by Donald E. Pszczola

The Rise of Gluten-Free

Gluten—the protein found in wheat, rye, barley, and spelt—gives elasticity to dough, helping it to rise and keep its shape. It is because of gluten that baked goods made with wheat have their characteristic texture, strength, and crumb structure, and other sensory properties. From that perspective, you might say that this protein is the "glue" that holds baked goods together. And let's not forget that gluten also functions as a thickening agent and filler for a wide range of other products from ketchup to vitamins (although some of them do not necessarily have gluten listed on their ingredients statements).

If gluten performs such a valuable service, why take it out of the formulation? Well, unfortunately, for a certain percentage of the population, the consumption of gluten can cause serious medical conditions, such as celiac disease, an autoimmune disorder. People with celiac disease have only one recourse: they must avoid gluten in their diets. An estimated 2.1 million adults are afflicted with celiac disease; this is approximately 1 in 133 people, an incidence of 0.9% of the total U.S. population. (The Celiac Sprue Association also estimates that there are more than 1.8 million undiagnosed adults with this disorder in the U.S.) Furthermore, studies have also shown that another 18 million Americans may be gluten intolerant and consequently would benefit from gluten-free products as well.

An increased awareness of celiac disease, in part, has driven interest in the gluten-free market. But the growth of this market has also been fueled by other consumer health trends including weight management and those that favor simpler, less processed foods. This has resulted in a gluten-free explosion over the past several years, with sales of gluten-free foods and beverages expected to reach $2.6 billion in 2012, up from $580 million in 2004. According to the market research organization Packaged Facts, the market for gluten-free foods has grown much faster than expected, at a compound annual growth rate of 30% from 2006 to 2010.

Whether this growth will continue has been the subject of debate. More important, I think, is the discussion regarding who should not consume gluten-free foods. In my opinion, gluten-free products are not meant to be consumed by everyone. Nor should they be interpreted or marketed as a general health food. (My blog on page 62 will cover more of these thoughts regarding the current gluten-free craze.)

Not surprisingly, when gluten is removed from baked goods and other formulations, sensory properties such as taste and mouthfeel have traditionally been compromised. And since gluten is present in a wide range of foods, it has been difficult for consumers to find gluten-free alternatives that taste good and have desirable texture properties. Consequently, manufacturers are looking for different ingredient solutions that will address these problems.

And they have been at least partially successful. Numerous products have been recently launched into the marketplace. For example, a leading provider of whole-grain foods, Bob's Red Mill Natural Products, Portland, Ore., launched gluten-free muesli, one of the few such products in the marketplace. The product is described as a hearty and wholesome mix of whole-grain gluten-free rolled oats, sunflower and pumpkin seeds, dried cranberries and apples, brown rice puffs, almonds, and coconut. The company now offers more than 70 gluten-free flours, cereals, baking mixes, and grains. Also, the company is offering a new booklet, "Gluten Freedom," that provides hospitals, universities, school cafeterias, and restaurants with information on how to set up safe, gluten-free commercial kitchens. The guide provides tips on avoiding cross-contact, on the selection of gluten-free foods and ingredients, on storage and preparation, and on safe gluten-free baking.

High Performance Muffins, Boonton, N.J., recently created a muffin that, according to the company, replaces ingredients such as gluten with alternatives that do not compromise on flavor. The product—*High Performance Muffins*—is made with gluten-free rolled oats. »»

In recent years, a variety of gluten-free products have been launched *in the marketplace. These products—ranging from cereals to pastas to pizzas—were developed for individuals with celiac disease or gluten sensitivities.* Photo © iStockphoto.com/jamesbenet

The Rise of Gluten-Free continued...

***From muffins to brownies (both shown in photos) to pancake mixes**, products are being developed with solutions that can replace gluten without compromising taste and texture. These solutions can include gluten-free flours, resistant starches, and modified tapioca starches.* Photos courtesy of Ingredion

Roland Foods, New York, N.Y., offers polenta, a gluten-free alternative to pasta. Made from ground yellow or white corn, polenta is prepared by boiling to a paste in water or other liquids such as chicken stock or heavy cream. It can be served as a base or side dish, grilled, fried, or baked. The company features a variety of recipes using polenta.

A few other examples include gluten-free bread from Denver-based Udi's; a line of gluten-free protein-based pasta dishes from Caesar's Pasta, Blackwood, N.J.; products such as *Rice Mac & Cheese*, *Garden Vegetable Lasagna*, and *Rice Crust Pizza* from Amy's Kitchen, Petaluma, Calif.; *Erewhon Buckwheat & Hemp*, a gluten-free cereal from Attune Foods, San Francisco, Calif.; a gluten-free gel fruit pouch from Buddy Fruits, Coral Gables, Fla.; and many other products ranging from chicken pot pies to snack crackers.

Interestingly, this increased awareness was reflected by the fact that the U.S. Senate designated September 13, 2012 as "National Celiac Awareness Day." That date was chosen, by the way, because it was the birth date of Samuel Gee, a pediatrician who published the first complete clinical description of celiac disease back in 1888; he was also the first to recognize that the symptoms of celiac disease are related to diet. Designation of this awareness day may be perceived as a step closer to an effective nationwide gluten-free labeling law.

