EUROPE TECHNICAL CONFERENCE

Corbion
Keep creating

EMULSIFIERS IN TORTILLAS

Les Stanbery

AGENDA

1. Tortilla Market
2. Emulsifers 101
3. How Emulsifiers Help Tortilla Manufacturers
4. Emulsifier Portfolio

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”.**

A little bit of tortilla history…

- 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.
- 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.

MARKET INFO

1

Global Macro Trends

Conscious & Ethical Society
Shifting Global Economy
Regulatory Change
A Circular Economy: Sustainability
Health & Nutrition
Convenience
Next Gen Technology
Less Skilled Labor
Alternative Sourcing
Experience More

U.S. Consumer Values Evolving in Response to Macro-Exposures

Lifestyle

- **Food & Public Health**
  In 1990, adult obesity rate was 19% or less in all states and now, only 2 states have less than 25% rate
- **Technology**
  57% of Gen Z watch TV with a computer, tablet, or smart phone (19% of boomers)

Social

- **Liberal Politics**
  54% of Millennials lean towards Democrat compared to 44% of Boomers
- **Work-Life Blurring**
  Over 50% of parents say it is very/somewhat difficult to manage work & family
- **Knowledge Workers**
  Manufacturing jobs in 2017 are 12M (-7M from 1979) while knowledge jobs grew to 60M

Demographics

- **Diversity**
  49% of the Gen Z population is non-white compared to 28% of Boomers
- **Upmarket Shift**
  Upmarket grew from 5% of population in 1990 to 10% in 2015
- **Urbanization**
  Since 1950, the US population in urban areas grew 25%, to 81% in 2000

Family

- **Living Alone**
  27% live in a single-person household (+9% from 1970)
- **Multi-Generational**
  19% or 61M live in a multi-generational household (+7% +33.1M from 1980)
- **Gender Roles**
  Since 1965, Men's weekly hours of housework grew 6 hours as women's decreased 14 hours

Source: The Hartman Group

Tortilla Manufacturers - Key Growth Drivers

Health & Wellness

- Tortillas viewed as a healthy substitute to bread
  - Low Carb Diet Trends
  - Functional Food – Protein, Fiber, Ancient &Whole Grains
- Gluten Intolerance/Avoidance

Growing Hispanic Population

- Increased exposure & demand for Mexican food products from retail & foodservice sectors.

Eating Trends

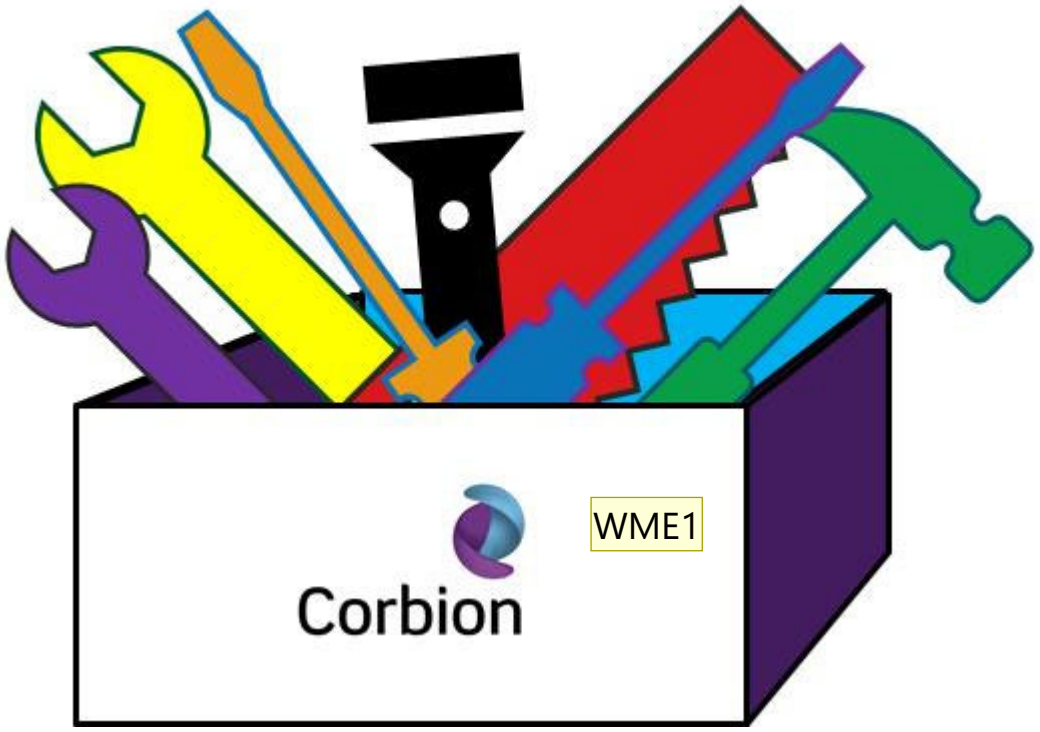
- Organic & Non GMO
- Snacking, Convenience, Portability
- Expanding day parts

EMULSIFERS 101

2

Emulsifiers are our tools in our solutions toolbox…

Goal: to show you which tools could be used for tortilla applications



Slide 10

WME1 If you can come up with a cooler 3-d toolbox image, I would love that!
Walsh, Margaret E., 10/3/2019

Key Functionalities

What is an Emulsifier?

