Tomato Sauce Application using Citri-Fi®

A break-thru technology using the natural citrus fiber’s composition to simulate tomato solids viscosity, texture and appearance.
Topics

- Fiberstar Overview
- Citri-Fi Portfolio
- Sauce Market Trends
- Structure/Function of Sauce Texturants
- Citri-Fi to Extend Tomato Solids
- Example: Tomato Sauce in a Frozen Meal
- Summary
Fiberstar Overview

Fiberstar Overview
- Privately held Company that sells its products in over 64 countries
- Headquarters & Milling: River Falls, WI
- Production Facility in Clewiston, FL

Citri-Fi® Technology
- A natural, citrus fiber produced from the orange juicing process’s byproduct
- Patented process keeps the insoluble, soluble fiber and protein intact to create high functionality ranging from hydrocolloidal functionalities to natural emulsification properties
- Labeling: Citrus fiber, orange fiber, orange pulp fiber, dried orange pulp or citrus flour which resonate well with global customer base

Citri-Fi Product Lines
- Citri-Fi 100 Series: Citrus Fiber (from pulp)
- Citri-Fi 125 Series: Citrus Fiber (from peel)
- Citri-Fi 200 Series: Citrus Fiber + Guar Gum
- Citri-Fi 300 Series: Citrus Fiber + Xanthan Gum

Key Functionalities
- Moisture Management
- Yield Improvement & Reduced Purge
- Stabilization
- Natural Emulsification Properties
- Gelling Properties in Brix/Low pH
- Texturizing
- Plating Technology

Food Applications
- Meats (Injected, Emulsified, Ground)
- Vegetarian Meat Analogs
- Baked Goods (Regular and Gluten-free)
- Bakery Fillings
- Dairy (Beverage, Yogurt, Ice Cream)
- Sauces & Dressings
- Beverages
Our main product line that includes 10 product types differentiated by composition and/or particle size. The products have great versatility in the application scope that includes meat, bakery, beverages, sauces and dressings, prepared foods, dairy, soups, fruits and vegetables, pet food etc. CF100 & 125. **Labeling: citrus fiber, dried citrus pulp, citrus flour**

<table>
<thead>
<tr>
<th>Product Series</th>
<th>Description</th>
<th>Available Grinds</th>
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<tbody>
<tr>
<td>Citri-Fi 100 Series</td>
<td>Enhanced Citrus Fiber</td>
<td>Standard, Fine, M40 and M20</td>
</tr>
<tr>
<td>Citri-Fi 125 Series</td>
<td>Enhanced Citrus Peel Fiber</td>
<td>Fine and M40</td>
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<tr>
<td>Citri-Fi 200 Series</td>
<td>Enhanced Citrus Fiber Co-Processed with Guar Gum</td>
<td>Standard and Fine</td>
</tr>
<tr>
<td>Citri-Fi 300 Series</td>
<td>Enhanced Citrus Fiber Co-Processed with Xanthan Gum</td>
<td>Fine and M40</td>
</tr>
</tbody>
</table>
North America
Sauce Category Trends

• **Clean Label, Natural, Transparency and Simplicity**
  • Label reading consumers demanding removal of artificial, chemical-based or non-conventional ingredients
  • Brand loyalty and trust is also driving what is considered natural vs. not natural

• **Flavors & Ethnicity**
  • Younger generations demanding healthier and more flavorful products¹
  • Ingredients from a wider variety of cultures, spicy levels and ethnic qualities¹
  • Examples: Sriracha Ketchup, Heinz Flavored Ketchups, Red Gold sriracha ketchup and salsa products¹

• **Traditional Sauces & Condiments Suffer from Stagnant Sales**

• **Gourmet Cooking Trend¹**
  • Internet cooking blogs and demonstrations as well as TV cooking shows
  • Grilling still a growing trend

• **Convenience is King**
  • Busy lifestyles demanding easy preparation sauces
  • Examples: McCormick skillet sauces

1) Euromonitor, 2016
North America
Prepared Meals Category Trends

• Foodservice is Back In Business¹
  • Uptick in economy caused consumers to switch from eating home frozen meals to eating out
  • Consumers looking for nutritious and healthier food options
  • Frozen meals have a negative perception: salty, fatty, etc.

