



Penford

NASDAQ: PENX

Expanding Your Gluten-free Toolbox



Smarter Ingredients...Smarter Solutions

How Gluten Works

- Gluten is a composite of the proteins gliadin and glutenin
 - These proteins, along with starch, are found in the endosperm of cereal grains such as wheat, rye and barley

- Viscosity and elasticity
 - When dough is kneaded, glutenin cross-links with itself and then associates with gliadin to form gluten strands
 - This is what provides the viscosity and elasticity to dough
 - More kneading = more gluten development = chewier texture (bagels, pizza crust)
 - Less kneading = less gluten development = more tender texture (breads)

How Gluten Works

□ Leavening

- In leavened products, the gluten network traps CO2 bubbles
- Enables the dough to swell or rise

□ Stabilization and Texture

- Baking the dough coagulates the gluten
- Along with starch, this stabilizes the structure and texture of the finished product

Development Challenges

- ❑ Broad market acceptance means products must have the organoleptic attributes of a full gluten product
- ❑ Gluten-free ingredients are subject to contamination if they are processed in facilities that process gluten-based ingredients
- ❑ Opportunities for processing at true gluten-free facilities are limited

Gluten-free Ingredients

Primary flours	Specialty Flours	Starches	Protein	Fiber	Hydrocolloids
Brown Rice	Amaranth	Corn	Corn	Bamboo	Cellulose
Rice	Buckwheat	Pea	Egg	Bran	Guar
Sorghum	Chia	Potato	Hemp	Chia	Konjac
Tapioca	Legume	Rice	Legume	Flax	Pectin
Waxy Rice	Millet	Tapioca	Pea	Inulin	Tara
	Nut		Soy	Psyllium	Xanthan
	Quinoa		Whey	Resistant starch	
	Teff			Sugarcane	
	Vegetable			Vegetable	

Gluten-free Food Starches

□ Tapioca

- Native
- Modified
- Pregelatinized

□ Potato

- Native Extract
- Modified
- Pregelatinized

□ Corn

- Native
- Modified
- Pregelatinized

□ Rice

- Native
- Pregelatinized

Properties of Native Starch (6% Solution)

	Potato	Corn	Waxy Corn	Tapioca	Rice	Waxy Rice
Gel. Temp. ° F	136-149	144-176	145-162	126-149	144-167	150-156
Peak Viscosity BU	>2500	250	700	700	800	800
Swelling (g water/g)	>100	24	64	71	19	70
Paste Clarity	Clear	Opaque	Clear	Clear	Opaque	Clear
Paste Texture	Long	Short	Long	Medium	Short	Long
Paste Flavor	Mild	Cereal	Cereal	Mild	Mild	Mild

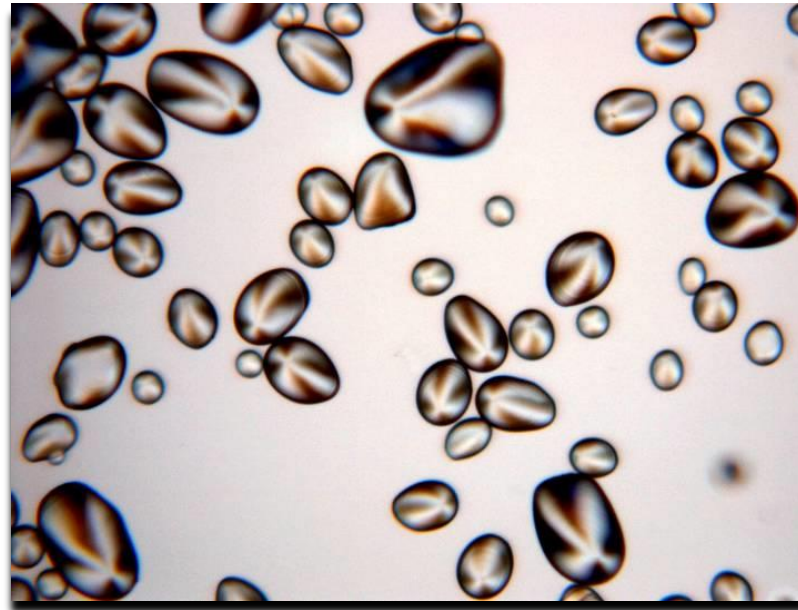
Potato Starch Characteristics and Benefits