In essence, emulsifiers are surface-active agents that aid in the interaction of two or more immiscible phases (i.e. water, oil, air) promoting stabilization.

- Starch Complexing
- Protein interaction
- Aeration
- Crystal Modification
- Lubrication & Processing Aids

Emulsifiers (aka Surface Active Agents, Surfactants, etc)

By making changes to the two portions of the molecule, Scientists can "tune" an emulsifier's functionality

Hydrophilic Head

- Glycerol
- Lactic Acid
- Sorbitol
- Propylene Glycol
- Sucrose

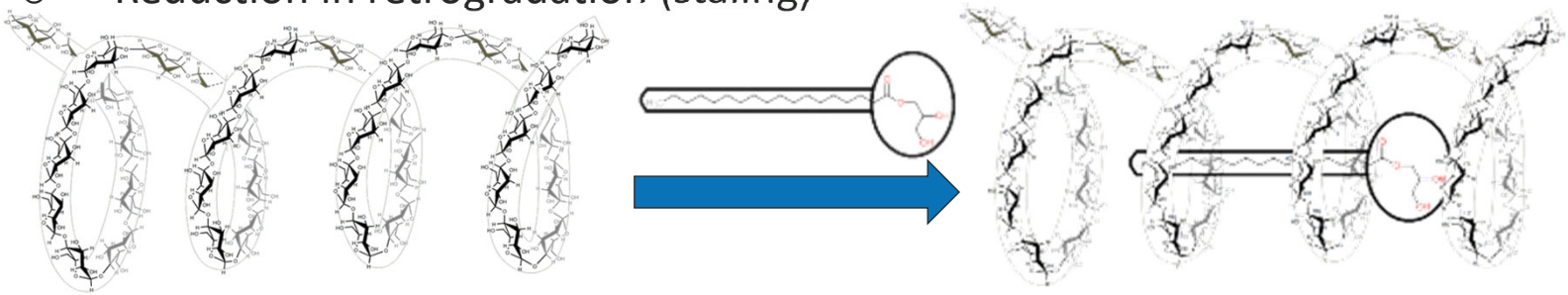
Hydrophobic Tail

- Stearic Acid (saturated fatty acid)
- Palmitic Acid (saturated fatty acid)
- Oleic Acid (unsaturated fatty acid)
- Linoleic Acid (unsaturated fatty acid)
- Etc.

Starch / Emulsifier Interactions WME3

J Cereal Sci., **1984**, *2*, 105-118.

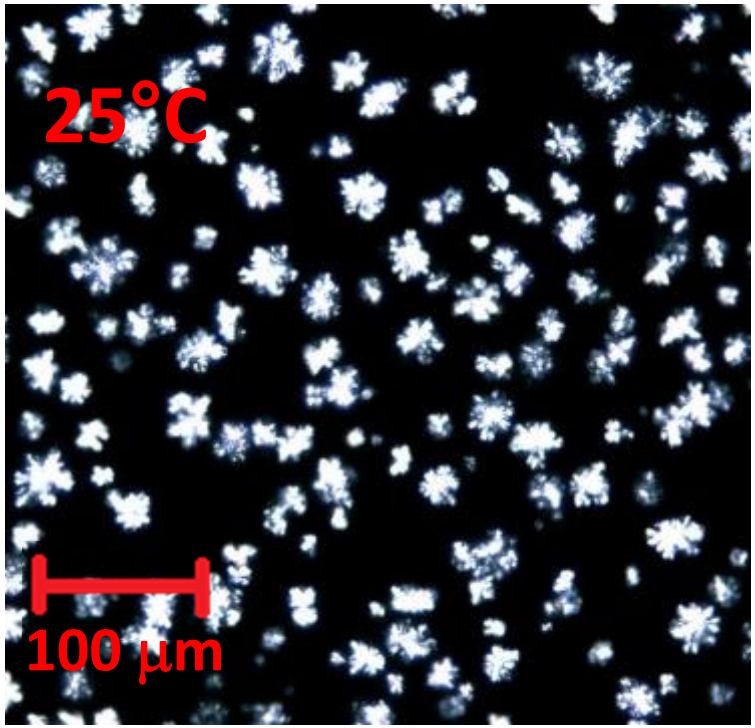
- Coat surface of starch granule delaying gelatinization and reducing
  - Starch Granule Swelling
  - Amylose Excretion
- Insertion into Starch Helix once granules rupture
  - Saturated and *trans* Emulsifiers with Small Polar Head Groups
  - Reduction in retrogradation (staling)



