

GLUTEN-FREE FORMULATION CHALLENGES

# Advanced ingredient solutions for gluten-free tortillas

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## Market snapshot

The gluten-free market in the U.S. still is chalking up double-digit growth percentage rates. This year's sales in the gluten-free category in the U.S. are expected to close near one-and-a-half billion dollars, according to consumer research group Packaged Facts. That figure is expected to climb past \$2.3 billion by the end of the decade.<sup>[1]</sup> Moreover, a combination of Millennials' interest in global cuisines and the infusion into the mainstream of food favorites from Central and South America have made the tortilla more popular than bread in many regions.

Sales of tortillas in the U.S. surpassed \$12 billion in 2015 and are expected to steadily rise about 9-10% per year. Of these, chips, taco shells, and similar items only make up about 20% of the total sales, with soft tortilla sales divided evenly between flour and corn varieties with each at just over 40% of the market. Sales of flour tortillas accounted for about \$5 billion in 2014.<sup>[2]</sup> Gluten-free tortillas, excluding the ones made with corn, make up only a small fraction of that market share.

These changes to the modern American foodscape could not have come together more perfectly for the humble, yet comforting, tortilla. Consumers have demonstrated a growing love affair with easy, tasty offerings such as wraps, roll-ups, and quesadillas, and the convenience of ease provided by hand-held foods helps food makers cater to today's modern, "grab-and-go" lifestyle. Yet with so few choices to fill the gap between booming gluten-free sales and the increased tortilla fervor, the market size opportunity in gluten-free tortillas is substantial.

## Gluten-free formulation challenges

Flour tortillas must meet certain critical parameters in order to be successful in the market. A winning flour tortilla is flexible and rolls up easily without cracking or ripping. It should have a round, even shape. Its texture must be somewhat elastic, but not rubbery, layered, and slightly moist without being tacky. Also, tortillas should not stick together when stacked; rather, they must be easily separated.

Gluten is the protein complex in wheat that allows wheat flour to form a cohesive and viscoelastic dough when

mixed with water. It enables the dough to retain gas during fermentation and set during baking, delivering a soft and chewy crumb structure. Removing the gluten from a formulation brings significant challenges to food manufacturers. A gluten-free dough lacks the viscosity and elasticity of the wheat-containing dough. In addition to causing difficulties in processability and machinability, gluten-free products typically have different taste, texture, and appearance compared to wheat-containing products.

Some of the challenges to overcome when formulating gluten-free tortillas include the dry, powdery, and rubbery texture, the off flavor and color, and the poor rollability. Decreased shelf-life is another challenge that is closely associated with gluten-free tortillas due to increased water mobility. The nutritional profile for gluten-free tortillas can also be significantly different from wheat-containing ones due to the lack of protein, nutrients, and fiber.



## Solutions to bridge the gap

It takes a comprehensive library of functional ingredients based on such flour sources as tapioca, corn, rice, potato, and pulses, successfully applied, to provide good processability, taste, texture, nutrition, and extended shelf-life in gluten-free products. These ingredients can be categorized as bulk flour systems ingredients, bulk flour components, and co-texturizers based on their usage level and their role in a gluten-free formula (Figure 1).

**FIGURE 1:** Attributes associated with the different categories of gluten-free solutions

Bulk flour systems	Bulk flour components	Co-Texturizers
<ul style="list-style-type: none"> <li>• Use level of 20-50%</li> <li>• Wheat flour replacements</li> <li>• Provide structure and texture</li> </ul>	<ul style="list-style-type: none"> <li>• Use level of 10-20%</li> <li>• Shelf-life stability</li> <li>• Freeze-thaw stability</li> <li>• Improve water holding</li> <li>• Enhance elasticity</li> <li>• Modify texture</li> <li>• Added nutrition (pulse flours)</li> </ul>	<ul style="list-style-type: none"> <li>• Use level of 0.5-10%</li> <li>• Provide up-front viscosity</li> <li>• Allow soft, elastic, workable dough</li> <li>• Water motion control</li> <li>• Freeze-thaw stability</li> <li>• Modify texture</li> <li>• Suspension</li> <li>• Added nutrition (pulse protein concentrates)</li> </ul>

**Bulk flour systems ingredients** involve the one-to-one replacement of the wheat flour in a formula and are commonly used at a 20-50% level. Ingredion’s bulk flour systems include PRECISA® Bake GF starch, HOMECRAFT® Create GF 20 functional flour, and HOMECRAFT® Create GF 10 functional flour. PRECISA® Bake GF starch is a highly functional starch-based solution that enables the commercial production of gluten-free baked goods with texture and product quality that closely resembles that of gluten-containing products, all at an affordable cost. It provides dough elasticity, freeze-thaw stability, and enhances ambient shelf-life. PRECISA® Bake GF starch is used for bread and bread-like products like tortillas. On the other hand, HOMECRAFT® Create GF 10 functional flour is used for batter-based products like cakes and muffins, whereas HOMECRAFT® GF 20 functional flour is used for sheeted products like crackers and cookies. Both HOMECRAFT® GF 10 and 20 functional flours provide soft, smooth texture, good volume, fine homogenous crumb cell-structure, and reduced product crumbliness.