• Convenience is Still Key¹
  • Refrigerated meal kits are perceived to be fresher and more nutritious than frozen meals
  • Meal delivery services
    • Meal plan services such as Blue Apron are providing convenient recipes, perishable/non-perishable foods to use and cook times under a hour
    • Digital ordering, take-out and delivery services make it easy

¹) Euromonitor, 2016
## Citri-Fi® Clean Label Solutions

### Citri-Fi Clean Label Replacement/Reduction Solutions

<table>
<thead>
<tr>
<th>Replacement Ingredient</th>
<th>Meats</th>
<th>Bakery</th>
<th>Dairy</th>
<th>Sauces/Spreads</th>
<th>Beverages</th>
<th>Plating</th>
<th>Confection</th>
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<tr>
<td>Maltodextrin</td>
<td>♦</td>
<td></td>
<td></td>
<td>♦</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Starches</td>
<td>♦</td>
<td>♦</td>
<td>♦</td>
<td>♦</td>
<td>♦</td>
<td>♦</td>
<td></td>
</tr>
<tr>
<td>Pectin</td>
<td></td>
<td></td>
<td>♦</td>
<td>♦</td>
<td></td>
<td>♦</td>
<td></td>
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<tr>
<td>Certain Gums</td>
<td></td>
<td></td>
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<td>♦</td>
<td></td>
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<td>♦</td>
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<td>Cellulose Products</td>
<td>♦</td>
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<td>♦</td>
<td>♦</td>
<td></td>
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<td>♦</td>
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<tr>
<td>Allergens (e.g. soy, wheat, gluten, egg)</td>
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<td>♦</td>
<td>♦</td>
<td>♦</td>
<td>♦</td>
<td>♦</td>
<td>♦</td>
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<tr>
<td>Hydrogenated Fats</td>
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<td></td>
<td></td>
<td>♦</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Phosphates</td>
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<td></td>
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<td>Titanium Dioxide</td>
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<td></td>
<td></td>
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<tr>
<td>Sodium*</td>
<td>♦</td>
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<td></td>
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<tr>
<td>Silicates</td>
<td>♦</td>
<td></td>
<td></td>
<td>♦</td>
<td></td>
<td></td>
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<tr>
<td>Chemical Emulsifiers</td>
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<td></td>
<td></td>
<td>♦</td>
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<td></td>
<td></td>
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<tr>
<td>Chemical Stabilizers</td>
<td>♦</td>
<td></td>
<td>♦</td>
<td>♦</td>
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<td></td>
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</table>

* Dependent on brine injection formulations
Technical Review

Citri-fi

FiberStar
Enhancing Products...Naturally
• Citri-Fi is natural citrus fiber with a unique composition

<table>
<thead>
<tr>
<th></th>
<th>Citri-Fi 100 (pulp)</th>
<th>Citri-Fi 125 (peel)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble Fiber</td>
<td>33.3%</td>
<td>44.3%</td>
</tr>
<tr>
<td>Insoluble Fiber</td>
<td>34.9%</td>
<td>38.1%</td>
</tr>
<tr>
<td>Total Fiber</td>
<td>68.2%</td>
<td>82.4%</td>
</tr>
<tr>
<td>Protein</td>
<td>8.15%</td>
<td>5.71%</td>
</tr>
</tbody>
</table>

• Citri-Fi is left in its natural form, it is not extracted or isolated

• Complex form gives a number of unique functionalities as a food ingredient

• One ingredient with multiple functionalities

Making the Case for Texture

Starches, Maltodextrins, Flours and Roux

1. Exist as granules (generally spherical) in a wide range of diameters (2 – 100 microns)
2. Insoluble and swell like a balloon during heating to gain viscosity, will eventually burst (losing viscosity) if not modified
3. Not acid-stable or freeze-thaw stable generally
4. Can give a pasty texture in tomato sauces
Gums and Hydrocolloids

1. Even though gums are soluble, they are very big molecules that can bind up large volumes of water at low concentrations.

