SinnovaTek

Thermal Processing of Sweet Potato

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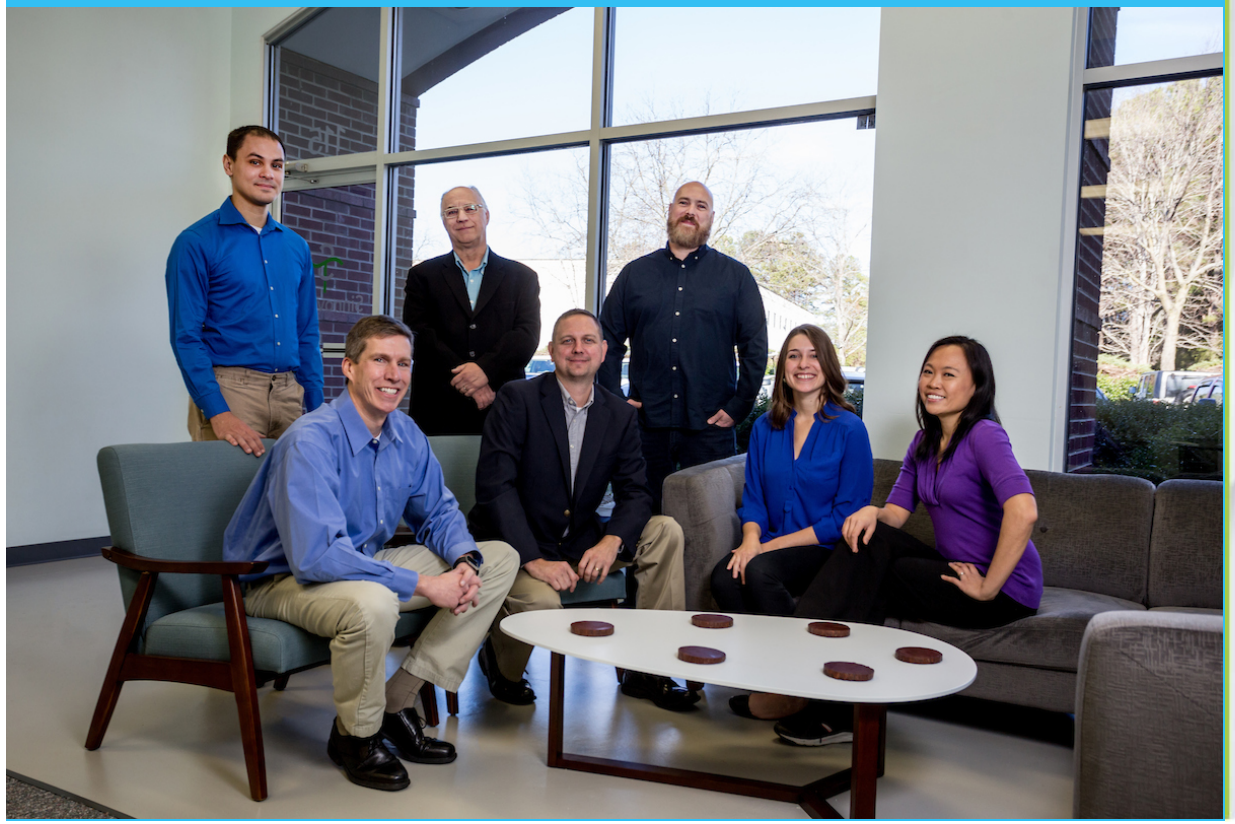
Leading the Next Wave of Food Innovation

The SinnovaTek Team



Food Processing Experts on a Mission

NUTRIENT RETENTION **CLEANER LABELS** **REDUCE WASTE** **INCREASED SHELF LIFE** **NATURAL**

Our Mission:

Promote worldwide health and wellness by fostering the delivery of high quality, healthy food through sustainable methods

Be The Change We Seek

- Certified B Corporations are to business what Fair Trade certification is to coffee or USDA Organic certification is to milk.
- B Corps are for-profit companies certified by the nonprofit B Lab to meet rigorous standards of social and environmental performance, accountability, and transparency.
- Today, there is a growing community of more than 2,200 Certified B Corps from 50+ countries and over 130 industries working together toward 1 unifying goal: to redefine success in business.
- This global movement now includes 200+ Food & Beverage companies.

Sweet Potato – A Global Food Source

- 130 Million Tons of Sweet Potato Produced Globally
- 7 Million Tons Produced in Africa
- 40% Lost to Food Waste

The Goal – Create a Shelf Stable Sweet Potato Puree

- ✓ Extend the Shelf Life
- ✓ Reduce Spoilage
- ✓ Expand Distribution
- ✓ Maintain Quality and Nutrients