This article will look at a variety of ingredient innovations that can help enhance the taste, texture, and nutritional profile of foods where the gluten has been removed.

Flipping Over Gluten-Free Pancakes

The October 2012 *Food Technology* Ingredients section discussed *Dial-In™ Texture Technology*, a comprehensive, data-driven modeling approach to food texture and optimization used by Ingredion, Westchester, Ill. (phone 708-551-2600, www.foodinnovation.com). One practical application of this approach would be in the area of gluten-free foods, which traditionally have unappealing textures such as dry, gritty qualities. With this approach, the company can create a variety of gluten-free solutions that can help food manufacturers produce cookies, cakes, muffins, pancake mixes, and other products that will appeal to individuals suffering from celiac disease without compromising the taste and texture that is frequently lost when removing gluten from a formulation.

At the 2012 IFT Food Expo, Ingredion highlighted prototype gluten-free pancakes made with *Homecraft® GF 10* co-processed gluten-free flour that delivered a taste and texture that is expected from traditional offerings. *Homecraft GF 10* and *Homecraft GF 20* are specialty flour systems that are derived from rice and tapioca, and have functionality similar to that of wheat flour. Functional flours under this brand maintain the positive attributes of traditional flours—they are versatile, lending opacity, flavor, mouthfeel, and a smooth, pourable texture. The flour can also be used to replace 25% to 60% of the fat in dry mix and ready-to-eat brownies, cakes, and cookies.

Other solutions for gluten-free formulating include *Expandex* modified tapioca starch, which improves eating qualities and visual appeal, and *Hi-maize* resistant starch—a natural insoluble dietary fiber—that has been shown to enhance the nutritional value of gluten-free products while maintaining a desirable taste and texture.

In a white paper, "Adding Texture Appeal to Healthy Baked Goods: A Systematic Approach to Satisfying Consumer Preferences," Ingredion provided a case study of gluten-free cookies and muffins and the approach that was used to create doughs with properties that produce a texture that is moist and chewy instead of dry and crumbly.

According to the paper, when food companies try to address the resulting demand for gluten-free baked goods, they face problems in formulating products that can be handled in traditional manufacturing processes and that have the appealing texture and appearance that consumers want. Common issues in

***It has been difficult for consumers to find gluten-free alternatives that taste good and have desirable texture properties. Consequently**, manufacturers are looking for different ingredient solutions that will address these problems.*

gluten-free bakery products include reduced volume, lack of an even cell structure, and a dry, crumbly, grainy texture that consumers find unattractive. To overcome these barriers to consumer acceptance, Ingredion employs its systematic approach to texture mapping to further characterize the sensory attributes that were most important in cookies and muffins. Benchmarks were traditional wheat-based products. While benchmark products displayed smooth, moist, chewy textures, commercial gluten-free products had significantly drier, more crumbly, and less moist and smooth profiles.

The company's gluten-free prototypes, on the other hand, ranked very close to the benchmark products in texture, mouthfeel, and moistness. Using *Dial-In* technology, the company was able to optimize products in two key areas: 1) process improvements for enhanced moisture management, dough consistency, and machinability, and 2) volume, cell structure, and textural sensory attributes in the final product. This systematic process led to the development of the *Homecraft* gluten-free flour replacements to meet the demands of both bakery manufacturers and consumers.

Easy to Forget That It's Gluten-Free

ConAgra Mills, Omaha, Neb. (phone 402-240-5153, www.conagramills.com), offers a variety of gluten-free flour solutions. For example, a gluten-free, all-purpose multigrain flour is available under the *Eagle Mills*® brand. The product is an all-natural whole-grain blend of the company's *Ancient Grains* flours—amaranth, millet, quinoa, sorghum, and teff—as well as brown rice and tapioca starch. The proprietary blend was formulated to achieve optimal texture, flavor, appearance, and functionality in a variety of popular grain-based foods. The formula optimizes the special properties of each of the *Ancient Grains* to deliver flavor, texture, and baking performance. It also represents a nutritional and quality breakthrough for manufacturers of gluten-free products, many of which lack fiber, B vitamins, and other important nutrients.

Its versatility can be leveraged across a range of products, such as breads, tortillas, muffins, cereals, cookies, snacks, and pasta. Take gluten-free bread, for example. Nutritionally, two slices of bread made with the flour deliver 6 g of fiber. A slice of gluten-free bread made with the flour has the same fiber as a slice of 100% whole wheat bread. By incorporating and certifying the gluten-free grains of

The Rise of Gluten-Free continued...