2. How the gum responds to shear forces in the mouth determines the perceived texture.

3. Sliminess or gumminess is a common trait.

4. Leads to an unnatural texture and mouthfeel in tomato sauces.
The Case for Texture

Tomato Pulp Cells

Citrus Pulp Cells

Tomato Fibers are Similar to Citrus Fiber

1. Insoluble fibers, that are very difficult to see.
2. Linear shreds of fiber, with high surface area and entanglements
3. Pectin reinforces the entanglements
4. Tomato sauces are traditionally thickened this way
5. Natural mouthfeel
Shredding the Cells with Shear

Tomato cells as they exist in the tomato fruit

Tomato cells as they exist in tomato paste

Tomato cells as they exist in processed sauce
Citri-Fi Process

**Unique Functionality:** Citri-Fi begins as raw orange fiber after the juicing process. The natural cell structure is mechanically processed to create the extended surface area individual to Citri-Fi.
Starches and gums cannot effectively recreate the texture and natural mouthfeel of a tomato sauce, but Citri-Fi 125 can!

12% NTSS Tomato Sauce

12% NTSS Tomato Sauce 0.2% Citri-Fi 125FG
Tomato Sauce Microstructure with Added Starch

- Tomato Sauce with added potato starch
- Tomato Sauce with added maize starch
- Tomato Sauce without added thickeners
Thicker, Richer Tomato Sauces

**Highlights**

- Large boosts in *sauce thickness* can be achieved using <1% Citri-Fi 125FG.
- Use *shear to comingle* the tomato and citrus fibers intimately.
- Can use technique to:
  - reduce cost while maintaining texture and flavor
  - or, drive preference by improving body, color and flavor

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![Graph showing the effect of shear on thickness](image-url)
Ingredients:

• Citri-Fi 125 FG @ 0.2 to 0.4%
• Tomato Paste 31% NTSS Hot break
• Water

Procedure for a 12% NTSS Sauce:

1. For every 100 kg of sauce, 12 kg of tomato solids needed.
2. Since paste has 31% solids, use $12 \div 0.31 = 38.7$ kg of paste per 100 kg batch.
3. Cut paste with a portion of the water and wash into a batch tank with stirring. Rinse all paste into batch tank and make to batch volume with water.
4. Add Citri-Fi 125FG slowly and mix vigorously.
5. Heat to pasteurization temperature and hold.
6. Pump into a 1-stage homogenizer at desired pressure (2500 psi, unless otherwise stated).
7. Hot fill into glass jars.
8. Verify NTSS by measuring Brix with a refractometer.
Use a Bostwick To Measure How Thick And Rich The Sauce Is

(lower numbers are thicker)

12% NTSS Control
2500 psi homogenization
Bostwick = 6.3

12% NTSS + 0.2% CF125FG
2500 psi homogenization
Bostwick = 4.4
Improving Texture of Tomato-based Sauces with Citri-Fi® 125

Boost the quality of tomato sauces without adding tomato cost or unnatural thickeners

Value Proposition:
A classic tomato sauce is thickened by an abundance of insoluble fibers and pectin that give it its unique texture and flavor release. Citri-Fi is a cost-effective, concentrated source of very similar fibers and pectin that simulate the tomato composition compared to traditional modified starch and gum thickeners. This unique natural citrus fiber:

- Creates a texture matching the hearty texture of tomato sauces
- Maintains tomato color and flavor
- Supports clean label declarations – no E-number
- Provides potential cost savings vs. using tomato
Improving Texture of Tomato-based Sauces with Citri-Fi® 125

Formulation:

<table>
<thead>
<tr>
<th>Simple Enhanced Tomato Sauce</th>
<th>Control 0.0% Citri-Fi 125FG</th>
<th>Control %</th>
<th>Citri-Fi 125 0.2% Citri-Fi 125FG</th>
<th>Citri-Fi 125 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato Paste (31% NTSS, HB)</td>
<td>96.78</td>
<td>38.7</td>
<td>96.58</td>
<td>38.6</td>
</tr>
<tr>
<td>Water</td>
<td>153.23</td>
<td>61.3</td>
<td>152.92</td>
<td>61.2</td>
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<tr>
<td>Citri-Fi 125FG</td>
<td>0.00</td>
<td>0.0</td>
<td>0.50</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>250.00</td>
<td>100.0</td>
<td>250.00</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Procedure:
1. Cut paste with portions of water, or mix vigorously in a Likwifier or similar batching tank.
2. Mix in Citri-Fi 125FG, with good agitation.
3. Heat to pasteurization conditions.
4. While still hot, pump through a homogenizer at 2500 psi.
5. Hot fill or aseptically fill into containers, or alternatively use directly as an ingredient in a downstream product such as a prepared meal or another sauce or condiment.