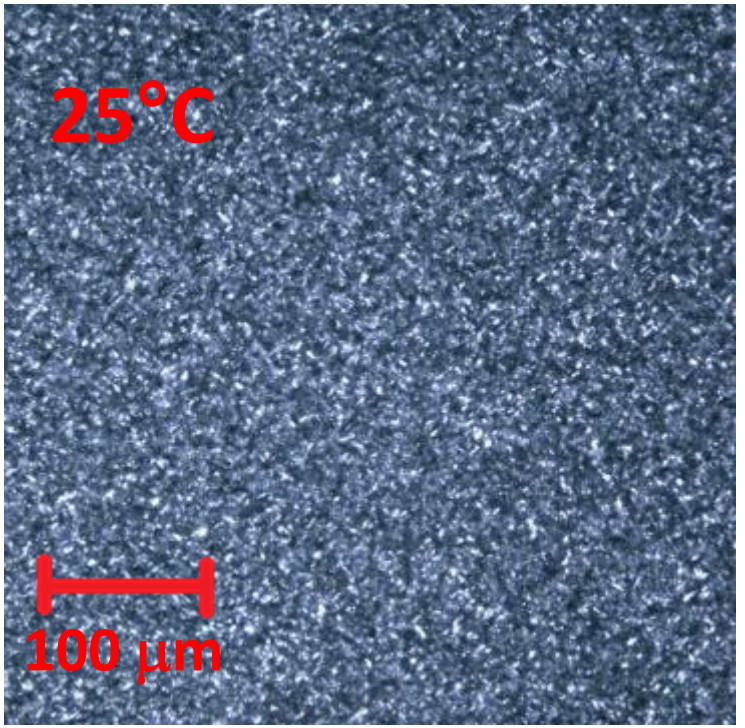
Monoglyceride	Complexing Index
monopalmitate	99%
Monooleate (cis)	9%
Monolinoleate (cis, cis)	0%

WME3 relevant to wheat-based systems in general.
Walsh, Margaret E., 10/3/2019

Microstructure Control
Crystal Cluster Size & Density WME2



***trans* Fat Free Shortening**



***trans* Fat Free Shortening with 2% Trancendim® 180**

- ✓ greater surface area
- ✓ critical to oil binding capacity

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Slide 14

WME2 Relevant to Trancendim use in tortillas

Walsh, Margaret E., 10/3/2019

HOW DO EMSULSIFIERS HELP TORTILLA MANUFACTURERS

3

ANTI STICKING

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.

Baking & Cooling

- Final MC ≈ 30-32%.
- Temperature suggested at +/- 10° F package room.
- Reduce Humidity in cooling area… <70%...Cooling rooms that rain

Pallet Configuration

- 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.

Process & Formulation

- The options go on and on, but traditional fixes are illusive
- Temper the product before going into refrigeration or freezing.
- Warehouse & Transportation temperature… Minimize temperature shifts

Factors that Affect Tortilla Stickiness

- Water Activity
- Glass Transition Temperature (Tg)
- Surface Energy
- Processing and Baking Conditions

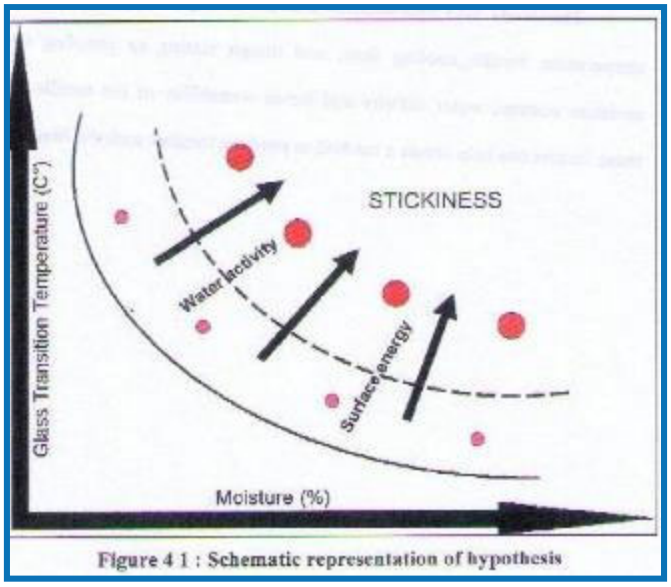

Figure 4 1 : Schematic representation of hypothesis

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Latest Anti- Stick Technology - to alter tortilla surface characteristics

