

# WHOLE GRAINS ON EVERY PLATE CONFERENCE

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## GLUTEN-FREE DOESN'T MEAN GRAIN FREE Is gluten-free here to stay?

Gluten-free diets are hot. Every day the Twittersphere uncovers a new celebrity or sports figure who's forsaking gluten, and gluten-free products are on the shelves in every store. But how much of this is a trend, here today and gone tomorrow – and what is the science behind the sensation?

In this section we'll separate the fad from the facts. We'll explain the health issues associated with gluten for a small percentage of the population, detail the wide range of gluten-free grains, and present intriguing research showing how farmers and manufacturers can make sure whole grains contribute optimally to health. Topics include:

**What is Gluten?** An explanation of the benefits and challenges associated with gluten.

**Celiac Disease & Gluten Intolerance** – What are the medical issues with gluten grains, and why? Is gluten intolerance the same as celiac disease?

**A Wealth of Gluten-Free Grains.** Gluten-free doesn't mean whole grain free. Most grains are gluten-free so there are many good choices for those who have difficulty digesting gluten proteins.

**Turning the Tide on Gluten.** Research shows gluten problems are increasing, and we'll detail some of the possible reasons why. With increased understanding of the reasons for increased gluten intolerance and celiac disease comes an increase in possible solutions, which we'll also detail here.



# WHAT IS GLUTEN?

Gluten is a term used to refer to certain seed storage proteins found in wheat, barley, rye and triticale (a wheat-rye hybrid). These proteins have many specific names – including *gliadins* in wheat, *secalins* in barley, and *hordeins* in rye – and although they differ slightly from each other, we collectively refer to them as gluten when talking about their effects on health and their benefits in baking.

Gluten is a wonderfully elastic protein. Our distant ancestors discovered that ground-up wheat mixed with water picked up wild yeasts and soon began to ferment and bubble. When this mix was slapped on a hot rock by the fire, it became the earliest flatbreads, rising to create a lovely open texture. This explains why wheat became so favored as a grain: its glutes were the strongest, and created the most delectable breads. The same glutes that stretch and hold together so well in bread, however, also hold together well in our bodies, sometimes too well.

Enzymes in our body easily break down most proteins we eat as they pass through our stomach and small intestine. These enzymes change the giant molecules that make up most proteins into smaller molecules that can easily be absorbed through the small intestine and into the blood. But humans have a harder time digesting gluten proteins, as they can be resistant to these digestive enzymes (peptidases). Long, partially-digested chains of amino acids can hang around in the lining of the digestive tract, where – in some people – they cause health problems that range from annoying (bloating and cramping) to life-threatening (see next section).

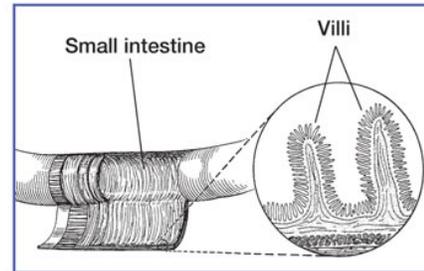
Let's put this in context, though. Digestion of food isn't always a walk in the park; many healthy foods present challenges to your digestive tract. If you don't routinely eat legumes, for example, your gut may not have the enzymes needed to break them down, and you'll suffer gas or bloating until your body revs up its enzyme production. Some of the healthiest vegetables, like broccoli and cabbage, can also cause digestive distress in some people. Dairy products can't easily be digested by those with lactose intolerance, because they're lacking the enzymes that break down lactose (milk sugar).

For most of us though, our bodies rise to the challenge, and we benefit from the healthy nutrients found in legumes, vegetables, dairy products – and wheat, barley and rye. For an unfortunate but small segment of the population, gluten proteins present digestive problems that are best addressed through a gluten-free diet, as explained in the following pages.

# CELIAC DISEASE AND GLUTEN INTOLERANCE

In the previous section, we explained that gluten proteins can be difficult to digest, and that long chains of amino acids can get stuck in the lining of the digestive tract. For most people, this is not a problem, but for an estimated 1% of the population, these stuck gluten proteins can trigger inflammation and an immunological reaction called celiac disease. Another 6-7% of the population is said to be gluten intolerant.