Different types of starches—tapioca, potato, and rice—can provide gluten-free solutions *that offer the volume, texture, color, and crumb grain that can traditionally be found in wheat-flour-based products. These gluten-free crackers, for example, can add a level of festivity to any gathering.*
Photo courtesy of Penford Ingredients

amaranth, millet, quinoa, sorghum, and teff, the company provides a solution that delivers nutrients and fiber that are often lacking in other gluten-free flours. The fiber content of these *Ancient Grains* is far superior to the potato starch and tapioca starch used in many other gluten-free flours and products. Furthermore, bread is traditionally a difficult product to replicate without gluten. Many of these breads are hard or grainy, leading consumers to avoid them altogether. However, bread made with this flour more closely resembles traditional bread in texture, color, and consistency. In a blind taste test, the gluten-free bread was described as "more moist," "more flavorful," and "more like regular bread." For these reasons, the company claims that "it's easy to forget that it's gluten-free."

In addition to this gluten-free, all-purpose, whole-grain flour blend, ConAgra Mills makes available a variety of custom blends based on its line of *Ancient Grains*. All of its gluten-free products receive gluten-free certification per the requirements of the Gluten-Free Certification Organization. GFCO certification means that a product has a gluten concentration of less than 10 ppm (5 ppm gliadin) as measured using industry-accepted methods for gluten detection.

Providing the Necessary 'Glue'

Formulating breads, muffins, pizza crusts, and cakes without using wheat flour can be an intimidating task, as gluten provides the "glue" that holds components together in these formulas, noted Penford Food Ingredients, Centennial, Colo. (phone 303-649-1900, www.penfordfoods.com). However, it's a necessity to address the needs of those with gluten intolerance, wheat allergies, or celiac disease. By incorporating different types of tapioca, potato, and rice starches into the formulas, the company has been successful in creating several gluten-free solutions that can offer the volume, texture, color, and crumb grain that can traditionally be found in a product made with wheat flour.

Take pizza crust, for example. When gluten is removed, the crust can have the consistency of cardboard. The raw dough loses elasticity and the crumb grain in the finished product becomes very dense and too firm, making for a very unappetizing crust. These problems can be solved by incorporating pregelatinized starches such as *PenPlus® WR* waxy rice starch or *PenPlus® 2510* tapioca starch, which will give the dough much needed elasticity along with resilience and the appropriate amount of chewiness. The use of cook-up starches, such as *PenBind® 150* tapioca starch, aid in creating a consistent crumb grain and reduces potential gumminess that may arise.

In 2010, Penford launched *PenTech GF*, a system developed for gluten-free baking and coating applications. The ingredient system allows manufacturers, processors, and foodservice companies to create product lines that have all the wellness attributes of gluten-free combined with the visual, mouthfeel, and flavor of wheat-based items.

On the bakery side, the system can create gluten-free breads, rolls, muffins, pizza crust, cookies, cakes, and other products, as well as customized versions, without compromising taste and sensory attributes. The use of the proper starch can give dough the much-needed elasticity, the right amount of chewiness, and a consistent crumb grain, explained John Randall, the company's president. The system allows for volume to give bread height, textures that aren't too gummy or dry, crumb grain for muffins similar to that of wheat-based products, a resilient body for pastries to prevent crumbling, cakes that are light and fluffy, and a neutral flavor that won't interfere with other ingredients for pizza dough or pie crusts.

For consumers who must restrict gluten, batter-coated and fried products such as chicken, fish, or vegetables have typically been off limits because of the presence of wheat in the mix. Using potato- and corn-based derivatives as its main ingredients, *PenTech GF* can provide coating systems with the texture and appearance of a wheat-based product and an equally appealing taste. The coating technology can retain moisture and help create a crispy coating while aiding in the retention of heat within the food. "Batter-coated and fried meats, vegetables, chicken—and even the moistest seafood—can have a mouth-watering and crispy gluten-free coating," noted Randall. "A newly developed corn starch is the key ingredient to the company's gluten-free fish batter mix. It sticks better, providing a pleasing 'bite' with no gummy interface. Its neutral flavor allows for creative custom spice and flavor combinations."

Another innovation from the company is *PenFibe™ RS*, a potato-based resistant starch that is gluten-free and serves as a dietary fiber source. The ingredient contains about 85% dietary fiber on a dry solids basis and its bland flavor and color adapts well to a wide variety of applications, including gluten-free products. It also maintains a smooth texture and provides a good volume in these applications. Benefits include low water-holding capacity that allows for increased solids/bulk without affecting product quality and good recovery of fiber content level after manufacturing. In addition, *PenFibe™*

RS contributes minimal viscosity to food systems, is a concentrated source of dietary fiber, lessens caloric content of food by replacing higher-calorie ingredients in the formulation, reduces postprandial glucose levels, and is nonallergenic.

Gluten-free foods such as breads, cookies, pancakes, waffles, and bagels can also benefit from a new line of specialty pre-gel corn starches made of waxy maize capable of thickening in cold liquids and producing freeze/thaw and retort-stable fillings. The ingredient line can improve the texture in baked goods, especially gluten-free versions.

In addition, Penford offers its *PenPure*™ portfolio of clean label starches, which because of their multiple functionality benefits, can have further implications for gluten-free formulating. The starches—potato, corn, rice, and tapioca—can function in customized blends, making them especially suitable for gluten-free foods. Functionality benefits include moisture retention, enhanced texture and mouthfeel, elasticity improvement, crisping, viscosity, and many others that can aid in the development of gluten-free foods.