Above: A commercial marinara sauce extended with modified starch and xanthan gum. Note the long, gel-like texture.
Removing Tomato Cost

Tomato Paste & Sauce Overview
• Tomato paste is sold on the basis of how concentrated it is, as measured by brix
• Abbreviated NTSS (Natural Tomato Soluble Solids)
• However, the thickness of tomato sauce is much more determined by:
  - Pectin - quantity and quality
  - Tomato cell wall fibers

How Citri-Fi 125 Works
• Citri-Fi 125FG is a convenient, concentrated form of cell wall fibers and high-quality pectin from orange cells
• Supplementing Citri-Fi 125FG can boost the tomato's natural thickening mechanism
Cost Savings Estimate


- Cost savings are achievable for sauces that depend on tomato for thickness
- Price basis:
  - 31% NTSS tomato paste @ $0.40/lb
  - Citri-Fi 125FG @ $3.50/lb
- Natural variations in tomato paste can impact the viscosity effect
Making the Case for Improving Tomato Sauce Organoleptic Quality

Blind Internal Sensory Panel
12% NTSS Tomato Sauce

- Adding CF125FG without reducing tomato solids:
  - Improves color
  - Improves flavor
  - Improves thickness
  - Improves preference
Use a “System” Approach for Citri-Fi in Sauces

Tomato Sauces
• Natural mouthfeel & texture  
  • Not pasty  
  • Not gummy  
• Clean label  
• Water holding  
  • Syneresis/weeping  
  • Freeze thaw  
• Paste extension for cost reduction

Emulsified Sauces
• Can form highly stable emulsions with very little shear  
• Clean label  
• Prevent breaking of delicate sauces  
• Gravies and marinades stay homogenous when cooked with meats that generate free fat

Above: Extending tomato paste with gums and starches can lead to an unnatural texture
Envisioning Citri-Fi in a Frozen Lasagna Example

Benefits

• Improved body or cost-out in tomato sauce
• Oil/Fat control
  • Eliminating greasing-off
  • Cheese oiling-off
• Freeze thaw stability during freezer abuse
• Water control from:
  • Sauce syneresis
  • Condensate in package
  • Weeping from vegetables
• Microwavability
• Improving sodium taste impact
Chunky Versus Smooth Sauce

• Some manufacturers may want visible vegetable pieces
• Often possible to have 2 streams
  1. “Juice”
  2. Vegetable dice or chunks
• Thicken the juice phase with CF125FG and homogenization before adding to the dice or chunks
Citri-Fi Keeps Food Uniform

- Emulsification of oil into product for a dual role of improved appearance and mouthfeel of final product.
- Some tomato sauces like sofrito or pizza sauce traditionally add oil
- Optionally can add spices in essential oil form plated onto Citri-Fi for a fresher taste
Fiber Comparisons

Water Holding Capacity of Various Fibers in a Centrifuge
A comparison of the water binding functionality of various fibers measured in ml of water retained per gram of fiber.

Water Holding Capacity of Various Fibers in Meatballs
Each product was used in identical meatball formulas (ground meat, salt and fiber). After cooking, the meatballs were weighed to compare yields. Meatballs containing 1.0% Citri-Fi 100 held 2.1 times more water than meatballs containing 1.0% wheat fiber. Meatballs made with potato 300 and wheat 600 purged more water than the control meatballs that contained no fiber.