Celiac disease is an auto-immune disease, which means that your body begins to attack its own tissues. In the case of celiac disease, the target is the *villi*, finger-like projections that line the small intestine (as shown in this illustration from the National Institutes of Health). In a healthy digestive tract, the villi hugely increase the surface area of the intestine that can capture nutrients and pass them on to the bloodstream.



Celiac disease destroys the villi, cutting the body's ability to absorb nutrients to almost nothing. The devastating malnutrition that follows can cause any number of different bodily symptoms, making celiac disease notoriously hard to diagnose. There is at present no cure and no medication for treating celiac disease – except for lifelong adherence to a gluten-free diet. Once gluten is completely removed from the diet, the villi can begin to regenerate, and those with celiac disease can once again derive nutrients from the foods they eat.

People who have a reaction to gluten that is not immunological are said to be gluten-sensitive or gluten-intolerant. While they may not suffer permanent biological damage from ingesting gluten, they may experience a range of symptoms that can include gas, bloating, diarrhea, rash, brain fog and headaches, runny nose, etc. It's estimated by Dr. Alessio Fasano, Director of the University of Maryland Center for Celiac Research, that about 6-7% of Americans may be gluten sensitive.

As with celiac disease, the only sure-fire treatment for gluten intolerance is following a gluten-free diet for the rest of your life. While that's no easy task, the recent increased availability of gluten-free products in groceries, and the rise in restaurants serving true gluten-free meals (carefully prepared following GF protocols) now make following a gluten-free diet a bit less daunting.

Compared to the years of illness and misery most people with celiac disease put up with before being diagnosed, even this difficult "prescription" can seem easy. As one person told me, "It's not so hard. I don't have to have an operation, or take expensive drugs with awful side effects. All I have to do is eat really good food and I feel great."

# A WEALTH OF GLUTEN-FREE GRAINS

Fortunately for people following a gluten-free diet – and for the farmers and manufacturers producing their food – most grains do not contain the glutes that are off-limits in a gluten-free diet.

Grains with Gluten	Gluten FREE Grains
Wheat, including varieties like einkorn, spelt, Kamut®, farro, and durum, and products like freekeh, bulgur, semolina	Amaranth
Barley	Buckwheat
Rye	Corn
Triticale	Millet
	Montina (Indian rice grass)
Oats ** see below	Oats ** see below
	Quinoa
	Rice
	Sorghum
	Teff
	Wild Rice

*\*\* Oats are inherently gluten-free but are frequently contaminated with wheat during growing or processing. Several companies now offer pure, uncontaminated oats. As your physician if oats are acceptable for you.*

Whether you are sensitive to gluten or not, eating a wide variety of whole grains is a good idea. If you were advised to eat more vegetables, you wouldn't just eat carrots, would you? Even though carrots are healthy, we know instinctively that different vegetables provide different nutrients our bodies need, and eating many different vegetables is important to good health.

It's the same with whole grains. For almost everyone, wheat is a healthy food, but even still, it's good to branch out and enjoy oats today, quinoa tomorrow, corn or wild rice the next day. That way you'll cover all your bases, and discover great new tastes and textures you might have missed otherwise. Check out "Whole Grains A to Z" under Whole Grains 101 on the WholeGrainsCouncil.org website for more.

**So what about the fad?** Beyond the small number of people with celiac disease and gluten intolerance, some people may be following a gluten-free diet just because actress Miley Cyrus or tennis player Novak Djokovic or some other celebrity says going gluten-free has changed their lives.

People who follow a gluten-free diet for no medical reason may be unnecessarily complicating their lives, but as long as they still enjoy plenty of gluten-free whole grains, like those above, they can still enjoy good health. An overall balanced diet of whole, minimally processed foods is always more important to health than any one food.

# TURNING THE TIDE ON GLUTEN

Most of us had never heard of celiac disease or gluten-free diets until sometime in the past decade, and now it seems that these topics are everywhere we turn. Are we simply seeing increased awareness and diagnosis as medical technology improves, or has there been a real increase in the prevalence of celiac disease?