Gluten-Free Baking Facility Opens in U.S.

A new manufacturing facility dedicated to producing gluten-free breads and other bakery products in the United States was recently opened by Dr. Schar U.S.A., Lyndhurst, N.J. (phone 201-355-8470, wwwschar.com), a subsidiary of Europe's market leader in gluten-free foods. Located in Swedesboro, N.J., the 60,000-sq-ft state-of-the-art facility will produce the company's gluten-free baked goods, including breads, rolls, and bagels.

"The launch of our first facility in the United States is an exciting milestone for the *Schar* brand," said Donna L. George, the company's President and COO. "The facility will help accelerate the growth and availability of innovative gluten-free foods in grocery, natural, and specialty stores as well as restaurants and other food outlets across the country. Dr. Schar is committed to raising awareness and improving the quality of life of those in the U.S. who have celiac disease or gluten sensitivity."

The facility makes it possible for Schar to introduce its gluten-free plain and cinnamon bagels to the U.S. marketplace. The site will also produce classic and multigrain ciabatta parbaked rolls and baguettes, *Hearty White Frozen Bread*, *Hearty Grain Frozen Bread*, and several other baked goods items currently in development.

The Rise of Gluten-Free continued...

Challenging traditional notions, desserts can be created that are both indulgent and gluten-free. Shown in this photo is an assortment of gluten-free cupcakes and fillings.
Photo courtesy of David Michael

As a gluten-free facility, Schar will strictly adhere to the same rigorous production standards followed by all company facilities across the globe. From the selection of raw materials to the manufacturing of gluten-free baked goods, the facility will comply with the 20 ppm or less maximum gluten content standard established by the Codex Alimentarius Commission.

With a comprehensive portfolio of products—more than 300—in Europe, the U.S. facility enables Schar to expand its distribution in the country, while strengthening the Schar brand. Dr. Schar's parent company, Dr. Schar AG/SPA, based in Burgstall, Italy, invested more than $15 million into its new facility. The company has been developing and producing a flavorful selection of gluten-free products for more than 30 years. Its product portfolio includes breads, rolls, pasta, cookies, crackers, and frozen meals. Schar U.S.A. was incorporated in 2007 and has introduced more than 33 products to the U.S. market.

Gluten-Free Flours for Soups and Sauces

Two new gluten-free flours for use in soups and sauces have been introduced by Kampffmeyer Food Innovation GmbH, Hamburg, Germany (phone 0049 0 40/75109-630, www.kampffmeyer.com). The flours, which function as binding systems, extend the company's *Purafarin*® functional flour portfolio, which includes more than 25 products for a wide range of uses.

According to the company, the two new flours are based on corn and rice, and were developed in response to an increasing demand for gluten-free binding systems from companies in the foodservice sector, especially from those who supply hospitals, schools, and kindergartens. The corn flour is yellow in color while the rice flour is white. Both flours are heat treated, allergen-free, and can be directly incorporated into applications such as soups and sauces. They are said to provide creaminess and a desirable mouthfeel.

The development of these flours began in early 2012, and both are now commercially available. These gluten-free ingredients were launched at the 2012 Health Ingredients Europe exposition, which was held this fall in Frankfurt, Germany.

Kampffmeyer Food Innovation GmbH—a joint venture between the leading milling group Kampffmeyer Milling GmbH and the globally operating Danish food ingredient manufacturer Palsgaard A/S—is one of the leading suppliers of refined milled grain products. The company specializes in the processing of genuine grain varieties using the latest physical refinement processes, resulting in highly functional flours, compounds, and extrusion products.

Gluten-Free Indulgence?

The allergy-suffering customer base continues to grow, and with it, the need and demand for not only more, but better-tasting, allergen-free and gluten-free options.

"From retail to foodservice, allergen- and gluten-free products continue to carve out more real estate," noted Victoria Vaynberger, Marketing and Consumer Insights Manager for David Michael & Co. Inc., Philadelphia, Pa. (phone 215-632-3100, www.dmflavors.com). "Both retailers and fast-casual restaurant chains stand to benefit by providing better-tasting options in this consumer category."

Food technologists at the company are working to challenge the notion that "gluten-free" is synonymous with "not as tasty." At the 2012 David Michael Innovation Roadshow, several gluten-free prototypes were highlighted that demonstrated how gluten-free products that are "deliciously indulgent" could be created. These products were said to be developed with a thorough understanding of the requirements of allergen- and gluten-free baking and fueled by the goal of creating decadent-tasting treats that would not disappoint individuals who follow gluten-free diets.

Examples of these dessert prototypes included bite-sized lemon cupcakes (*Gluten-Free Lemon Cupcakes with Gluten-Free Lemon Buttercream Frosting and Raspberry Filling*); miniature devil's food cupcakes (*Gluten-Free Devil's Food Cupcakes with Gluten-Free Cocoa Buttercream Frosting*); and what the company describes as the ultimate allergen-free chocolate chip cookie (*Nut, Dairy, Egg & Gluten-Free Chocolate Chip Cookies*).