- Water Activity
- Glass Transition Temperature (Tg)
- **Surface Energy**
- Processing and Baking Conditions

Hypotheses for Anti-Stick Functionality

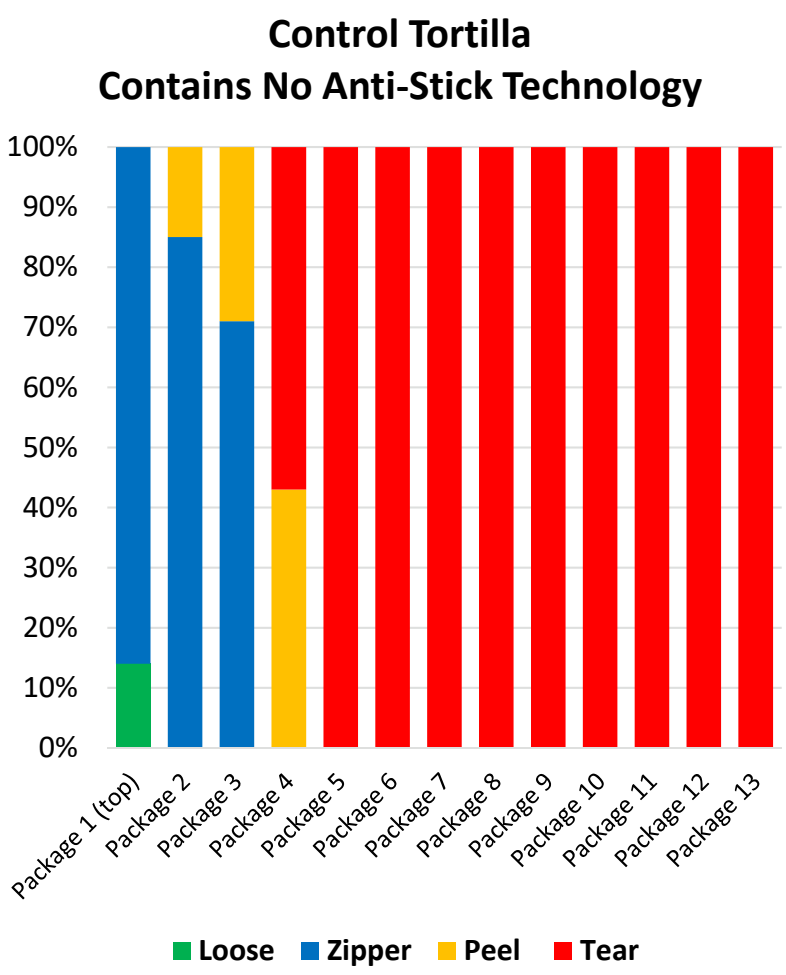
Physical modification of the tortilla surface

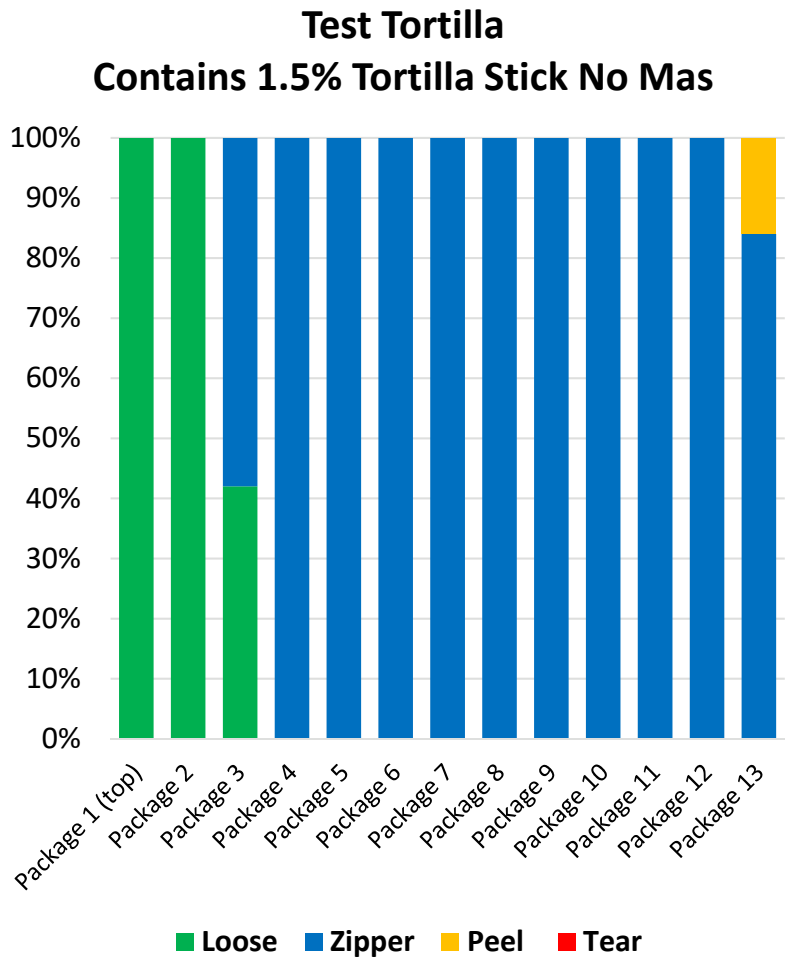
- Surface roughness – Nano or micro-scale
- Smooth vs. rough surfaces – ease of slip; number of contact points