A team of researchers including Dr. Joseph Murray of the Mayo Clinic carried out a clever study<sup>1</sup> to answer that question. They compared blood samples taken from Air Force recruits from 1948-54 to blood samples taken in the 1990s, and studying both of them for antibodies to gluten. The new blood samples came from two control populations: people who are the same ages *now* as the original donors were in the 1950s, and people who were the same age *then*. They found that in both cases, the modern blood samples showed a four-fold increase in evidence of gluten antibodies – indications that these bodies are reacting negatively to gluten.

More recently, Dr. Murray took part in another study<sup>2</sup>, comparing active duty military personnel from 1998 to 2008, and found that during this brief period, in this population of otherwise healthy adults, celiac disease increased from 1.2 per 100,000 in 1998 to 6.5 per 100,000 in 2008 – a five-fold increase in *addition* to his previous documented increase above.

Dr. Murray states that about 30-40% of us are genetically pre-disposed to celiac disease (i.e., we have the HLA DQ2 or DQ8 genotypes). But genetic predisposition must be joined by two other factors – gluten consumption and a trigger – before someone develops celiac disease. Since we know that genes can't change that quickly, we need to look at factors in gluten consumption and at triggers to figure out why gluten reactions are on the rise – and how we as a society can turn the tide.

## Gluten Consumption Factors

The age at which you begin consuming gluten, the amount of gluten you consume, what other foods or nutrients are consumed in conjunction with gluten, and changes in baking technology have all been raised as possible factors in the increase in gluten reactions.

**Consumption Factor 1: Introduction of cereals to infants.** There may be an optimum time for the introduction of gluten grains. A recent meta-analysis<sup>3</sup> by Portuguese researchers looked at fifty-eight studies and articles and concluded that a gradual introduction of gluten at no earlier than four months of age and no later than seven months of age reduced the risk of celiac disease, gluten allergies, and type 1 diabetes (another auto-immune disease).

To underscore this issue, Dr. Murray cites an incident in Sweden, in the late 1980s, when a leading infant formula maker introduced a new formula containing wheat. “There was an explosion of infant celiac disease, which dropped off again when the wheat was taken out,” he reports. Breastfeeding may also be protective against gluten allergies, and viruses may be a trigger – so we may be creating a perfect storm for

babies when we wean them from the breast, introduce cereals, and start them in day care all at the same time, according to Dr. Murray.

***What we can do:*** *As parents and as a society, we can encourage the gradual introduction of gluten cereals during this 4-month to 7-month window, a low gluten load in early life overall, and continuation of breastfeeding, if possible, until gluten cereals have been introduced.*

**Consumption Factor 2: Wheat Varieties and Breeding.** We use the term “wheat” to refer not just to one plant but to a family of plants, some quite different from another. Wheat varieties fall into three main groups, depending on the number of chromosomes they have: diploid wheat, with just 14 chromosomes (Einkorn, for example); tetraploid wheat, with 28 chromosomes (Durum wheat, often used for pasta, for example); and haploid wheat, with 42 chromosomes (most modern wheat used in baking and other food products except pasta). In general, scientists have found that wheat varieties with fewer chromosomes are likely to have lower levels of disease-linked gluten – though gluten levels vary widely in each category.

Because of the wonderful and positive functional benefits of gluten, some plant breeders have for years seen the development of wheat strains with more gluten as a positive advance. Dutch researchers found that, overall, modern strains of wheat tended to have higher gluten levels and that “modern wheat breeding practices may have led to an increased exposure to Celiac Disease epitopes.”<sup>4</sup>

***What we can do:*** *Now, with the knowledge that some people can't properly digest wheat, plant breeders are exploring ways to reduce the gluten load in wheat. They have identified both ancient and modern wheat varieties with lower gluten levels and there is a concentrated effort underway to find varieties of wheat that may be safe for celiacs – or that, in the least, may reduce the risk that someone may develop celiac disease. NB: Currently no known wheat varieties are safe for celiacs.*

**Consumption Factor 3: Growing Conditions.** Researchers in Lithuania analyzed the technological properties of winter wheat grown under both organic and conventional conditions. They found that the organic winter wheat had significantly lower protein and gluten content.<sup>5</sup> Meanwhile, scientists in Norway found that proteins including glutens in wheat underwent changes with different levels of nitrogen and sulfur fertilization.<sup>6</sup>