Other gluten-free prototypes featured at the show included a *Chia Seed Pudding* and a *Chia Milk Alternative*. See the 2010 October *Ingredients* section for a complete description of these seed-based products. For the purpose of this article, these two prototypes are further indications of the interesting directions that gluten-free formulating can take.

As noted by Vaynberger, "It's easy to see how a food allergy weighs more heavily on a purchase decision than a taste preference does—but that doesn't mean that taste doesn't matter."

Gluten-Free Soy Sauce

With the increasing demand for gluten-free applications, a new

soy sauce product, *Kikkoman Gluten-Free Soy Sauce*, enables food manufacturers to develop a broader spectrum of globally inspired formulations designed for customers who are on diets in which gluten has been restricted for health reasons.

The soy sauce, launched by Kikkoman Sales USA Inc., San Francisco, Calif. (phone 415-229-3605, www.kikkomanusa.com), is naturally brewed with four ingredients—water, soybeans, rice, and salt—using the company's fermentation process. However, the traditional wheat in conventional soy sauce is replaced with rice, and meets FDA's proposed guidelines for a gluten-free declaration.

According to the company, the resulting product has a rich flavor and a complex, pleasing aroma that enhances umami and blends seamlessly with other ingredients. Available in liquid or powder form, the soy sauce can be used to boost flavor naturally in dry mixes, soup bases, bouillon, sauces, dips, rubs, snack coatings, and seasonings. At the 2012 IFT Food Expo, the product was highlighted in gluten-free turkey meatballs.

Potential of Rice Bran in Gluten-Free Bread

A stabilized rice bran ingredient from NutraCea, Scottsdale, Ariz. (phone 602-522-3000, www.nutracea.com), was highlighted in new research on the potential benefits of the ingredient in gluten-free bread. The research, published in *Journal of Cereal Science*, demonstrates the potential of rice bran to enhance nutritional value of gluten-free bread formulations.

The new research, entitled "Quality Improvements of Rice-Based Gluten-Free Bread Using Different Dietary Fiber Fractions of Rice Bran," was prepared by independent researchers from Chiang Mai University in Thailand and the University of Natural Resources and Life Sciences in Austria. The researchers were studying ways to address the traditionally low nutritional quality of gluten-free breads.

In the report, researchers created an optimized bread formulation made with Nutracea stabilized rice bran at a level of 10%. Results showed that inclusion of rice bran produced bread with a better color, higher volume, and softer crumb firmness, leading the researchers to write that "results prove that addition of rice bran not only enhances the physiochemical and nutritional profile of the final gluten-free breads, it was also preferred by the panelists over the control bread."

W. John Short, CEO and President of NutraCea, commented, "We have long recognized the many positive nutritional benefits of rice bran—it is hypoallergenic, gluten-free, contains a full range of amino acids, and is easily digestible. As noted in this exciting new research, it also supplies valuable protein content to foods such as bread and other baked goods."

A Slice of Gluten-Free

When it comes to pizza, there are a variety of choices—sausage, pepperoni, even anchovy. But

The Rise of Gluten-Free continued...

New gluten-free solutions *such as pea-derived ingredients and fiber sources can help create a pizza that is gluten free. And don't forget about those gluten-free toppings.* Photo © iStockphoto.com/flyingroosterphoto

how about gluten-free?

At the 2012 IFT Food Expo, Roquette America Inc., Keokuk, Iowa (phone 319-524-5757, www.roquette.com), demonstrated that it is possible to create a gluten-free pizza dough and a whole mini pizza using a number of ingredient solutions from its extensive portfolio.

For example, *Nutralys*® pea protein—a vegetarian, non-allergenic protein source extracted from the dry yellow pea—can be used in formulating gluten-free foods such as pizza. Pizza manufacturers can also use *Nutriose* soluble fiber, which can add a source of fiber, making it especially suitable for application in gluten-free.

The highlighted pizza dough was made with ingredients such as pea starch, pea fiber, *Nutriose FM06*, and a gluten-free dough conditioner. The gluten-free whole mini pizza provided a good source of fiber.

With the demand for protein continuing to rise, the hunt for new protein sources and alternatives is gathering pace, and as shown by Roquette, pea-derived ingredients may find new opportunities in the area of gluten-free formulating.

Eggs-amining Gluten-Free

One of the new functionality videos offered by American Egg Board, Park Ridge, Ill. (phone 847-296-7043, www.aeb.org), covers the use of egg products in gluten-free formulating. Here is some of the information that is found in that video.

When egg proteins are heated or exposed to acid, the weak bonds holding the amino acid chains together in a three-dimensional structure break and the chains unfold

IngredienTalk:

Gluten-free foods are designed for individuals who suffer from celiac disease or gluten sensitivities, both small percentages of the marketplace. And yet with the way the gluten market is growing, one would initially think that these medical conditions have reached epidemic proportions like those involving diabetes and obesity. The truth is this: Factors influencing the growth of the gluten-free market have much more to do with consumer perceptions regarding what is healthy. And, unfortunately, along the way, wheat and wheat-derived ingredients are getting an undeserved negative image. If you have some dietary advice to offer (or just care to provide some perspective on the current gluten-free craze)—and you're an IFT member—visit www.ift.org, type in your name and password, click on the IFT Community button, and go to the blog section. Let's field some sound views.