Chemical modification of the tortilla surface

- Surface hydrophobicity/hydrophilicity
- Water bridges / migration rates

Impact of anti-stick technology on sticking tortillas





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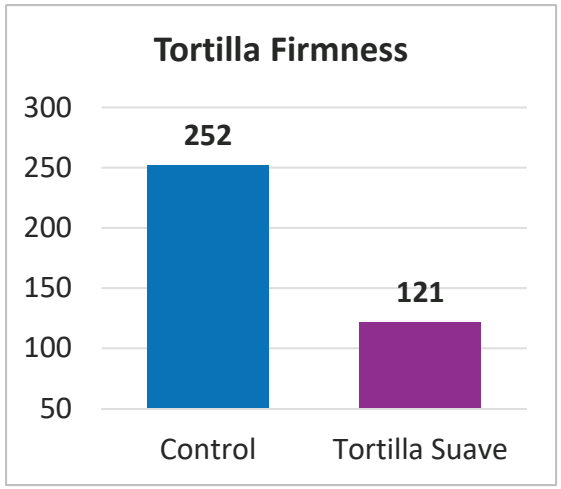
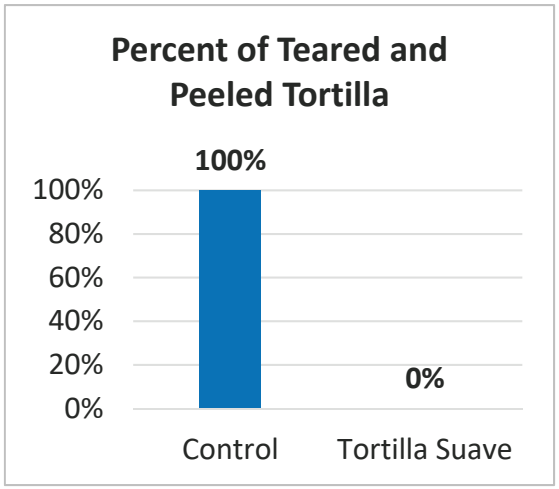
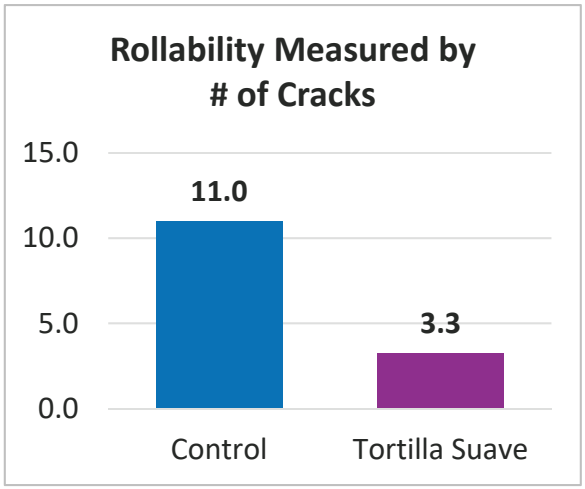
Effects of Emulsifier Systems on Tortilla Quality and Shelf Life







Summary of Results

- Tortilla Suave significantly improves the softness and flexibility of the tortilla.
- Tortilla Suave also significantly reduced the tortilla stickiness.