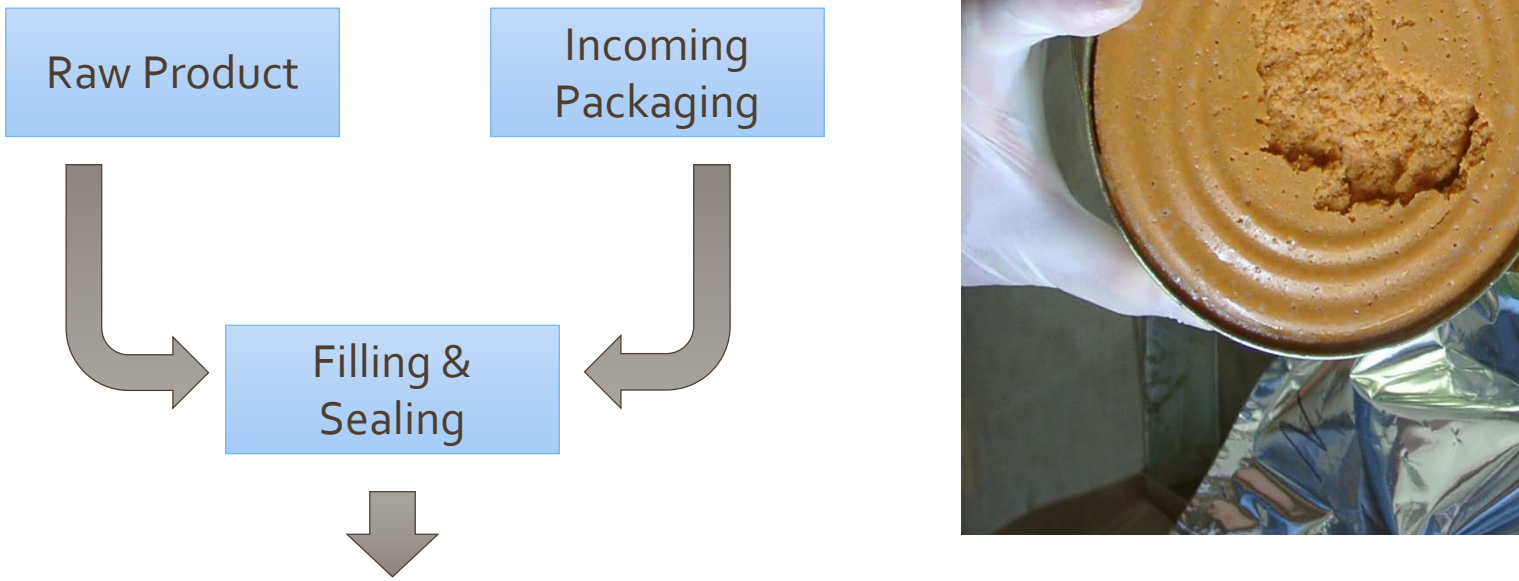
Enabling Shelf Stability for Sweet Potato

Processing Options – Quality Attributes

Attributes/Puree Types	Fresh	Frozen	Canned	Conventional Aseptic	Microwave Aseptic
Commercially Sterile	✗	✗	✓	✓	✓
Ambient Storage	✗	✗	✓	✓	✓
Superior Natural Color	✓	✓	✗	✗	✓
Superior Flavor	✓	✓	✗	✗	✓
Fresh Appearance	✓	✓	✗	✗	✓
Preferred Texture	✓	✗	✗	✗	✓
Ease of Use	✗	✗	✓	✓	✓
High Beta-Carotene Retention	✓	✓	✗	✗	✓
% Preferred [Sensory Test]	25%	1%	5%	1%	68%

Batch Thermal Processing – Canned (Retort)