Is Gluten-Free for Everyone?

If you wanted a piece of candy, would you choose a cough drop? Hopefully not, as a cough drop is designed to suppress a cough. Candy may make you feel good, but let's be realistic—it's not medicine. I think this same kind of reasoning should be applied to gluten-free formulating. These foods are designed for individuals with celiac disease or gluten sensitivities, and not for those looking to eat more healthfully or desiring to lose weight.

People affected by celiac disease and gluten sensitivity must avoid all foods containing gluten. Approximately 1% of Americans have celiac disease (which is an immune disorder) and another 6% are estimated to suffer from gluten sensitivity (which is a digestive disorder). For these individuals, their only recourse is a gluten-free diet. And yet, somewhat ironically I suppose, many other consumers—more than those who actually have celiac disease or gluten insensitivity—believe that gluten-free leads to better health. This view is probably influenced by endorsements from celebrities when it should be shaped by food scientists or medical professionals. Why isn't that a surprise?

A recent Harris survey polled more than 2,000 adults about their perceptions and use of a gluten-free diet. Of those participants who followed the diet, half reported doing it to "feel better" and 26% as a "diet for losing weight." Furthermore, according to a 2011 report from Packaged Facts, the gluten-free product market grew by a rate of 30% each year between 2006 and 2010. Reasons for this rapid growth included the perception that gluten-free products are healthier in addition to endorsements from celebrities. According to a Packaged Facts survey conducted in fall 2010, only 8% to 12% of consumers who bought gluten-free products did so because they or a member of their household has celiac disease or an intolerance to gluten. And in 2012, a new survey by Vitacost.com, a leading online retailer of health and wellness products, looked at reasons why consumers avoid gluten. Among the results, 31% chose gluten-free foods because they see them as the "healthier" option while only 13% mentioned celiac disease. Results of such surveys are rather disturbing.

Not too long ago, research published in the *Journal of the Academy of Nutrition and Dietetics* indicates that there is no benefit for the average healthy adult to follow the gluten-free diet. It also disputes the perception that going gluten-free is an effective way to lose weight and may in fact lead to weight gain because of the

or denature. When they aggregate back together (a process known as coagulation), they entrap air and moisture. In essence, they create cells where the cellular wall is composed of proteins and the cell contents are composed of air or moisture. When the cells contain air, this is referred to as foam. It is very similar to when gluten traps and holds air bubbles. This egg foam is generally irreversible and is able to provide height, volume, and stability to cakes, muffins, quick breads, and other chemically leavened baked goods.

One other surprising benefit that scientists discovered was that egg products slow down the staling process. This is accomplished through their ability to retain moisture. Researchers plan to further evaluate this benefit to determine if it is possible to omit chemical anti-staling agents when formulating gluten-free products with egg products.

In general, gluten-free cakes, cookies, and muffins are easier to formulate than gluten-free breads when egg proteins are part of the formulation. Sugar molecules, which are generally present in greater quantities in these products than in bread, raise the temperature at which egg proteins coagulate. This allows for more and larger air cells to form, resulting in a light, fluffy texture.

Looking beyond baked goods, wheat flour is typically used in the batter that encrusts or breads frozen appetizers, chicken, and fish products. The elasticity of the gluten helps with adherence of breading to the food. The proteins in egg products—specifically in the egg whites—can provide the same adherence properties. Heat or acid causes the egg proteins to coagulate. When they solidify, they function as an adhesive, connecting ingredients or food components with each other.

When it comes to pasta, wheat flour has historically been the grain of choice. The gluten enhances the machinability of pasta dough, contributes to good cooking quality, and produces a desirable cooked pasta texture. Additionally, pasta made from refined wheat flour is visually what consumers have come to expect. When using gluten-free grains to make pasta, formulators will often incorporate egg products. Once again, the proteins function similarly to gluten in this application. In addition, egg yolk contains xanthophyll, a carotenoid that has a yellow-orange pigment that gives the

extra sugar or saturated fat added to improve the taste of gluten-free products. The paper, "Gluten-Free Diet: Imprudent Dietary Advice for the General Population?" is authored by Arizona State professor and researcher Glenn Gaesser. "While the gluten-free diet is an important medical treatment for people with celiac disease and gluten sensitivity, far too many Americans are following the diet for reasons that simply do not make sense," stated Gaesser. "Even though it has been endorsed by celebrities for weight loss, let's face it—they are not the experts on nutrition and health. It's time to listen to the science."