❑ Firm gel

- Provides structure and texture to baked goods

❑ High water holding capacity

- Provides moisture to baked goods



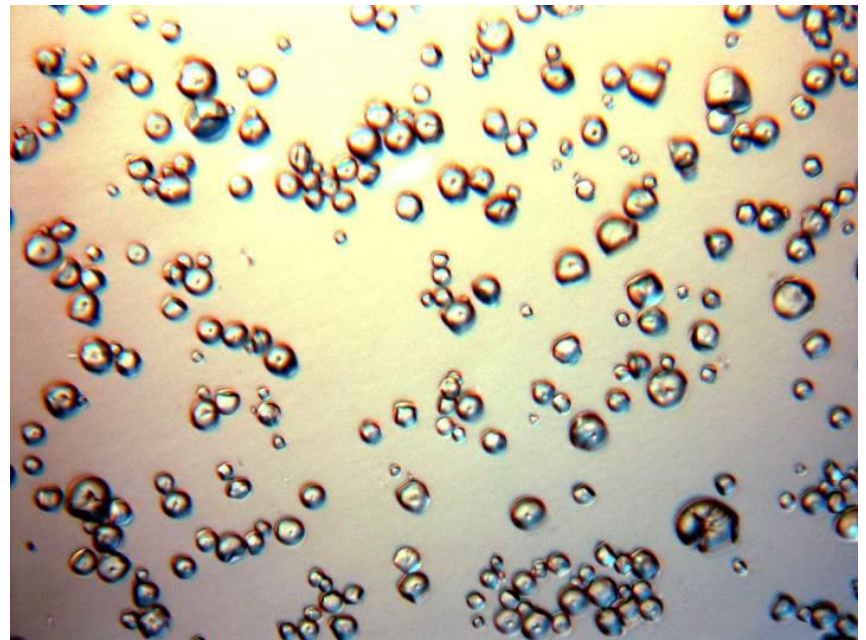
Tapioca Starch Characteristics and Benefits

