Citri-Fi® Natural Citrus Fiber
"Using Shear to Improve Sauces and Dressings"

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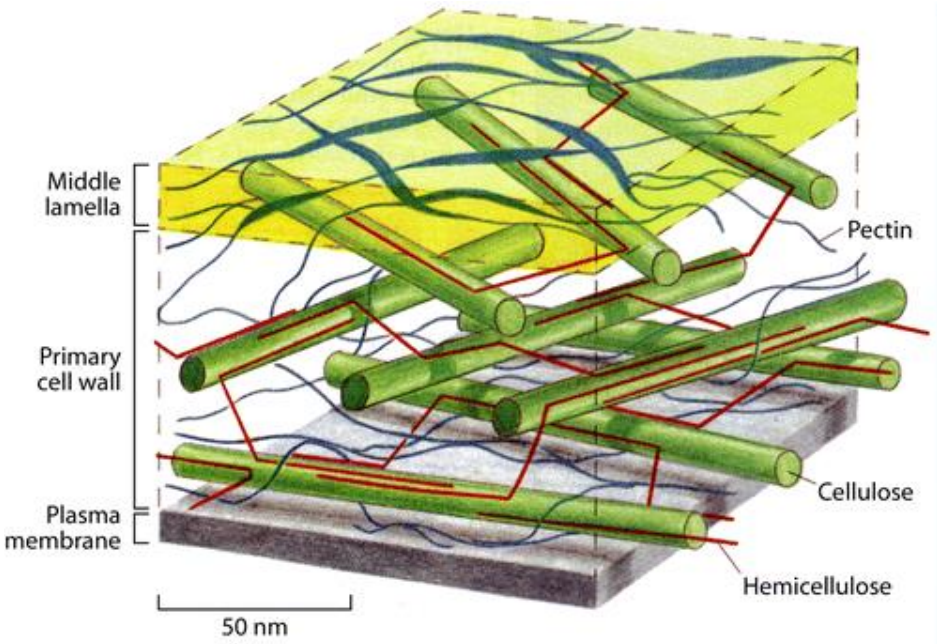
Citri-Fi, a Versatile Formulating Tool

- Citri-Fi is a fiber of the citrus fruit cell wall that delivers a natural texture as a food ingredient
- Clean label: labeled as citrus fiber, dried citrus pulp or citrus flour
- One ingredient with multiple functionalities in food:
  - Minimal syneresis or separation
  - Thickening
  - Emulsification or oil control
  - Mouthfeel and body
  - Freeze-thaw stability

Diagram: Plant Cell Wall Architecture



Composition	Citri-Fi 100 (Citrus Fiber)
Soluble Fiber	34.7%
Insoluble Fiber	41.4%
Total Fiber	**76.1%**
Protein	7.0%

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Emulsification In-Action

Citri-Fi forms an emulsion which remains stable for weeks

- Citri-Fi holds three times its weight in oil.
- Citri-Fi 100M40 is premixed with oil.
- Water opens up the fiber further to allow more oil to bind.
- The fiber continues to bind oil and water and swell.
- Hydration is complete when the emulsion is formed.
- Emulsions remains stable for weeks after formation.

Citri-Fi Emulsification Demo (click to start)