**Bulk flour components** are individual flours that are added to gluten-free formulas at a 10-20% level to adjust product texture, and improve the freeze-thaw and shelf-life stability of the end product. Some of Ingredion’s bulk flour components include HOMECRAFT® Pulse flours, which provide 10-25% protein and can be used in a variety of gluten-free applications. These products are a good source of plant-based protein that also improve texture and add warm color to the final product.

**Co-texturizers** include pre-gelatinized starches and/or flours, such as HOMECRAFT® Express 390 flour, ULTRA-TEX® 3 starch, and hydrocolloids. These co-texturizers are

used to provide up-front batter/dough viscosity, stabilize crumb cell-structure, provide freeze-thaw stability, allow suspension, and reduce water mobility. Hydrocolloids include hydroxypropyl methylcellulose, xanthan gum, guar gum, cellulose gum, alginates, konjac, and psyllium husk among others and can be also used alone or in combination with a pre-gelatinized starch. For example, adding GUMplete™ Psyllium Husk 95% NT to a formula allows the formation of a gluten-free dough that closely resembles the viscoelasticity of a wheat containing one. GUMplete™ Xanthan Gum 80 Mesh SR-2 on the other hand is used to increase the viscosity and cohesiveness of batters and doughs, and to improve product shelf-life by reducing its staling rate. Another type of co-texturizer is the protein concentrates such as VITESSENCE™ Pulse 3600 faba bean protein. Pulse protein concentrates are mostly used to provide structure, increase nutritional content, and improve the texture of the product rather than to provide up-front viscosity of the dough/batter systems. They can also replace animal-based protein such as egg whites and whey concentrates in a gluten-free formula.

Typically, combinations of two (2) to four (4) starches and flours, plus one or two hydrocolloid sources, are required to provide textures similar to the wheat-containing products. The right ingredient system can deliver a superior gluten-free product that has a chewy texture, enhanced elasticity and flexibility, tender bite, and the desired moistness and texture. Using the right ingredients from this toolbox is rather challenging; however, Ingredion’s DIAL-IN® Texture Technology can be successfully used as a holistic formulation approach to develop the right ingredients systems to formulate products with taste and texture similar to gluten-containing products (Figure 2).

**FIGURE 2:** DIAL-IN® Texture Technology, methodical, data-driven approach to texture optimization

### DIAL-IN® Texture Technology

The shortest path to the perfect texture



DIAL-IN® Texture Technology is a rapid and robust consumer-centric approach to product development. By applying DIAL-IN® Texture Technology to gluten-free tortillas, developers can target optimal texture and achieve their definition of product perfection faster than before. First, the textural attributes of gluten-containing and gluten-free benchmark products are defined using descriptive sensory analysis conducted by a trained sensory panel.

The results of the descriptive sensory analysis help to identify the texture gaps between gluten-containing and gluten-free products. Then, a range of ingredients is screened for potential functionality to fill the gaps. Finally, solutions with key functional ingredients are shown to deliver a superior tortilla product that has enhanced elasticity for correct flexibility, tender bite, and the desired moistness and texture.

## CASE STUDY – Gluten-free tortilla

The Ingredient Bakery Applications team developed three (3) formulations of gluten-free tortillas with different texture profiles: Solution 1, Solution 2, and Solution 3, to help meet consumer expectations for a gluten-free flour tortilla that mimics a standard wheat flour tortilla (contact us at [salesupport@ingredion.com](mailto:salesupport@ingredion.com) for copies of the three formulations). Four (4) gluten-free commercial tortilla wraps and one (1) soft-wheat, gluten-containing, tortilla wrap were also evaluated. Table 1 summarizes the functionality provided by each of Ingredient’s products incorporated into each of the three (3) gluten-free solution prototypes in terms of dough handling and processability, and tortilla physical attributes.

The Ingredient Descriptive Analysis trained panels evaluated the prototype and commercial tortilla wraps. Characteristics of tortilla wraps that were assessed included in-mouth textural attributes such as hardness and toughness in the first bite and cohesiveness of mass and moisture absorption during chewing. Manual texture characteristics were also captured with attributes such as stretch to break and surface roughness.