***What we can do:*** *More research is necessary, but it may be that organic wheat is lower in problematic glutens. We can choose to buy organic, and we can advocate for increased understanding and research into the pros and cons of conventional and organic agriculture.*

**Consumption Factor 4: Novel Nutrient Pairings.** Our bodies have evolved to eat certain foods and food components as a package. Efforts to isolate supernutrients – from Vitamin E to beta-carotene – have repeatedly fallen flat, teaching us that these nutrients are somehow working their magic as part of hidden synergies with other nutrients. Some health professionals postulate that taking gluten out of its normal context within grains could be at least partially responsible for the increase in gluten reactions.

Dr. David Katz, Director of Yale's Prevention Research Center, wrote in the *Huffington Post* that "some reactions to gluten may be primed by the company it is keeping. There may also be an influence of nutrient combinations due to modern food processing. Gluten is a widely used texturizer. That it is found in wheat, barley, rye, triticale and possibly oat-containing products is expected. That it is found in everything from candy, to deli meats, to potato chips may be less so. Its use in all these foods is producing novel nutrient pairings, and perhaps these also function at times as an immune system trigger."<sup>7</sup>

***What we can do:*** As consumers, we can make whole, minimally processed foods the backbone of our diets. As manufacturers, we can develop products with an awareness of the historical context of various foods.

**Consumption Factor 5: Changes in Baking Technology.** As we said earlier in this report, baking may have been discovered when our distant ancestors learned to grind grain and mix it with water for porridge. After the leftovers had sat unrefrigerated for a few days and had picked up wild yeast and undergone lacto-fermentation, someone may have left bits of it on a hot rock near the fire, and discovered that the dough cooked up into a flatbread that was both tasty and portable.

For millennia after this chance discovery, bread was made through a similar process. While bakers waited for slow wild yeasts to do their work, their dough was colonized by lacto-bacilli. This sourdough method was an uncertain and time-consuming process, and bakers everywhere breathed a sigh of relief when commercial bread yeast and then instant yeast became widespread in the 20<sup>th</sup> century.

Today we're learning that there were some unknown advantages to the old ways of making bread. Researchers in Italy<sup>8</sup> found that certain lacto-bacilli can be very effective at reducing the allergenic fractions of glutes in bread – without affecting the dough's ability to make a well-risen loaf and without returning commercial bakers to a slow and unpredictable process. They took wheat with 75,000 parts per million (ppm) of gluten and fermented it with specific lacto-bacilli, in essence creating a sourdough starter. After lacto-fermentation, the gluten in the wheat had been reduced to 12 ppm – a level legally considered gluten-free in most countries. They then dried this slurry, and used it as flour with quick yeast in a normal commercial baking process. They found the loaves rose well, and the finished product was similar to modern bread – though virtually gluten free!

Other technological research is also underway, exploring ways to "disarm" the gluten proteins in wheat. "Enzymes or probiotics can detoxify gluten a great deal," says Dr. Fasano. At the same time that Dr. Fasano advocates new approaches, though, he also argues for the importance of respect for the old ways. "We want grains that will perform in ways that they never performed before, and strawberries twelve months of the year. That comes with a price."

***What we can do:*** We can find ways to harvest the wisdom of the old ways and combine it with modern technology for better health. Lacto-fermentation (also used in the creation of other healthy foods from kimchi to yogurt) was one of the earliest ways of processing food; it encouraged the proliferation of good bacteria to crowd out bad bacteria. In essence, the bacteria pre-digest the wheat, breaking down its molecules into different forms that the human body can more easily assimilate.

*Bakeries should find ways to incorporate lacto-fermentation into their baked goods once again. An added bonus: sourdough breads have a longer shelf life, allowing bakers to also cut back on salt and other preservatives.<sup>9</sup>*

## **Trigger Factors**

So let's say you are genetically disposed to celiac disease, your parents fed you lots of wheat when you were a baby, and you've continued to eat lots of wheat and gluten in your diet for decades. Will you get celiac disease? It's still highly unlikely. Remember, an estimated 30-40% of us have the DQ2 or DQ8 genotype, but only an estimated 1-6% of people contract celiac disease. That's because of that third factor: the trigger.