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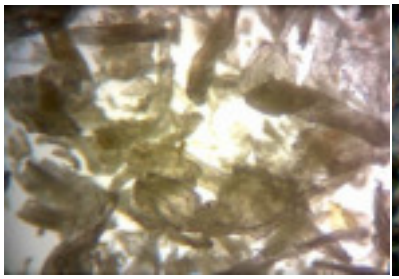
Photos of Rehydration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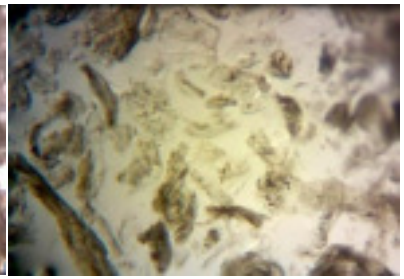
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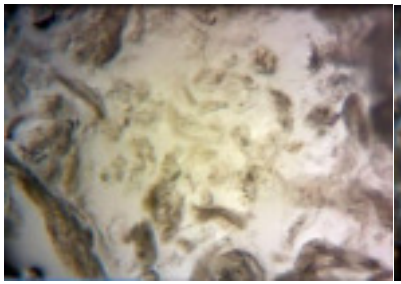
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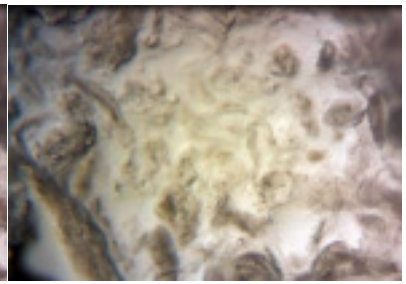
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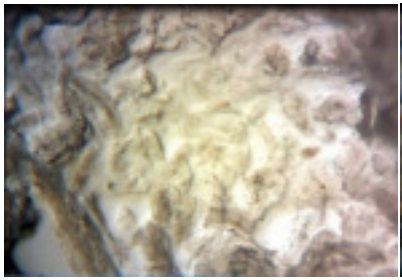
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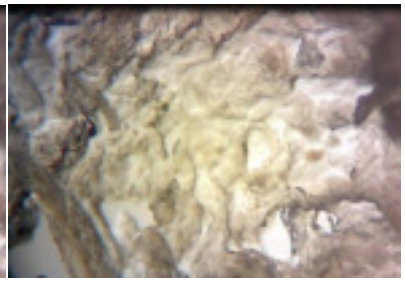
19 seconds

- Photos from 0 - 20 seconds
- Fibers rapidly swell and lose fibrous identity in water
- Gel-like appearance forms after hydration

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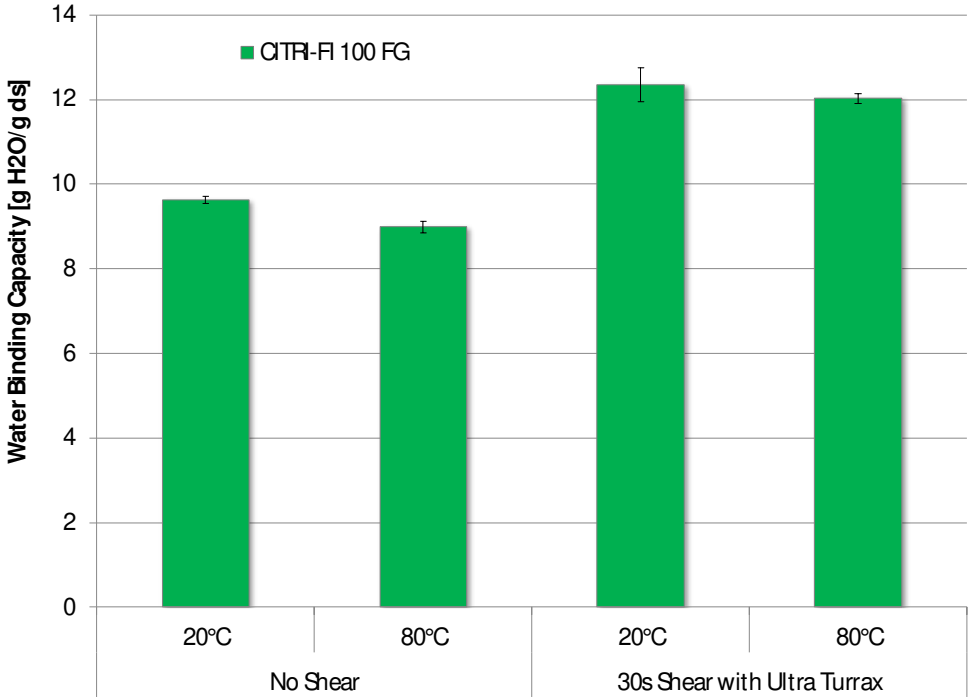
Water Holding Capacity vs. Shear And Temperature