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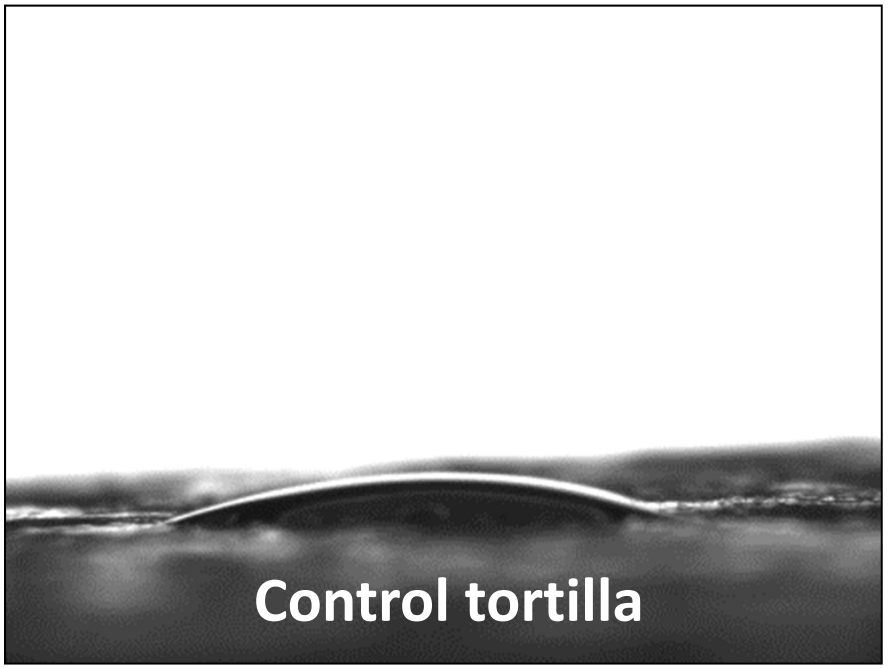
Effect of Anti-Stick Technology on Surface Energy (Wetability)

Corbion anti-stick technology reduces the tortilla surface wetability.



FRESHNESS & ANTI-STALING

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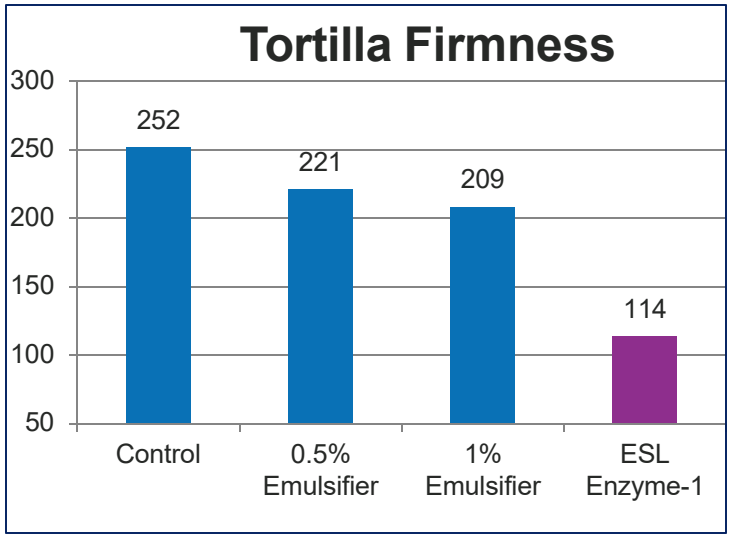
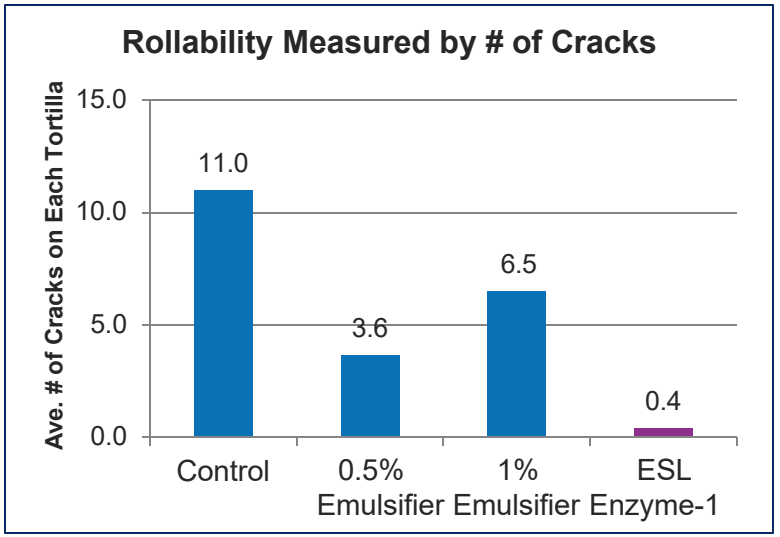
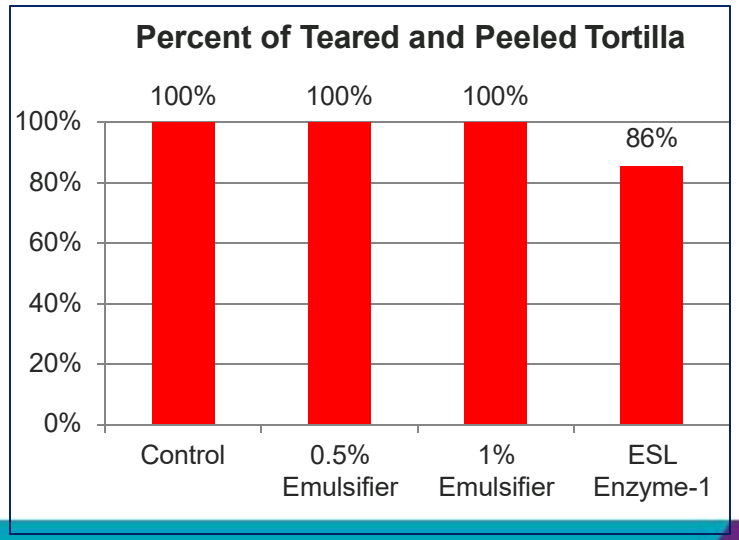
Anti-Staling Effect of Enzyme & Emulsifiers







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.