Retort Process



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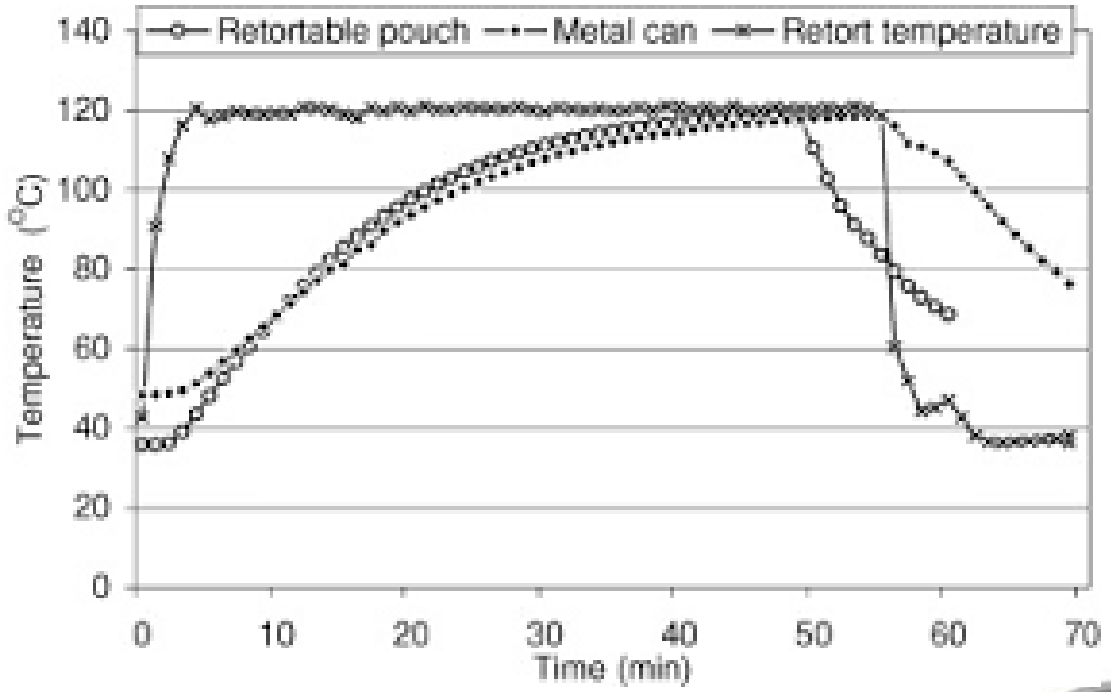
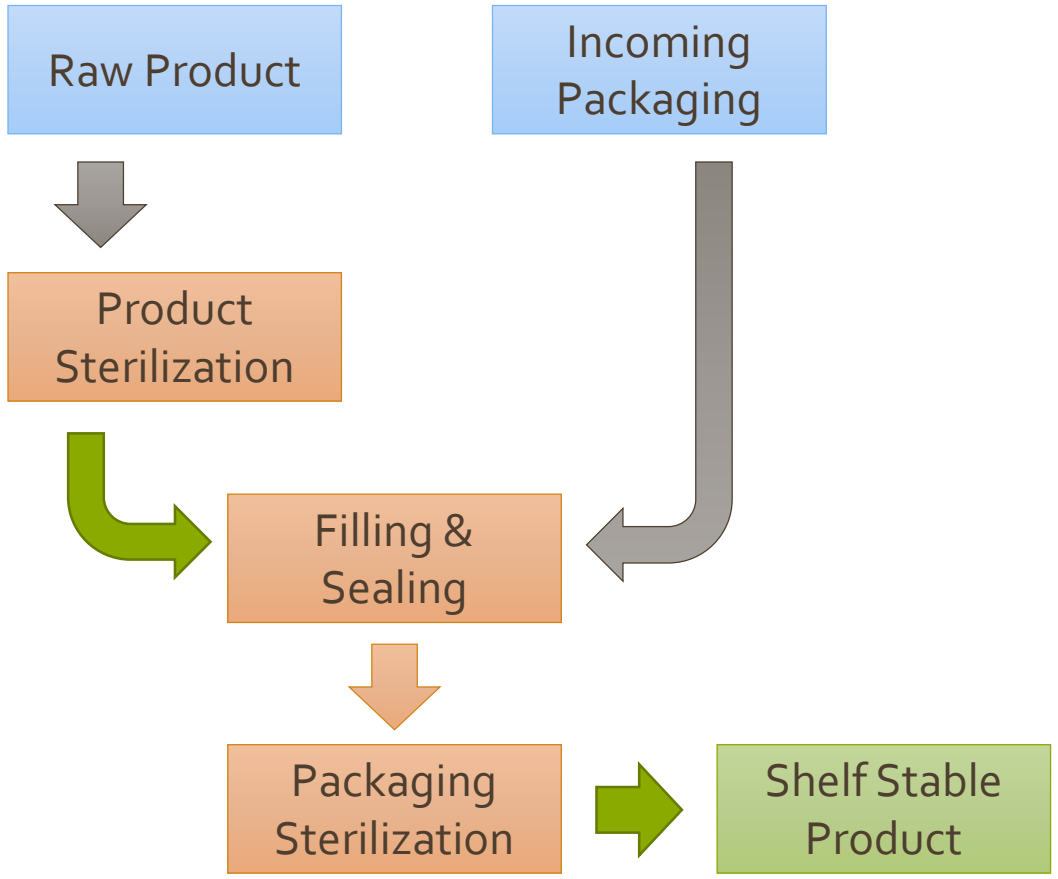


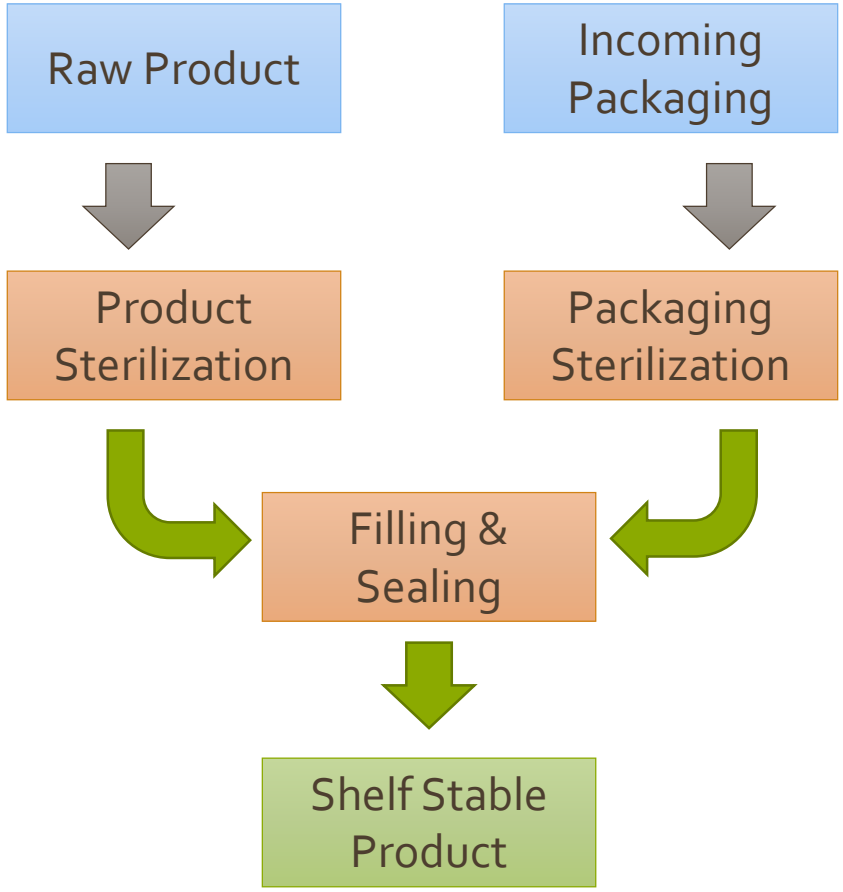
- Oldest form of sterilization
- Processing time 30 min to 3 hours
- Limited to below 10 lbs
- Also works for cups and pouches
- Maximum thermal destruction