Shear effects creates additional water holding capacity and speeds up hydration rates

- Shear effects opens the fiber even more to create additional surface area
- Shear can quicken & elevate water holding capacities
- Temperature had no effect



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Source: Schalow et al., 2017

Shear Effects of Citri-Fi

- Shear opens up the fiber to create additional surface area and volume which increases viscosity

- Shear Methods:
  - No Shear – stirring, mixing
  - Mild Shear – blender, Likwifier
  - Moderate Shear – colloid mill, Koruma, IKA, etc.
  - High shear – piston homogenizer

Mild Viscosity

High Viscosity

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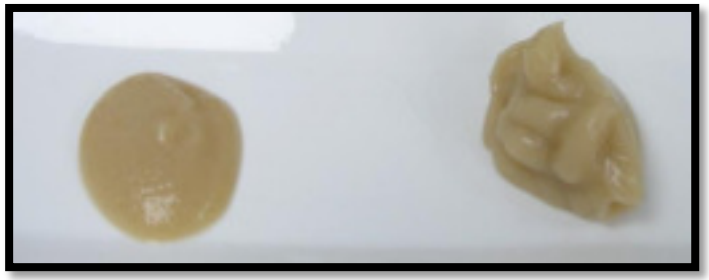
Citri-Fi 100 Shear Effects

No Shear | High Shear

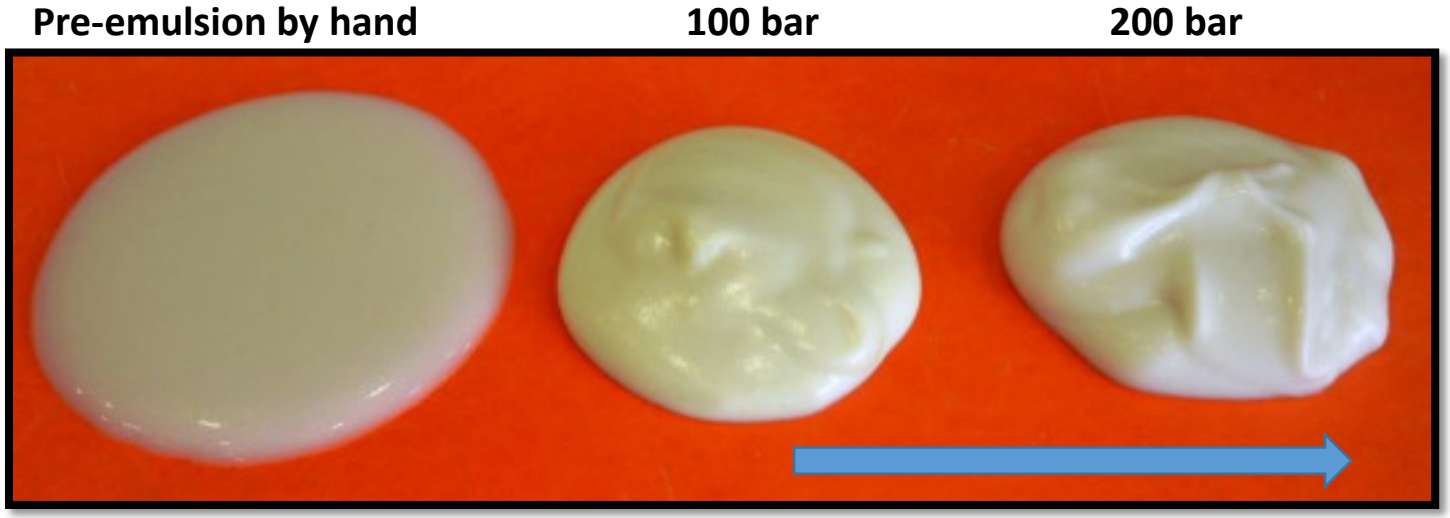


Citri-Fi Emulsions: Effect of Homogenization Pressure

Shear effects open the citrus fiber to create additional stabilization for food products exposed to adverse conditions.