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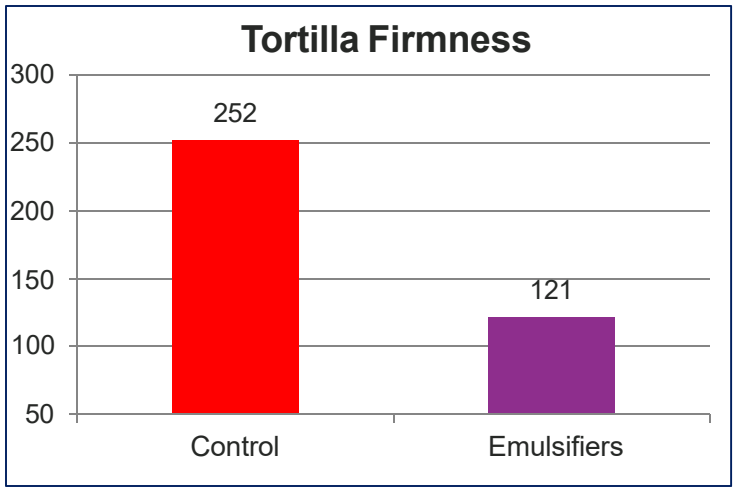
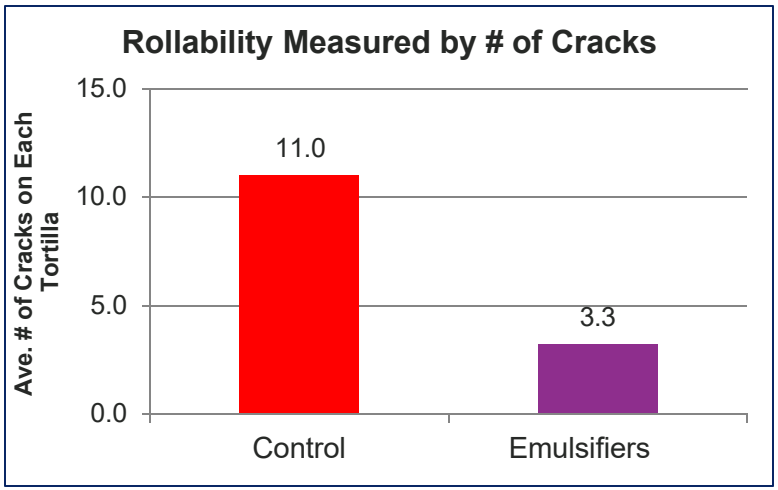
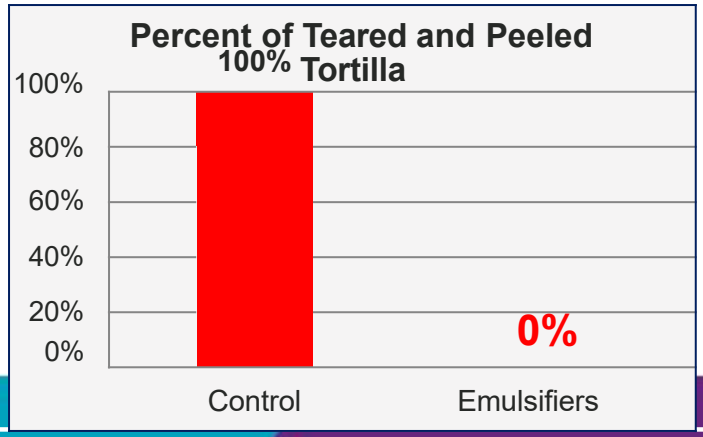
Effects of Emulsifier System on Tortilla Quality and Shelf Life

Emulsifiers significantly improves the softness and flexibility of the tortilla.

Emulsifers also significantly reduced the tortilla stickiness.