In addition to concluding that that the gluten-free diet is not an effective weight loss method, Gaesser indicated his concern that the elimination of gluten may, in fact, result in the loss of several important benefits, such as supporting heart, gut, and immune system health. The study identified a number of potential health benefits associated with gluten that would be lost on a gluten-free diet. "Gluten-rich grains, especially wheat, may have health benefits attributable to naturally occurring fructan-type resistant starches as well as gluten itself," Gaesser said. "By creating a healthy composition of colon bacteria, whole-grain wheat products may protect the gut from some cancers, inflammatory conditions, and cardiovascular disease. Gluten, and one of its component proteins gliadin, may contribute to blood pressure control and immune function. Because wheat is the main source of gluten in the American diet, these studies may help explain the consistent findings of health benefits of whole-grain consumption."

As a sidepoint to Gaesser's findings, a new article published by AACC International refutes many of the claims published in the recent book, *Wheat Belly*, which charges that it is wheat consumption that is causing obesity and a myriad of other common health problems in the U.S. The AACC article challenges the book's author William Davis' recommendation to cut wheat entirely from the diet. In her article, Julie Jones, a consultant and Professor Emeritus with St. Catherine University, assesses many of the statements provided by Davis. While Davis finds that eliminating wheat from the diet creates rapid weight loss and may cure or mitigate conditions such as type 2 diabetes, asthma, and joint pain, Jones reminds readers that many diets that severely restrict calories are successful in the short term. Further, she notes that significant weight loss, regardless of the inclusion of wheat or not, helps relieve or cure conditions such as those listed above. "An attribution of improvement in such conditions to the wheat removal is overly simplistic," she said. Jones also addresses Davis' assertions concerning glycemic index and starches, wheat breeding and genetics, celiac disease, and other diseases and allergens, by looking at his assertions in light of current published research.

And speaking of research … Noting that gluten-free dieting has gained considerable popularity, Gaesser recommended that additional research is needed to "clarify the health effects of gluten and potential consequences of avoiding gluten-containing grains." This seems to me a very prudent position to take, especially when realizing that eating a gluten-free diet without a specific medical need may actually be detrimental to your health. Gluten-free foods are often high in calories and lack the nutritional vitamins and fiber recommended in a normal diet.

Another important point that should be made regards innovation. By removing

The Rise of Gluten-Free continued...

Formulating gluten-free products such as breads can be a difficult task, but new ingredient developments continue to emerge that can help replace gluten without compromising sensory properties. Photo courtesy of Penford Ingredients

yolk its characteristic color. This pigment contributes a rich color to the pasta, particularly pastas based on very light-colored flours such as those obtained from rice and soy.

Egg proteins can also provide structure and coagulative properties to bind food products such as snacks, processed meats, and prepared entrees. They can coagulate and entrap moisture, creating gels that thicken, bind, and provide structure without the gluten of other ingredients. For example, egg products can often replace the small amount of wheat-based ingredients used to bind ingredients that go into crab cakes, meatballs, and pasta filling. Egg proteins can also improve the mouthfeel of sweet goods and puddings by providing substantial body and smoothness. They can be used to thicken sauces, smoothies, and other viscous products that normally rely on wheat-based starch ingredients. And finally, compared to many other proteins, egg proteins are bland, and thus they mix well into products, allowing characterizing flavors to come through clearly and cleanly.

Potential for Gluten-Free

As gluten-free formulating increases, several ingredient developments are emerging that may play a role in those products where gluten has been removed. Here are just a few examples.

Various gluten-free options that provide improved nutritive characteristics are being developed by ADM, Decatur, Ill. (phone 800-637-5843, www.adm.com). The company's *VegeFull*™ cooked bean ingredients are gluten-free, allowing manufacturers to add nutrition, texture, and bulk to gluten-free products. ADM also offers white sorghum flour and whole-grain white sorghum flour for the formulating of gluten-free products such as pancakes, cookies, buns, and cakes. Combinations of different gum systems and isolated soy proteins from the company can also help improve the taste of gluten-free products.

Rice-based ingredients from BENEO (www.BENEO.com) not only yield texture advantages but also enrich the nutritional profile of gluten-free bakery products. Rice starches, for example, can provide crispy or soft characteristics while reducing breakage of biscuits or crackers on the production line.

IngredienTalk: *(continued)*

gluten and just advocating gluten-free products (it sounds silly just saying that, folks), one should also consider the important advancements that are being made in the area of wheat and wheat-based ingredients. Take one from ConAgra Mills, for example. At the 2012 IFT Food Expo, the company introduced *Ultragrain® High Performance*, a whole-wheat flour that ConAgra claims is unlike anything the baking industry has ever worked with before. According to Glen Weaver, the company's Director of Research, Quality and Innovation, "*Ultragrain HP* has phenomenal gluten strength and utilizes water more effectively than traditional whole wheat flour, so it has an expanded mixing tolerance and unprecedented rise and volume." This ingredient is said to reduce added gluten requirements by 50% or more, to absorb 3–4% more water than traditional whole-wheat flour, and 8–12% more water than refined flour, and have a greater mix tolerance. The ingredient is suitable for any whole wheat bakery application that needs additional gluten strength or higher absorption, such as pan breads, bagels, hearth breads, frozen dough, par-baked breads, and hamburger and hot dog buns.

In closing, when developing gluten-free foods, it would be wise for food manufacturers to follow two guidelines.