Continuous Flow Thermal Processing

Hot-Fill



Aseptic



Thermal Processing Overview – Hot Fill

Low Cost Solution for Limited Applications:

- Processing time 1-10 mins
- Typically limited to below 10 lbs
- Formats include pouches, bottles, cups
- Lowest cost solution
- Limited to pH <4.0

Thermal Processing Overview – Aseptic

Highest Cost and Highest Quality:

- Lowest processing time <10 mins
- No size limit
- Most flexibility
- All package formats available
- Highest capital cost solution
- Low cost options do exist

Thermal Processing – Choosing Your Technology

Process Heating Options (Continuous Flow):

- Indirect: Plate, Tubular, Scrape Surface
- Direct: Direct Steam Injection, Advanced Microwave

Product Factors:

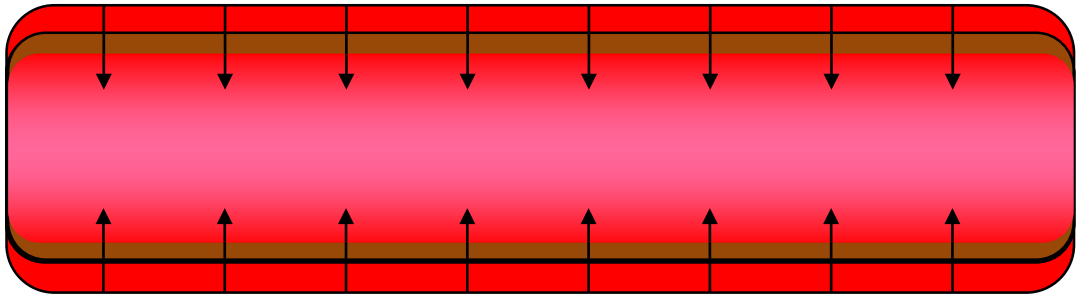
- Viscosity, pH, Particle Size, Thermal Sensitivity

Economic Factors:

- Yield, Run Size, Energy Efficiency

Thermal Processing – Indirect Heating

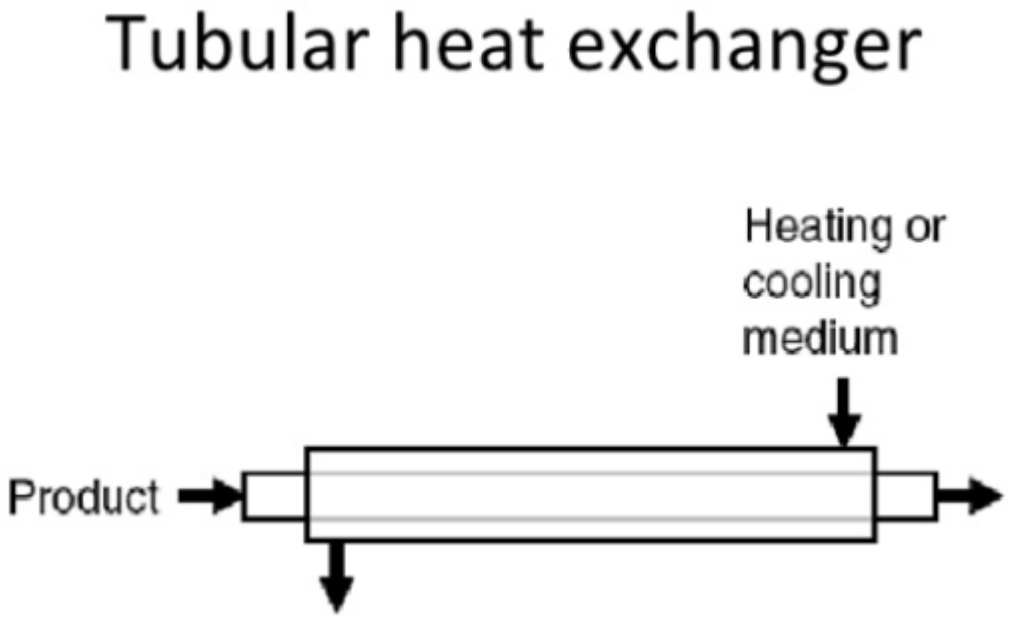
Conventional Heating



- Thicker products are harder to heat

Thermal Processing – Indirect Heating

Medium Viscosity Products – Tubular Exchangers



Tubular Heat Exchanger

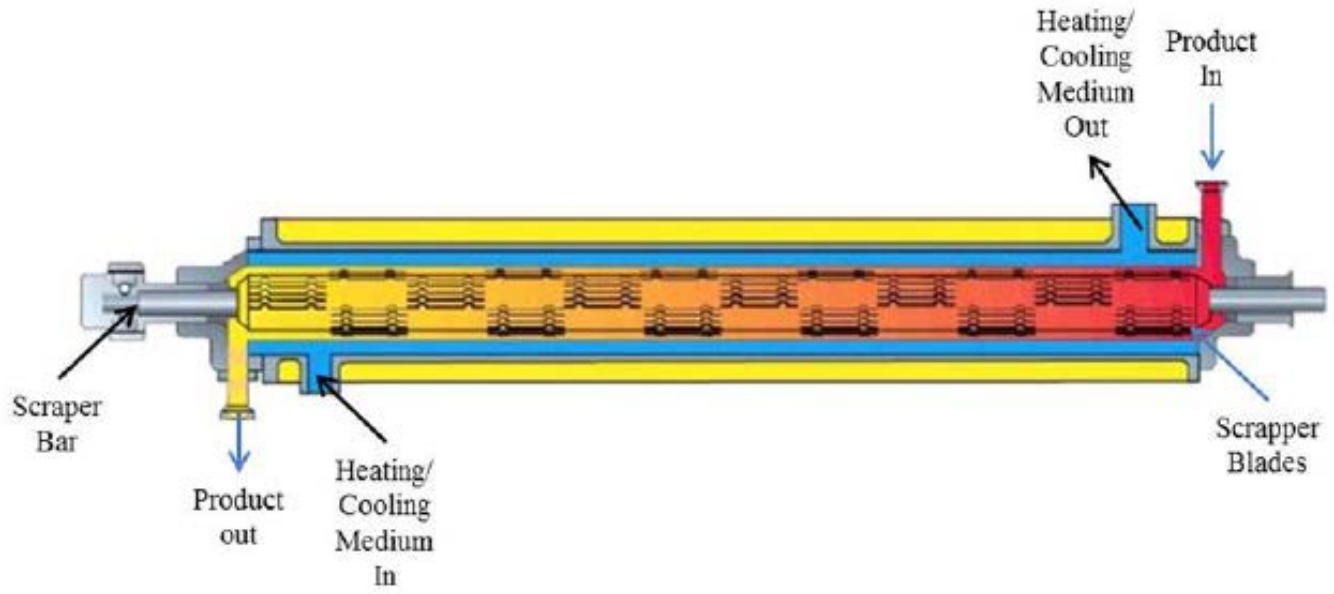
Typical Products:
Baby food
Fruit/Veg Puree
Soups