❑ Softer gel

- Soften crumb
- Provide chewiness
- Improve stretch and elasticity

❑ Good water holding capacity

- Improve moisture
- Improve shelf-life



Rice Starch Characteristics and Benefits

□ Smallest granule

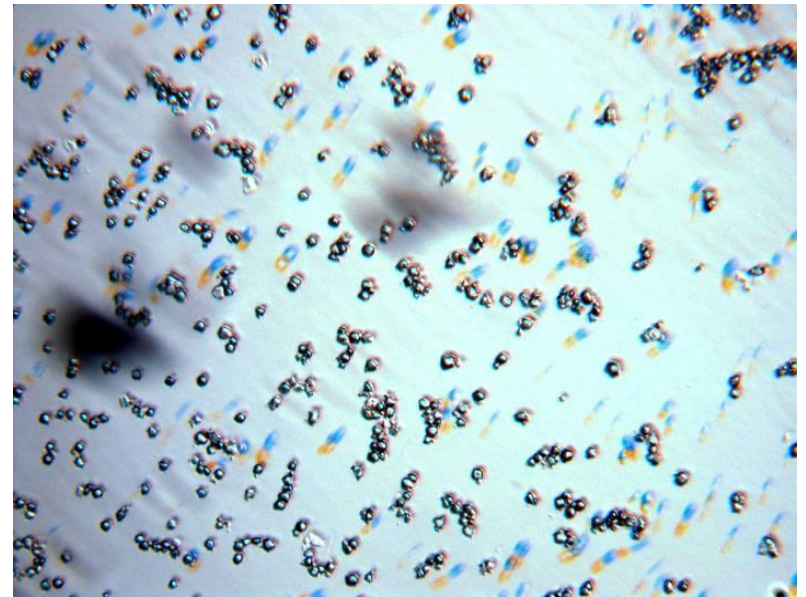
- Improves mouthfeel—fat mimic

□ High water holding capacity

- Improve freeze/thaw stability of baked goods
- Provides moisture

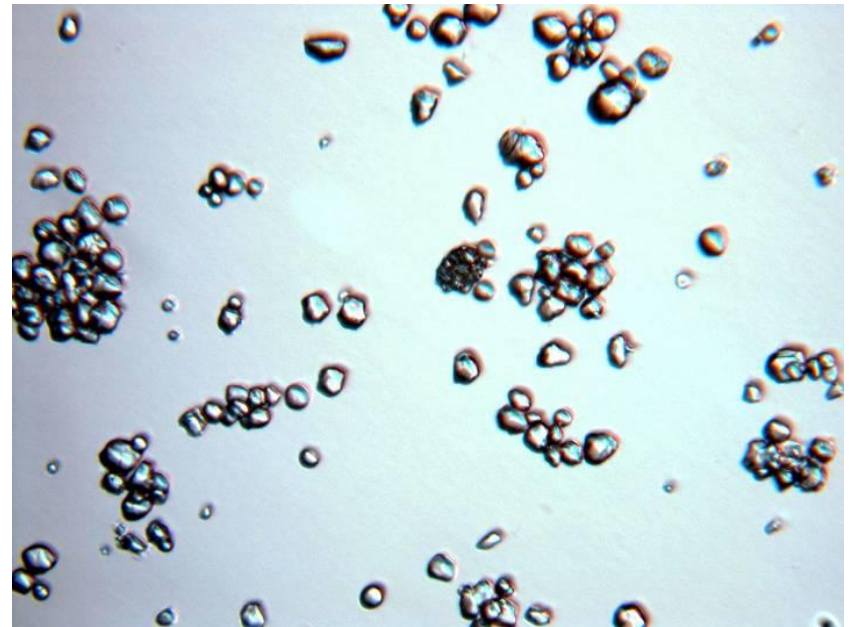
□ Soft gel

- Provides chewiness
- Improve stretch and elasticity



Corn Starch Characteristics and Benefits

- ❑ Good water holding
 - Improve moisture
 - Improve shelf-life
- ❑ Soft gel
 - Improves texture
 - Improves elasticity



Gluten-free Pizza Dough



Benefits:

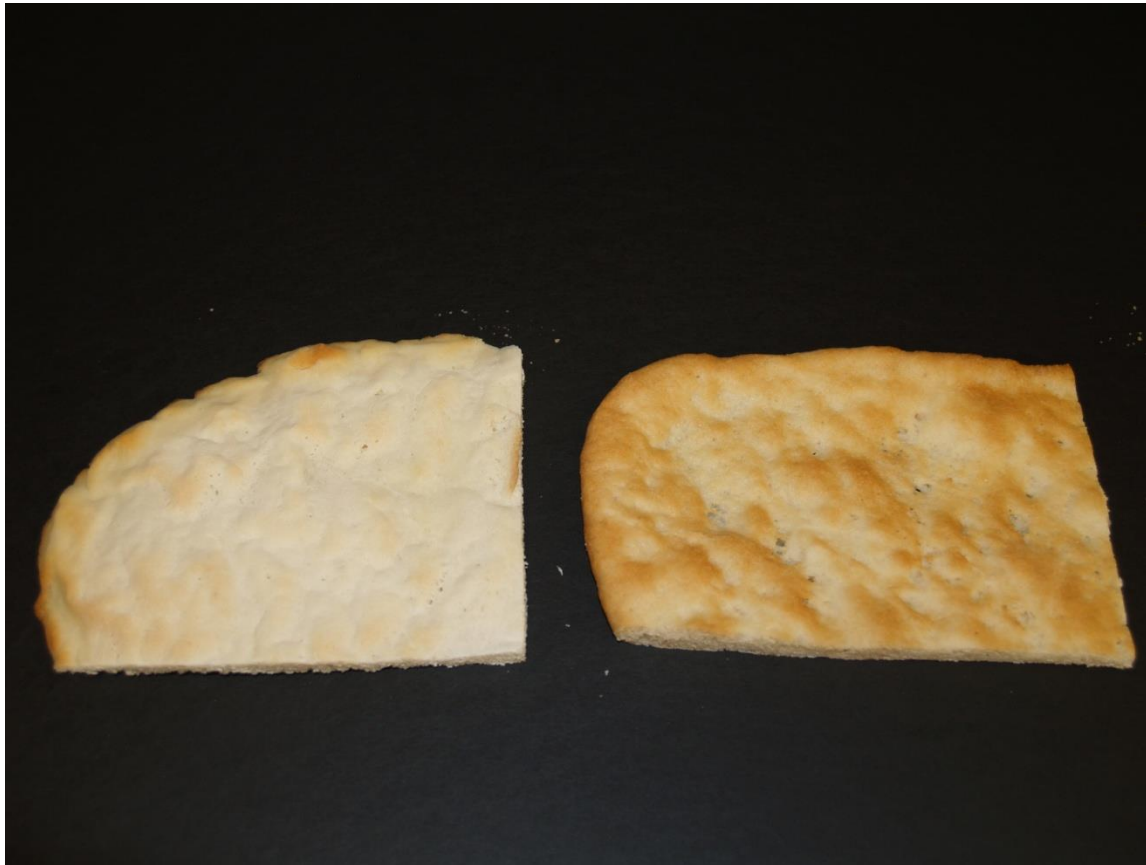
1. Two different types of tapioca starch to attain desired end product
2. Provides a crust with better overall height and an improved open structure
3. More desirable golden color to the crust