*Water Holding Capacity Measured by the AACC - Standard Method # 56 - 30
Related Applications

- Syneresis, wateriness
- Thickening, cost-out
- Oil control
- Mouthfeel, body
- Freeze-thaw
# Citri-Fi 125 Benefits in Tomato Products Vs. Other Solutions

## Favorable Market Positioning

<table>
<thead>
<tr>
<th>Benefit Attributes</th>
<th>Citri-Fi 125</th>
<th>Modified Starches</th>
<th>Xanthan Gum</th>
<th>Guar Gum</th>
<th>Carrot Fiber</th>
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</thead>
<tbody>
<tr>
<td><strong>Labeling</strong></td>
<td>Citrus Fiber, Dried Citrus Peel, Citrus Flour</td>
<td>Modified Starches</td>
<td>Xanthan Gum</td>
<td>Guar Gum</td>
<td>Carrot Fiber</td>
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<td>Clean Label*</td>
<td>Yes</td>
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<td>Depends?</td>
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<td>Non-GMO</td>
<td>Yes</td>
<td>Yes - $$$</td>
<td>Yes - $$$</td>
<td>Yes - $$$</td>
<td>Yes</td>
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<td>Natural*</td>
<td>Yes</td>
<td>No</td>
<td>Depends</td>
<td>Depends</td>
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<td>Organic</td>
<td>National Organic Program</td>
<td>Yes - $$$</td>
<td>Yes - $$$</td>
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<td>Allergen-free</td>
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<td>2-6%</td>
<td>0.2%</td>
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<td>Emulsion Properties</td>
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<td>No</td>
<td>No</td>
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<td>Freeze/thaw Stability</td>
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<td>Depends</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Flavor</td>
<td>Good</td>
<td>Masks the Tomato Flavor</td>
<td>Neutral</td>
<td>Neutral</td>
<td>Off-flavor</td>
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<td>Color</td>
<td>Good</td>
<td>Orange/Pink</td>
<td>Good</td>
<td>Good</td>
<td>Off-Color</td>
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<td>Appearance</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Color Issues</td>
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<tr>
<td>Texture</td>
<td>Rich, Delicious, Pulpiness</td>
<td>Pasty</td>
<td>Thick, Slimy, Gummy</td>
<td>Dense &amp; Gummy</td>
<td>Neutral</td>
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<tr>
<td>Availability</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Limited</td>
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</table>

*Subjectivity due to no Regulation

## Favorable Market Positioning

- **Citri-Fi 125**
- **Modified Starches**
- **Xanthan Gum**
- **Guar Gum**
- **Carrot Fiber**

### Labeling:
- **Citri-Fi 125**: Yes
- **Modified Starches**: Depends?
- **Xanthan Gum**: Depends?
- **Guar Gum**: Depends?
- **Carrot Fiber**: Yes

### Clean Label*:
- **Citri-Fi 125**: Yes
- **Modified Starches**: Yes - $$$
- **Xanthan Gum**: Yes - $$$
- **Guar Gum**: Yes - $$$
- **Carrot Fiber**: Yes

### Non-GMO:
- **Citri-Fi 125**: Yes
- **Modified Starches**: Yes - $$$
- **Xanthan Gum**: Yes - $$$
- **Guar Gum**: Yes - $$$
- **Carrot Fiber**: Yes

### Natural*:
- **Citri-Fi 125**: Yes
- **Modified Starches**: No
- **Xanthan Gum**: Depends
- **Guar Gum**: Depends
- **Carrot Fiber**: Yes

### Organic:
- **Citri-Fi 125**: National Organic Program
- **Modified Starches**: Yes - $$$
- **Xanthan Gum**: Yes - $$$
- **Guar Gum**: --
- **Carrot Fiber**: --

### Allergen-free:
- **Citri-Fi 125**: Yes
- **Modified Starches**: Depends (corn, wheat)
- **Xanthan Gum**: Depends
- **Guar Gum**: Yes
- **Carrot Fiber**: Yes

### Usage (%):
- **Citri-Fi 125**: ~0.2%-0.4%
- **Modified Starches**: 2-6%
- **Xanthan Gum**: 0.2%
- **Guar Gum**: 0.2%
- **Carrot Fiber**: ~1%

### Low pH/Heat Stability:
- **Citri-Fi 125**: Yes
- **Modified Starches**: Depends
- **Xanthan Gum**: Yes
- **Guar Gum**: Yes
- **Carrot Fiber**: --

### Emulsion Properties:
- **Citri-Fi 125**: Yes
- **Modified Starches**: No
- **Xanthan Gum**: No
- **Guar Gum**: No
- **Carrot Fiber**: --