Pros:
Low Cost
Easy Operation

Cons:
Slow Heating
Uneven Heating
High Pressures

Thermal Processing – Indirect Heating

High Viscosity Products – Scrape Surface Exchanger



Scraped Surface Heat Exchanger

Scrape Surface Heat Exchanger

Typical Products:
Soups
Sauces
Potatoes

Pros:
Thick Products
Small Footprint

Cons:
High Cost
Maintenance
Burn-on

Microwave Processing

Volumetric

- Rapid and consistent heating

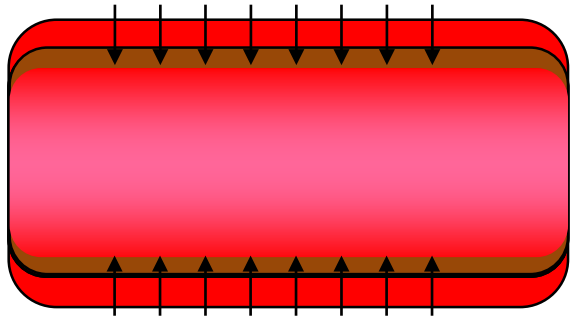
No Hot Contact Surfaces

- Less fouling and burn on

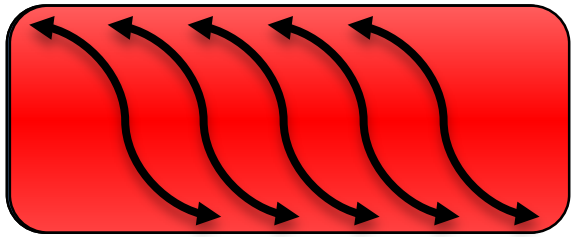
Direct Energy Application

- Not limited by indirect heating source

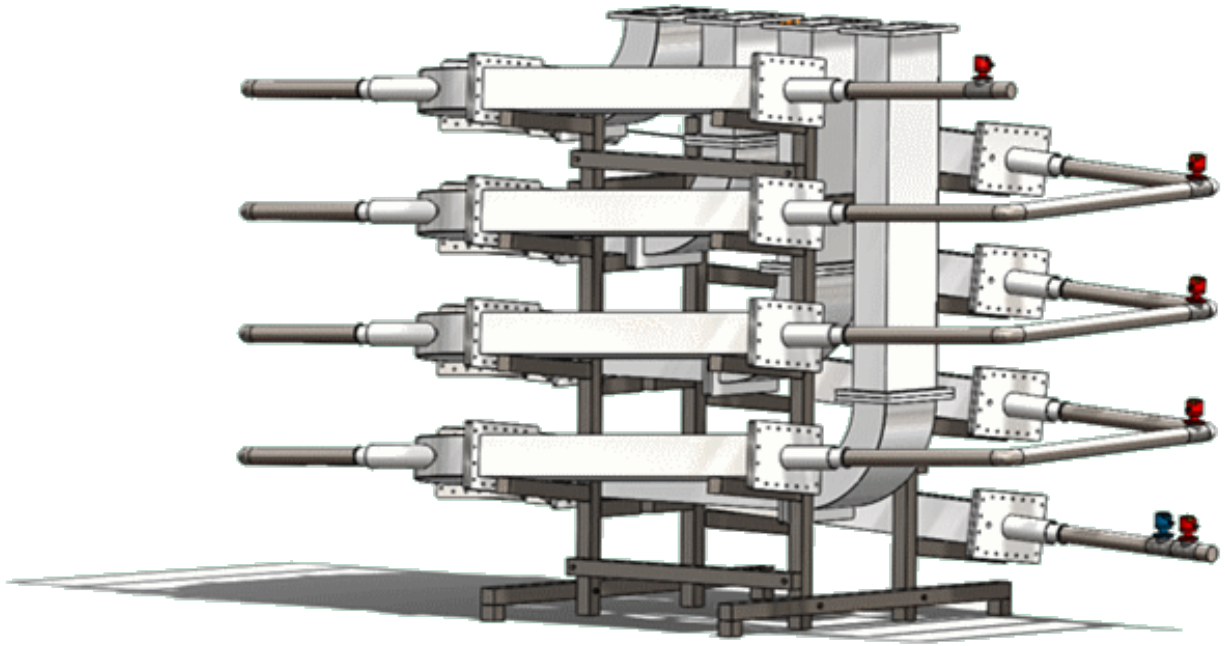
Conventional Heating



Microwave Heating

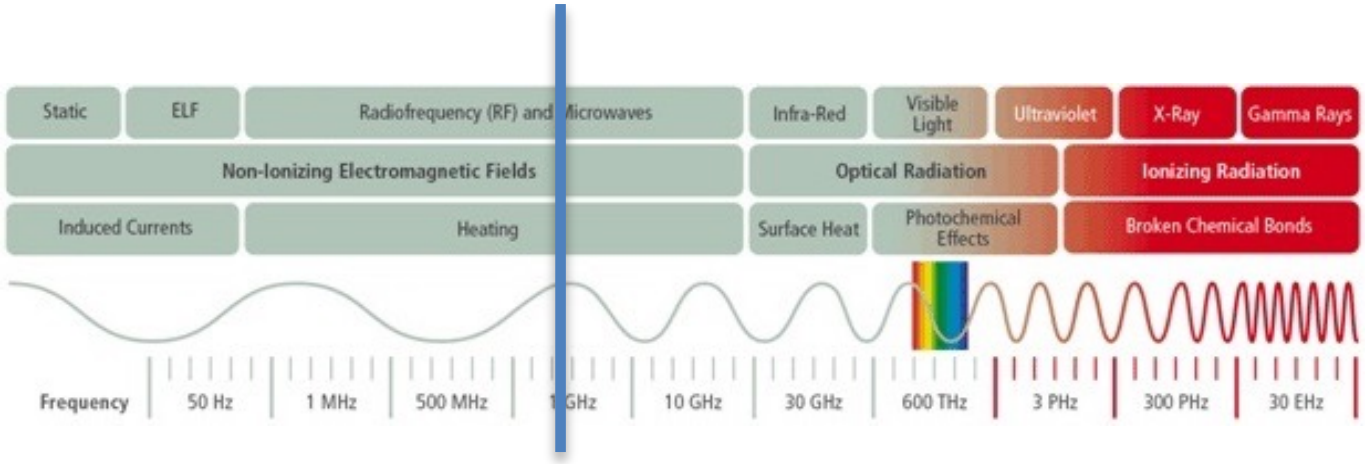


Microwave Processing



Microwave Heating:

- ✓ Safe
- ✓ Fast
- ✓ Gentle
- ✓ Flexible
- ✓ Efficient
- ✓ Proven



➢ Enables pasteurization and sterilization of sensitive products

Microwave Processing: Advantages

Heats the product, NOT the pipes!