Ingredients	%
Water	27.60
Tapioca Starch	23.50
Rice flour	11.30
Tapioca Flour	10.34
Rice Starch	9.40
Eggs	6.58
Oil	4.70
Sugar	2.54
Soy flour	1.88
Salt	0.94
Yeast	0.75
Xanthan gum	0.47
	100.00



Gluten-free Pizza Crust

Product on left does not contain starch



Gluten-free Pizza Crust

Product on left does not contain starch

Native Starches

☐ Usage: 5-50%

☐ Benefits

- Natural ingredient = clean label
- Cost effective
- In baked goods = opens cell structure

☐ Limitations

- Not as effective as modified food starches
- Not freeze-thaw stable

Modified Cook-up Starches

- ❑ Usage 15%-30%
- ❑ Labeled as modified food starch
- ❑ Benefits
 - Assist the pregel starch by reducing gumminess and opening the cell structure more
 - Acts as main replacement of flour systems
 - Can be customized for desired attributes
 - Improves freeze-stability
 - Improve volume

Pregelatinized Starch

☐ Usage 5%-10%

☐ Label

- Starch source i.e tapioca starch
- Modified food starch

☐ Benefits

- Cold water thickening
- Contributes a soft, elastic, workable dough
- Aid in processing raw dough
- Improves resilience and chew to the cooked dough
- Prevents dense, cardboard-like texture as frequently seen with Gluten-free products

Gluten-free Nutrition Enhancement Trends

❑ Whole Grain/Flours

- Teff, amaranth, quinoa, chia, sorghum, brown rice, buckwheat, millet

❑ Proteins

- Soy, pea, rice, corn, whey, legumes

❑ Oils

- Flax, fish, algal, soy, canola, phytosterols

❑ Fibers

- Brans, gums, specialty soluble fibers, resistant starches, etc.

How To Incorporate Gluten-Free Into Your Facility

- ❑ National Foundation for Celiac Awareness
- ❑ “...Offer educational programming... train-the-trainer training for chefs and food service managers. Included with the program are all the tools needed to educate the entire...staff on safe gluten-free...food preparation and serving.



Gluten-Free Resource Education and Awareness Training

How To Certify A Process As Gluten Free

There are several certifying organizations that can assist with gf certification – your level of need will dictate which service fits best with your organization

❑ Gluten free certification organization

- www.gfco.org



❑ Celiac spruce association

- www.csaceliac.org



❑ International certification services, inc

- www.ics-intl.com



❑ Quality assurance international

- www.qai-inc.com

Thank You

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