### Freeze/thaw Stability:
- **Citri-Fi 125**: Yes
- **Modified Starches**: Depends
- **Xanthan Gum**: Yes
- **Guar Gum**: Yes
- **Carrot Fiber**: --

### Flavor:
- **Citri-Fi 125**: Good
- **Modified Starches**: Masks the Tomato Flavor
- **Xanthan Gum**: Neutral
- **Guar Gum**: Neutral
- **Carrot Fiber**: Off-flavor

### Color:
- **Citri-Fi 125**: Good
- **Modified Starches**: Orange/Pink
- **Xanthan Gum**: Good
- **Guar Gum**: Good
- **Carrot Fiber**: Off-Color

### Appearance:
- **Citri-Fi 125**: Good
- **Modified Starches**: Good
- **Xanthan Gum**: Good
- **Guar Gum**: Good
- **Carrot Fiber**: Color Issues

### Texture:
- **Citri-Fi 125**: Rich, Delicious, Pulpiness
- **Modified Starches**: Pasty
- **Xanthan Gum**: Thick, Slimy, Gummy
- **Guar Gum**: Dense & Gummy
- **Carrot Fiber**: Neutral

### Availability:
- **Citri-Fi 125**: Yes
- **Modified Starches**: Yes
- **Xanthan Gum**: Yes
- **Guar Gum**: Yes
- **Carrot Fiber**: Limited
Thank you!

Citri-fi®

FIBERSTAR®
Enhancing Products...Naturally
Appendix
Water and Oil Binding

- Citri-Fi binds oil and water naturally due to the way nature assembled it.
- Oil is actively drawn into particles through access points generated by Fiberstar’s patented process.
- Oils are quite content to stay inside hydrophobic capillaries, note the striations.
Citri-Fi 125 Emulsification

Fluorescent Micrograph of Hydrated Citri-Fi 125 + Oil

**Color Legend**

- **Insoluble Fiber**: Trapping oil droplets
- **Soluble Fiber** (Pectin): Sticks particles together
- **Oil**: stabilized by fiber components
## Emulsion Stabilizing Index Comparisons

<table>
<thead>
<tr>
<th>Emulsifier/Fiber</th>
<th>Emulsion Stabilizing Index number</th>
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<tbody>
<tr>
<td>100M20</td>
<td>5.64</td>
</tr>
<tr>
<td>125FG</td>
<td>5.82</td>
</tr>
<tr>
<td>100M40</td>
<td>6.03</td>
</tr>
<tr>
<td>100</td>
<td>6.73</td>
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<tr>
<td>125M40</td>
<td>6.73</td>
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<tr>
<td>100FG</td>
<td>7.97</td>
</tr>
<tr>
<td>100FG (water dispersion)</td>
<td>7.98</td>
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</table>

Comparisons to other fibers & emulsifiers:

- Oat Fiber: 1.01
- Lecithin: 2.90
- Carrot Fiber: 3.95
- Mono/diglyceride: 4.59
Emulsion Stabilizing Index Comparisons

Test Procedure:

- Weigh out 100 g pure vegetable oil, 360 g DI water, and 2.3 g emulsifier
- Place 100 g of oil into blender container and slowly add emulsifier while mixing (by hand)
- Add 360 g of water to blender container
- Shear for 3 minutes on low speed
- Place 40 grams of mixture into centrifuge tube (3 tubes, 120 g total)
- Centrifuge for 10 minutes at 1000 rpm
- Measure free oil of sample
- Increase emulsifier by 2.3 g until separation does not occur or emulsion stabilizing index reaches 1.
- Divide 100 g by the amount of emulsifier needed to make emulsion stable
FORMULA:

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Control Unit</th>
<th>Control %</th>
<th>15% Pulp Replacement Unit</th>
<th>15% Pulp Replacement %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>232</td>
<td>58.00</td>
<td>232</td>
<td>58.00</td>
</tr>
<tr>
<td>Mango Pulp</td>
<td>140</td>
<td>35.00</td>
<td>119</td>
<td>29.80</td>
</tr>
<tr>
<td>Sugar</td>
<td>28</td>
<td>7.00</td>
<td>28</td>
<td>7.00</td>
</tr>
<tr>
<td>Citri-Fi 100</td>
<td>0</td>
<td>0.00</td>
<td>1.5</td>
<td>0.37</td>
</tr>
<tr>
<td>Additional water</td>
<td>0</td>
<td>0.00</td>
<td>19.5</td>
<td>4.83</td>
</tr>
<tr>
<td>Total</td>
<td>400</td>
<td>100</td>
<td>400</td>
<td>100</td>
</tr>
</tbody>
</table>

CITRI-FI® USAGE:

- **Amount of Citri-fi:**
  - To achieve a 15% reduction, 21 units of pulp were replaced with 1.5 units of Citri-Fi 100 and 19.5 units of additional water to equal the 21 units of pulp removed. This calculation is based on the recommended Citri-Fi to water ratio, 1:13.

- **How to add Citri-fi:**
  - Pre-mix Citri-Fi with formula dry ingredients, such as the sugar. Add additional water with the other liquid ingredients in the formulation.
Pulp Replacement Example 2

Replacement Of 20% Tomato Paste Concentrate Using Citri-Fi 200 At 1:10 Ratio With Water

Basic Formulation with Tomato Sauce

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Control</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato Concentrate</td>
<td>20%</td>
<td>16%</td>
</tr>
<tr>
<td>Citri-Fi 200</td>
<td>0%</td>
<td>0.36%</td>
</tr>
<tr>
<td>Sugar</td>
<td>17%</td>
<td>17%</td>
</tr>
<tr>
<td>5% Vinegar</td>
<td>16%</td>
<td>16%</td>
</tr>
<tr>
<td>Starch and gums</td>
<td>4.60%</td>
<td>4.60%</td>
</tr>
<tr>
<td>Salt</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Spices and Flavors</td>
<td>0.20%</td>
<td>0.20%</td>
</tr>
<tr>
<td>Preservatives</td>
<td>0.10%</td>
<td>0.10%</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td>39.10%</td>
<td>42.74%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Physico Chemical Analysis

<table>
<thead>
<tr>
<th></th>
<th>Acidity</th>
<th>pH</th>
<th>Brix</th>
<th>Consistency (cm)</th>
<th>Viscosity (mPa.s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.07</td>
<td>3.75</td>
<td>29.6</td>
<td>4.5</td>
<td>2520.05</td>
</tr>
<tr>
<td>Test</td>
<td>1.02</td>
<td>3.67</td>
<td>29.5</td>
<td>4.5</td>
<td>2870.14</td>
</tr>
</tbody>
</table>

Consistency was measured using Bostwick Consistency meter 25C 30s Bohlin viscometer

Mixing procedures:
Disperse Citri-Fi with the other dry ingredients, adjusting the water of the formulation according to the level of hydration used. The additional water level can be adjusted based on the texture requirements

Formulation was developed by Tecnas www.tecnas.com.co
Fiberstar’s distributor in Colombia
# Pulp Replacement Example 3

## Pulp Extension In Baking Stable Fruit Preparations

<table>
<thead>
<tr>
<th></th>
<th>with Pectin</th>
<th>Citri-Fi &amp; Reduced Pulp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple Puree</td>
<td>300</td>
<td>250</td>
</tr>
<tr>
<td>Lemon Juice</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>Sugar</td>
<td>600</td>
<td>605</td>
</tr>
<tr>
<td>Citri-Fi 100 M40</td>
<td>-</td>
<td>24</td>
</tr>
<tr>
<td>LM Pectin</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td>Tri-Na-Citrate</td>
<td>1.5</td>
<td>-</td>
</tr>
<tr>
<td>Tri-Ca-Dicitrate</td>
<td>1.0</td>
<td>-</td>
</tr>
<tr>
<td>Citric Acid (50 % solution)</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Water</td>
<td>125</td>
<td>140</td>
</tr>
<tr>
<td>Input Soluble Solids (°Bx)</td>
<td>~1040</td>
<td>~1040</td>
</tr>
</tbody>
</table>

**Benefits:**
- 17% pulp replacement with 2.4% of Citri-Fi
- Clean label formulation