- ✓ Processing time typically < 1 min.
- ✓ Uses 1/10 the pipe length of tubular systems
- ✓ Reduce/eliminate burning and fouling
- ✓ Even/consistent heating throughout the product
- ✓ Improved run-times
- ✓ Reduced maintenance and cleaning requirements
- ✓ Ideal for processing the most sensitive products



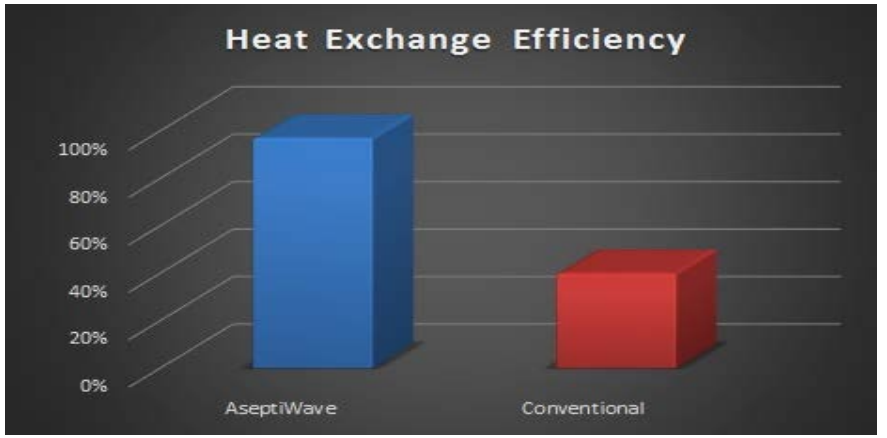

Microwave Processing: Energy Efficiency

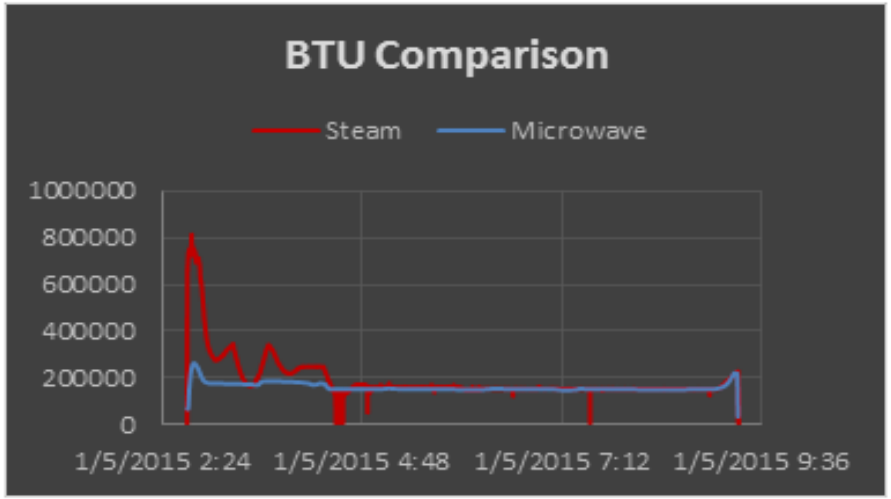
2.5x more efficient than steam

- Reduced energy consumption
- Reduced carbon footprint

Stabilized energy consumption

- Efficient line startup
- Throughout production





Microwave Processing: Nutrient Retention

Attribute	AseptiWave™
Vitamin A Retention	92%
Vitamin C Retention	93%
Antioxidant Retention	93%
Anthocyanin Retention	86%

Results of nutrient retention is based on third party testing of commercial products

Microwave Processing: Nutrient Retention

Nutrient	Nomatic™
Retinyl Palmitate	103%
Ascorbic Acid	100%
Thiamin	101%
Riboflavin	96%
Niacinamide	99%
Pantothenate	99%
Pyridoxine	102%
Biotin	98%
Folic Acid	103%

Note: This table uses sample group averages and does not address variance, thus values greater than 100% of control are possible.

Microwave Processing: Color Retention

Sample Name	L* (Pre)	L* (Post)	a* (Pre)	a* (Post)	b* (Pre)	b* (Post)	ΔE Value
Berry Chia Smoothie	34.6	35.3	11.0	10.7	-0.7	0.0	0.7
Berry Hibiscus Smoothie	37.4	37.4	11.0	10.3	1.0	1.6	0.9
Green Smoothie	44.3	43.6	-0.8	0.4	15.8	15.3	1.5
Spicy Mango Smoothie	48.9	48.3	5.2	5.1	28.7	27.4	1.4
Strawberry Banana Smoothie	46.4	46.3	14.1	13.3	5.4	6.9	1.7
Superfood Smoothie	39.7	41.2	-1.9	2.1	11.2	13.5	4.9