First, while these foods are designed for a specific health purpose, they still need to maintain a desirable taste, texture, and other sensory properties for them to be successful in the marketplace. (That by the way is probably true for all food categories, and not just gluten-free.) A March 2009 survey conducted by The Gluten Intolerance Group of North America revealed that gluten-free shoppers were dissatisfied with the quality of gluten-free food available in retail stores, citing 71% of respondents agreeing that good-tasting, gluten-free foods are hard to find, with 79% admitting they've wasted a lot of money on gluten-free foods that didn't taste good.

And second, these foods should never be promoted in such a way as to give the implication that their consumption is better-for-you in terms of the general population. While it's true that gluten-free foods are on the rise in the marketplace, let's not forget to be realistic as to why these foods are being designed and specifically for whom.

Suffice it to say, not following either guidelines, I believe, could lead to folly—the first one to failure in the marketplace, and the second to a possible lawsuit, or, if nothing else, a black eye in terms of ethical stances.

If you care to provide some sanity to the gluten-free craze, let's IngredienTalk.

Lupin Bean Flour B113 from Woodland Foods, Waukegan, Ill. (phone 847-625-8600, www.woodlandfoods.com), may be used as an alternative ingredient for gluten-free baked goods, adding nutritional value and a rich, creamy color to breads, crackers, coatings, desserts, pancakes, waffles, and soups. It offers a complete protein that contains all essential amino acids, about double the amount of protein in other beans, and is high in fiber and prebiotics.

SunOpta Rice Fiber 310 delivers a concentrated source of dietary fiber (greater than 90%) while providing a silky smooth texture and bland flavor. SunOpta Inc., Chelmsford, Mass. (phone 781-276-5100, www.sunopta.com), expanded its portfolio of value-added ingredients to include this gluten-free ingredient. Rice fiber currently in the marketplace is made from rice bran, not hulls, and does not exceed 50% total dietary fiber. The proprietary process to produce this fiber was internally developed and utilizes existing manufacturing assets. Scott Gordon, the company's President, noted, "As we continually seek to expand the company's fiber solutions, rice fiber provides a gluten-free, all-natural option for enriching foods that need a boost in fiber content. We are excited to be first to market with this high-fiber ingredient."

OptiSol 5300 hydrocolloid ingredient, derived from flaxseed, may be used as a cost-effective, all-natural guar gum replacer in gluten-free foods. The functional ingredient, available from Glanbia Nutritionals, Fitchburg, Wis. (phone 608-316-8500, www.glanbianutritionals.com), has a fibrous hydrocolloid mucilage and protein network that provides synergistic functionality to a variety of applications. It is high in both fiber and protein and offers moisture migration control properties and the ability to bind fat and water for improved texture and crumb structure, increased volume, and extended shelf life. The ingredient was featured in a gluten-free whoopie pie prototype at the 2012 IFT Food Expo.

King Lion Premium Cassava Flour, developed by American Key Food Products, Closter, N.J. (phone 201-767-8022), may be used as a replacement for wheat flour in gluten-free foods. The ingredient delivers baking performance characteristics that closely mimic the structure, texture, and taste of numerous wheat-based products with a single ingredient. This effectively eliminates the need for complex formulations of flours,

The Rise of Gluten-Free continued...

starches, and hydrocolloids commonly used in gluten-free products.

A combination of corn starches, both native and modified, offered by Grain Processing Corp., Muscatine, Iowa (phone 563-264-4265, www.grainprocessing.com), greatly improve the eating quality of gluten-free baked goods. For example, *Pure-Dent® B700* unmodified corn starch, along with *Inscosity® B656* and *Instant Pure-Cote® B792* instant modified starches, improve mouthfeel and extend shelf life.

As the hunt for new protein sources, replacers for certain gums, and new texturizers continues, one can expect that these innovations will create additional opportunities for the development of gluten-free products that do not have compromised sensory qualities. Furthermore, new fiber developments as well as vitamins, minerals, and other nutrients can help to enhance the nutritional profile of foods that can lose these nutrients when gluten-containing ingredients are taken out of the formulation.

And finally, there is no doubt that gluten-free has become a trend in today's food industry—for individuals with celiac disease and gluten intolerance, it is essential for this market segment to adhere to a strict gluten-free diet. Traditionally, bakers and food formulators have relied on wheat flour to provide structure in baked goods and other products, and the removal of gluten-containing ingredients can create significant challenges. Many of the gluten-free items available today are lacking in texture, flavor, and mouthfeel. As a result, food developers continue to search for effective solutions that will help create better quality gluten-free products that will meet the needs of the affected individuals. This article has examined a number of solutions that hopefully will make this possible. **FT**

Next month's Ingredients *section will look at new uses for dairy, including as antimicrobials, salt replacers, sweeteners, texturizers, flavors, and other ingredient alternatives.*

Donald E. Pszczola,
Senior Editor
• depszczola@ift.org

www.ift.org

Members Only: Read more about gluten-free at *www.ift.org*. Type the keyword into our search box at the upper right side of our home page.