TORTILLA EMULSIFIERS

4

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Emulsifier for Tortillas

Standard Products	Product Type	Description
BFP® 550	Plastic	**Mono & Diglycerides**
BFP® 65 PLM Non-GMO		
Starplex® 590	Bead	**Monoglycerides**
Starplex® 590 F	Powder	
Starplex® 590 HS	Bead	
Trancendim® 180	Powder	**Mono & Diglycerides**
Trancendim® 110		
GMS® 520	Hydrated	**Monoglycerides**

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Mono & Diglycerides

BFP 550, BFP 65 PLM Non-GMO

Mono & diglycerides, which are very popular throughout the food industry, are the most commonly used emulsifier. They are made by reacting glycerine with specific fats, oils or fatty acids to achieve 25%-60% monoglyceride content.

The primary usage of mono & diglycerides is in bakery prepared mixes; shortenings and margarines; convenience and processed foods; and frozen desserts. Normally, they are used along with a fat system, and frequently in conjunction with other emulsifiers.

The BFP line of mono & diglycerides is available in multiple physical forms (liquids, plastics, flakes, beads and powders) for convenience and use in a broad range of applications.

Beaded Hi Diglyceride
MP: 55-70°C (131-158°F)

Primary Functions

- Emulsification
- Aeration
- Starch Complexing
- Crystal Modifier (improves set time)
- Viscosity Modifier
- Wetting and Dispersion Agents
- Release Agent/Plasticizer for Confections

Primary Function in Tortillas

- Shelf life
- Flexibility
- Ease of Wrapping

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Distilled Monoglycerides

Starplex 590, Starplex 590 F, Starplex 590 HS

Mono & diglycerides that have been further processed to increase their monoglyceride content.

Although they share the same basic applications as the BFP product line, this concentrated form is better-suited for direct addition (i.e. at the bowl) to provide crumb softening or aid in extrusion.

This emulsifier system is available in many physical forms: fine powder, powder, bead, block and liquid. Powdered versions offer good dispersability into mixes and dry applications, while block and liquid forms are more suited for delivery via shortenings.

Beaded Or Powdered
Monoglyceride
MP: 73°C (163°F)

Primary Functions

- Starch Complexing
- Emulsification
- Aeration
- Crystal Modifier (improves set time)
- Structuring Agent (reduces oil migration)
- Wetting and Dispersion Agents

Primary Function in Tortillas

- Shelf life
- Flexibility
- Ease of Wrapping

Saturated Diglycerides

Saturated Diglycerides

This emulsifier system consists of mono & diglycerides products that have been further processed to increase the diglyceride content.

It can be utilized to promote or enhance the structure of shortenings and margarines, allowing removal of trans-fat and/or reduction of saturated fat. Further, these products' unique surface interactions allow for improved slicing and release properties for baked and extruded foods.

Powdered
Mono and Diglyceride
MP: 62°C (143°F)

Primary Functions

- Crystal Modifier (control fat crystal size)
- Structuring Agent (reduces oil migration)
- Lubrication and Plasticity

Primary Function in Tortillas

- Anti-Stick
- Release

What is the difference between the different emulsifiers?

When to use…

Starplex® 590 Smallest particle size in a distilled monoglyceride. Use when dispersion is difficult due to short mixing times. Suitable for powdered blends. 90% minimum monoglyceride content.

BFP® 550 Mono & diglycerides in paste form. At temperatures of 70-75 degrees Fahrenheit becomes very plastic and moves efficiently through a ram pump. 50-57 minimum monoglyceride content

What is the difference between the different emulsifiers?

When to use…

Trancendim	Palm based powdered emulsifiers have **INFERIOR THERMAL STABILITY** and **POOR POWDER QUALITY** resulting in ingredient **HANDLING CHALLENGES**
GMS 520	Hydrated mono and diglycerides in paste for that can be easily pumped. Easy to disperse, can be used in any dough system. Ideal for no-time doughs. 21% minimum monoglyceride content.

WRAP UP

QUESTIONS

Form	Description
Flakes	Flakes are formed by cooling a thin layer of molten emulsifier onto a cool metal surface. Flaked emulsifiers are most easily melted into food systems where the process requires rapid incorporation.
Liquid	Fluid at room temperature
Molten	Some bulk emulsifiers are shipped above their melt point.
Plastic Solid	This term describes the physical form of a product. Plasticity describes the deformation of a plastic or soft emulsifier when pressure is applied. Emulsifiers that melt near room temperature are too soft to form into beads or flakes but are very functional at room temperature. Products like BFP® 65 are processed into a firm paste. The paste will spread, but not melt, when work is applied without heat (i.e., mixing).
Powders and Beads	Beads are spray-congealed solid emulsifiers with more uniform size dispersion than powders. Average particle size is typically above 100 microns. Powders, on the other hand, fall into two main categories. They are produced either through a grinding process to form irregularly shaped pieces, or a spray congealed process to form spheres with an average particle size at or below 100 microns. Beads are typically used in applications where the emulsifier will be melted into a liquid. Powders are often added to dry blends or directly to a product. Corbion does offer certain emulsifiers in both bead and powdered forms.