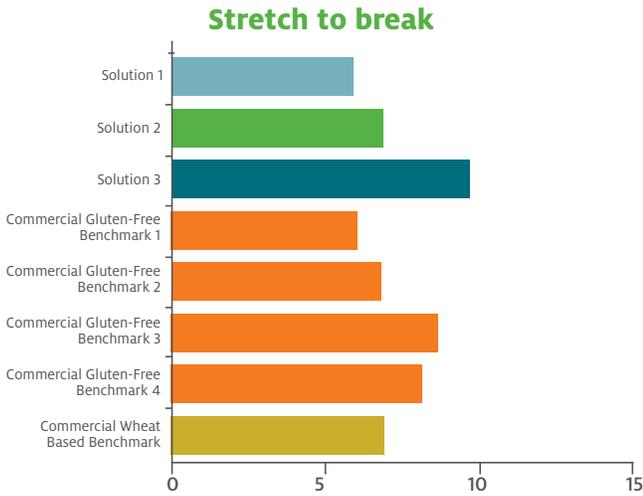
Results from the descriptive analysis study are displayed as a Principal Component Analysis (PCA) texture map in Figure 3.

**FIGURE 3:** Principal Component Analysis Texture Map of the sensory descriptive texture evaluation of the tortilla wraps



The descriptive analysis revealed that the Solution 2 is closest to the commercial wheat based benchmark and the commercial gluten-free benchmark 2. The Solution 3 was the closest in profile to commercial gluten-free benchmark 3.

**FIGURE 4:** Stretch to break of prototype solutions and commercial tortilla wraps



**TABLE 1:** Functionality provided by Ingredion’s products on the gluten-free tortilla prototypes

Solution #	Ingredient/system	Functionality
Solution 1	HOME CRAFT® Create GF 20 functional flour	• Tortilla elasticity
	HOME CRAFT® Express 390 tapioca flour	• Dough viscosity • Dough handling • Moisture retention
	HOME CRAFT® Pulse 4101 chickpea flour	• Tortilla color • Nutritional content
	VITESSENCE™ 3600 faba bean protein	• Protein content • Dough handling • Tortilla resilience
	GUMPLETE™ Xanthan Gum 80 Mesh SR-2	• Dough viscosity • Moisture retention
Solution 2	PRECISA® Bake GF modified starch	• Tortilla elasticity • Freeze-thaw stability
	ULTRA-TEX® 3 modified starch	• Dough viscosity • Dough handling • Reduces dough stickiness • Moisture retention
	HOME CRAFT® Pulse 4101 chickpea flour	• Tortilla color • Nutritional content
	VITESSENCE™ 3600 faba bean protein	• Protein content • Dough handling • Tortilla resilience
	GUMPLETE™ Xanthan Gum 80 Mesh SR-2	• Dough viscosity • Moisture retention
Solution 3	PENTECH™ GF TTB system	• Soft, pliable, and flexible texture

Figure 4 shows the manual texture attribute, stretch to break, for all the evaluated tortilla wraps, which is the measure of how far the tortilla wrap stretches before it breaks. This ability allows the consumer to fill their tortilla without it breaking. Solution 1 and Solution 2 are within the range of the stretch for the commercial gluten-free benchmarks as well as for the commercial wheat-based benchmark. Solution 3 exceeded the stretch of all tortilla wraps evaluated.

### In conclusion

Gluten protein in wheat forms the viscoelastic doughs needed to make a tortilla with a chewy texture and cohesive structure. Removing the gluten adds challenges of viscosity and elasticity compared to wheat-based doughs, not only altering processability and machinability parameters but changing taste, texture, and appearance in the resulting products. As consumer demand for gluten-free versions of favored foods such as tortillas continues to rise, with few desirable offerings able to fill the gap, the need to create gluten-free products formulated to be similar in texture to both commercial wheat-based and gluten-free tortillas rises. Ingredion’s solutions can improve the machinability of gluten-free tortillas and provide a range of different, custom textures depending on customer requirements. To achieve success in gluten-free formulating, several ingredients are needed. One ingredient is not able to do it all. The right combinations of starches, flours, and gums, correctly applied, can mimic each of these actions performed by gluten proteins in order to make a successful, tasty, and equally well-performing tortilla product.

### References

- [1] “Gluten-Free Foods in the U.S.”, 5th Edition; Packaged Facts/ Market Research Group, LLC (January, 2015)\*
- [2] Presentation: Industry Overview, by Jim Kabbani, Tortilla Industry Assn. Executive Director; Tortilla Industry Assn. Technical Conference 2015

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