Microwave Processing: Sensory Evaluation

Juice Smoothies

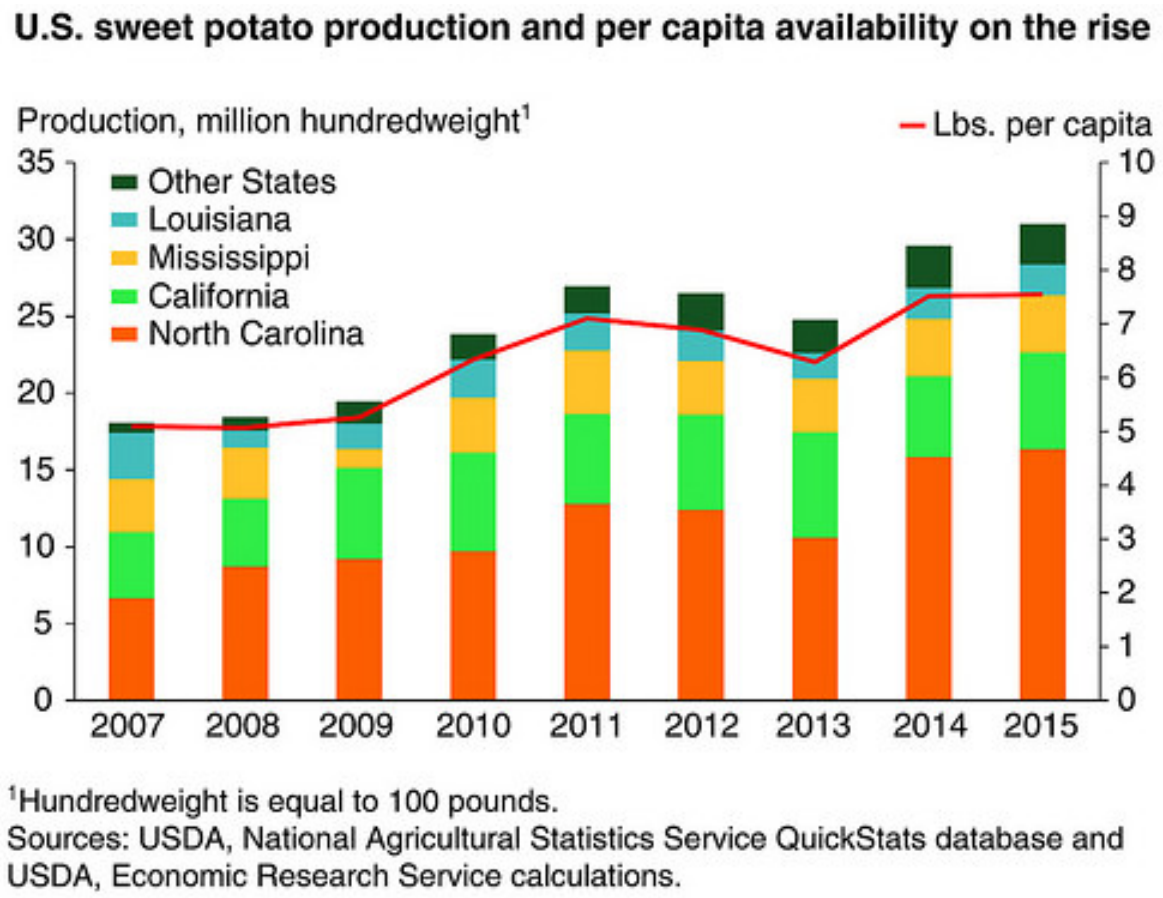
QUESTION	**AseptiWave™** Shelf Stable/12 Month Shelf-Life	**3 Market Leaders** Flash Pasteurized & Refrigerated
Freshness	★★★★	★★★★
Overall Preference	★★★★	★★★★
Purchase Intent	★★★★	★★★★

AseptiWave matched the refrigerated products in every way

Results are based on a third party preference test of 106 people

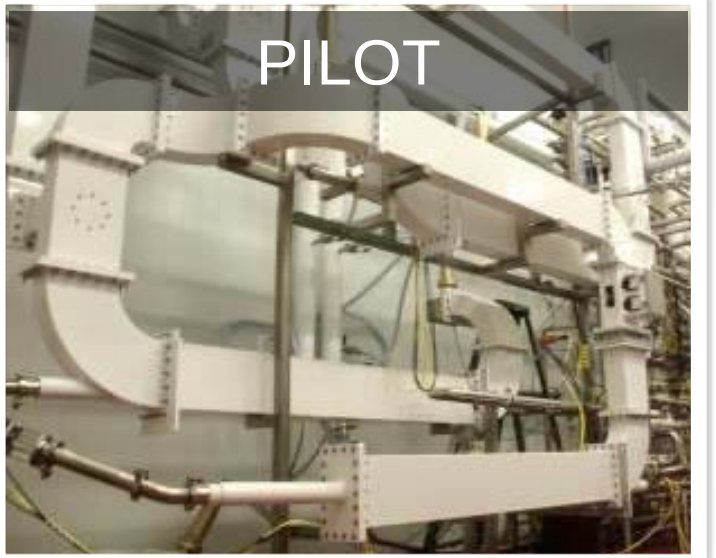
Microwave Processing: Commercial Products

Microwave Processing: Sweet Potato



- Timeline:
  - 2007 – North Carolina accounts for 38% of U.S. Sweet Potato Production
  - 2008 – First FDA filing for Microwave aseptic Sweet Potato at YamCo (growers co-op) in NC
  - 2009 – Technology wins IFT Industrial Achievement Award
  - 2017 – North Carolina accounts for 60% of U.S. Sweet Potato Production

Microwave Processing: Scalability



Consistent Results at Every Scale

Microwave Processing: Nomatic™ Production

- Portable. Scalable. Efficient.
  - Process 5 Gallons to 500 Gallons per Day
  - Configurable for Hot-Fill or Cold-Fill
  - Customizable for Any Viscosity
  - Portable Design is Easy to Move
  - Fully Automated
  - Self Cleaning (Integrated CIP)
  - Low Cost (CapEx & OpEx)
  - Great for Small Manufacturers

Microwave Processing: AseptiWave™ Pilot

Microwave Processing: AseptiWave™ Large Scale

SinnovaTek