**Trigger Factor 1: Infections and Operations.** Researchers still aren't completely sure what triggers celiac disease, but evidence indicates that bodily traumas such as infections and operations are two leading triggers. Dr. Murray says that women who undergo Caesarian deliveries double their chances of developing celiac disease (although it's important to remember that still leaves their chances very low) and that other surgical procedures and accidents may also act as triggers.

Recent research from Cuba<sup>10</sup> found that many patients with serious infections but no symptoms of celiac disease or type 1 diabetes in fact showed early markers for both auto-immune diseases in their blood, indicating that enterovirus, especially, may be an environmental factor in the development of celiac disease. Dr. Murray's latest study<sup>2</sup> echoed this finding when it reported "a significant association between infectious gastroenteritis and celiac disease."

***What we can do:** While Caesarians are often medically necessary, we can reconsider elective or "convenience" Caesarians sometimes used to control the schedule of a birth. Doctors can become aware of the link between infections and celiac disease, and consider testing if unexplained symptoms arise after a serious infection, especially a gastro-intestinal one.*

**Trigger Factor 2: The Gut Microbiome.** Dr. Elena Verdú, Associate Professor of Gastroenterology at McMaster University, agrees that "we are overloaded by the increased toxicity of wheat, and the amount of [gluten] foods that we are exposed to." But she also notes that auto-immune diseases of all kinds have increased in recent decades – not just celiac disease. She speculates that changes to the gut biome (the balance of bacteria in our digestive tract) may be contributing to the "sharp and persistent increase" in all these auto-immune diseases, including celiac, type 1 diabetes, irritable bowel disease and many others.

***What we can do:** A great deal of research is being done on changes in the gut biome, linking these changes to obesity and other public health challenges. We can take care of our gut biome by taking antibiotics only when absolutely necessary, and by eating foods that have (naturally?) probiotic and prebiotic properties to nurture our good bacteria.*

*Thanks to Dr. Joseph Murray, Dr. Alessio Fasano, and Dr. Elena Verdú for sharing their expertise with us in the preparation of this piece.*

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- <sup>2</sup> Riddle et al. *American Journal of Gastroenterology*, 2012 Aug; 107(8):1284-55. “The Incidence and Risk of Celiac Disease in a Healthy US Adult Population.”
- <sup>3</sup> Silva et al. *Acta Médica Portuguesa*, 2011 December; 24 Suppl 4:1035-40. “Diversification in the first year of food life.”
- <sup>4</sup> Van den Broeck et al. *Theoretical and Applied Genetics*. 2010 November; 121(8):1527-39. “Presence of celiac disease epitopes in modern and old hexaploid wheat varieties: wheat breeding may have contributed to increased prevalence of celiac disease.”
- <sup>5</sup> Ceseviciene et al. *Journal of the Science of Food and Agriculture*. 2012 April 11. [Epub ahead of print]. “Effects of organic and conventional production systems and cultivars on the technological properties of winter wheat.”
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- <sup>7</sup> David Katz, M.D. “Is Gluten-Free Just a Fad?” Posted July 25, 2011 at [http://www.huffingtonpost.com/david-katz-md/gluten-free-diet\\_b\\_907027.html](http://www.huffingtonpost.com/david-katz-md/gluten-free-diet_b_907027.html)
- <sup>8</sup> Rizzello et al. *Applied and Environmental Microbiology*. 2007 July; 73(14):4499-4507. Highly Efficient Gluten Degradation by Lactobacilli and Fungal Proteases during Food Processing: New Perspectives for Celiac Disease.”
- <sup>9</sup> Belz et al. *Applied Microbiology and Biotechnology*. 2012 May 9 [Epub ahead of print] “The effect of sourdough and calcium propionate on the microbial shelf-life of salt reduced bread.”
- <sup>10</sup> Sarmiento et al. *Journal of Medical Virology*. 2012 July; 84(7):1049-53. “Type 1 diabetes associated and tissue transglutaminase autoantibodies in patients without type 1 diabetes and coeliac disease with confirmed viral infections.”