- The consistency of emulsions can be improved by high pressure homogenization
- Citri-Fi can be dispersed either in aqueous phase or oil
- Increased pressure
  - reduces oil droplet size
  - enhances water binding of Citri-Fi

Composition:
- 2 % Citri-Fi 100FG
- 25 % Oil
- 73 % Water

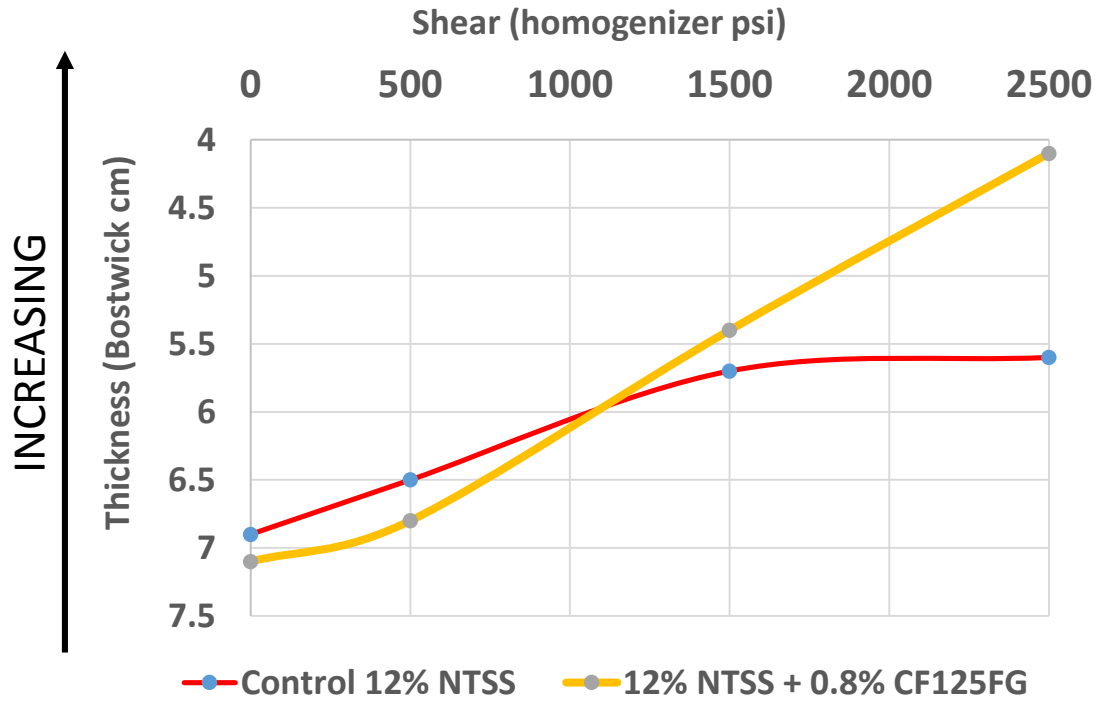


Thicker, Richer Tomato Sauces

Citri-Fi can be used to thicken sauces when exposed to shear

Highlights

- Large boosts in **sauce thickness** can be achieved using **<1% Citri-Fi**
- Use shear to **fray and 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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Improving Texture of Tomato-based Sauces with Citri-Fi

Formulation:

Simple Enhanced Tomato Sauce	Control		Citri-Fi	
	0.0% Citri-Fi		0.2% Citri-Fi	
	pounds	%	pounds	%
Tomato Paste (31% NTSS, HB)	96.78	38.7	96.58	38.6
Water	153.23	61.3	152.92	61.2
Citri-Fi	0.00	0.0	0.50	0.2
Total	**250.00**	**100.0**	**250.00**	**100.0**

Control (0% Citri-Fi)

