **Opacity – (opaque) Used to describe the overall whiteness of the finished product, or its inability to allow light to pass through the tortilla. This is the exact opposite of translucency.**
- **Translucency – (translucent) Used to describe the raw looking spots on cooled baked product, or the inability to stop light from passing through the tortilla. It is the exact opposite of opacity.**
- **Cracking/Breaking – A judgment of pressed and baked product that has tears or cracked edges. Relates to extensibility.**

Glossary continued

- **Sticking** – Usually means the product is fusing together in packaging. Could also mean fusing to the press or the oven shelf.
- **Batch Packing** – Synonymous with Convenience pack but also refers to bases that are convenience packed even in bulk. Mixer operator simply adds contents of bag or whole box to his formula.
- **Preblends** – This is a base containing all necessary ingredients but flour and shortening.
- **Dry Blend** – This is the process of blending in dry ingredients with flour to get even distribution. This is done before adding water and usually shortening (recommended).
- **Extensibility** – This would be the dough balls ability to spread under the press. This could also refer to the die-cut operations ability to reduce dough for cutting.

Glossary continued

- pH – An indication of its acidity. Most shelf stable tortillas are targeted at or below about 5.5.
- Acid – Refers to acidulate that impacts the pH of the finished product. Encapsulated acid is available.
- Shelf-Life – Usually referring to how long before it molds. Sometimes its flavor and appeal is also considered.
- Flour Tortilla – Tortilla that is made with wheat flour as opposed to corn tortillas.
- Gordita Style – Very fluffy thick flour tortilla.
- Burrito Style – Thin 10 inch tortilla for burrito making.
- Wraps – Usually 12 inch tortillas. Flavors in this size are popular. Some say it is synonymous with flavored (wraps).