0.2% Citri-Fi

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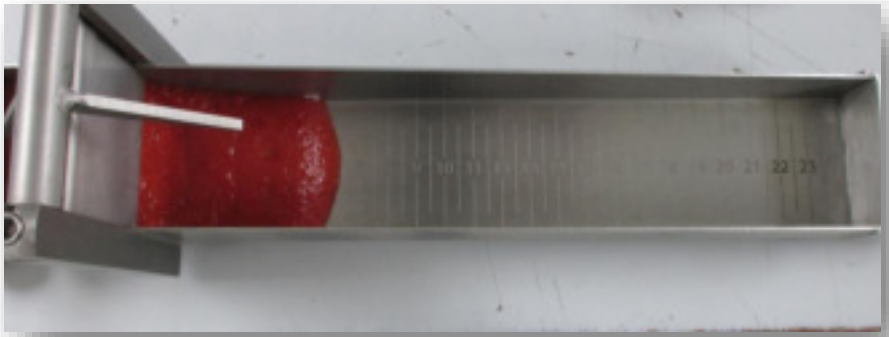
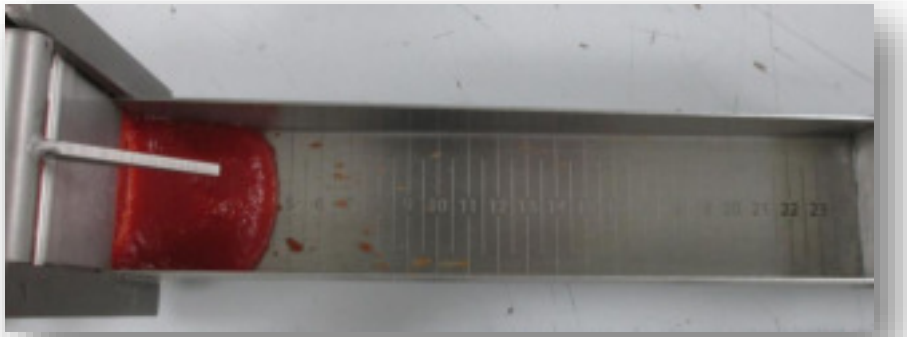
Use a Bostwick To Measure How Thick And Rich The Sauce Is

(lower numbers are thicker)





12% NTSS Control
2500 psi homogenization
Bostwick = 6.3

12% NTSS + 0.2% CF
2500 psi homogenization
Bostwick = 4.4

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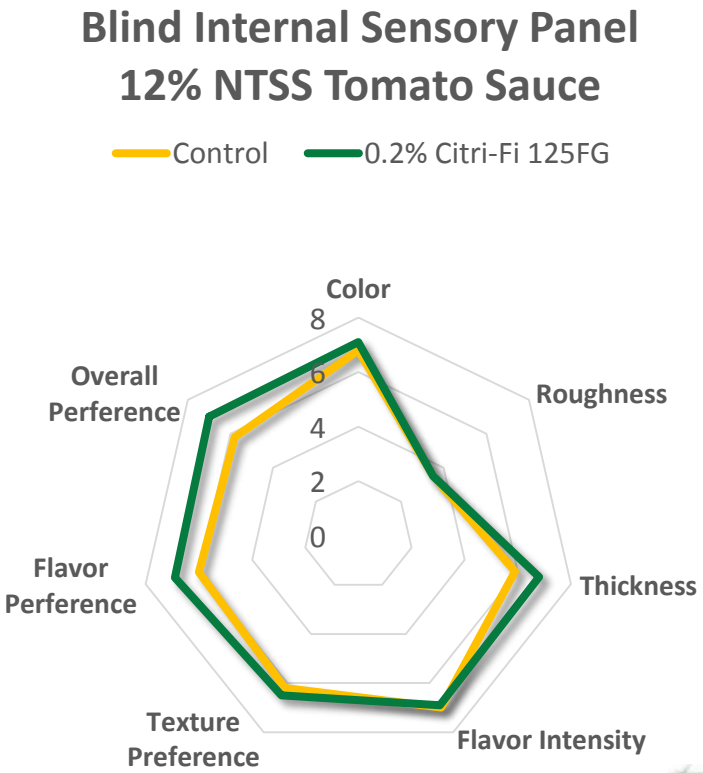
Improving Tomato Sauce Organoleptic Quality

Citri-Fi can be used to improve tomato sauce texture and quality without reducing the tomato solids



- Adding Citri-Fi without reducing tomato solids:
  - Improves color
  - Improves flavor
  - Improves thickness
  - Improves preference

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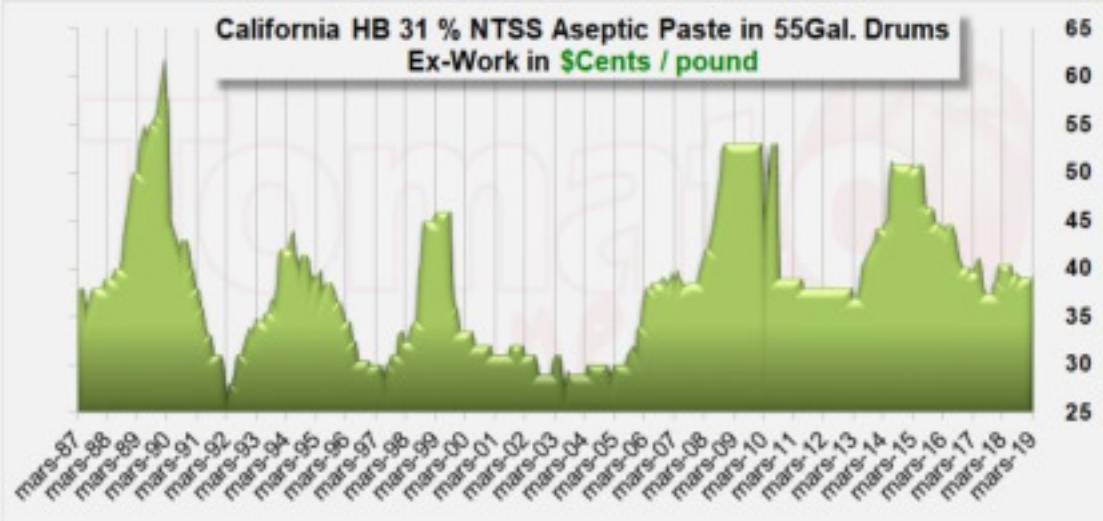
Cost Out

- Using high shear, one can keep the thickness of a tomato-thickened sauce but reduce tomato paste content by 15% using 0.2 to 0.4% addition of Citri-Fi 100 series.
- Net reduction in paste cost 6-10% using current volume pricing.



Source: www.tomatonews.com

BBQ Sauce Formulation & Methods

Ingredient	Physically Modified Starch (%)	Citri-Fi 100 (%)
Sugar	29.860	29.860
Tomato Paste	11.200	11.200
Vinegar	7.875	7.875
Molasses	6.030	6.030
Salt	1.400	1.400
Citri-Fi 100	**0.000**	**1.500**
Starch	3.260	0.000
Spice Mix	1.180	1.180
Water	39.195	40.955
Total	**100.00**	**100.00**

Citri-Fi Incorporation:
Citri-Fi is added to the dry ingredients such as sugar, salt and spices

Cook: 10 Minutes
Temp: 85°C

Bostwick Results:
Starch: 9.3
Citri-Fi: 8.0

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BBQ Sauces Textures

BBQ sauce containing sheared Citri-Fi is thick with consistent texture

Control (Starch) BBQ Sauce

Citri-Fi BBQ Sauce

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Atomo 3.0 Lab Homogenizer, Bertoli - Italy

Key Summary Points

- Citri-Fi citrus fiber is functional as-is, but using high shear equipment in a commercial food process can activate a powerful increase in viscosity
- Using shear to unlock viscosity is a useful clean label tool to thicken and stabilize sauces and dressings
- Citrus fiber works nicely to stabilize sauces containing fats and oils
- Citrus fiber is much more temperature-independent than other hydrocolloids
- Citrus fiber is naturally stable to acidic conditions

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