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The Gluten-Free Diet: An Update for Health Professionals



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A strict, lifelong gluten-free (GF) diet is currently the only treatment for celiac disease. The diet requires the elimination of all forms of wheat, barley and rye and their derivatives. This article reviews the specifics of the diet, including recommendations regarding the use of pure, uncontaminated oats. The GF diet may be lacking in B vitamins, fiber, calcium and other nutrients, but these may be obtained from nutrient dense GF foods and supplements if needed. To successfully implement and adhere to the diet, individuals need to learn how to avoid gluten contamination and manage the diet while eating out. They must become skilled in label reading and should benefit from the new food allergen labeling laws. Gluten-free cookbooks and a wide variety of GF specialty foods make meal preparation easier. Comprehensive diet education and follow-up from an experienced registered dietitian is a key element in the successful management of celiac disease.

CELIAC DISEASE

Celiac disease (CD) is a genetically determined condition in which certain grain proteins cause an autoimmune response that damages the lining of

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the small intestine, causing blunting of the villi and malabsorption of nutrients. Gluten is the general term for the proteins that have been found to be toxic in those with CD—specifically the storage proteins (prolamins) in wheat (gliadin), rye (secalin) and barley (hordein). Many individuals with CD may be only mildly symptomatic or asymptomatic at diagnosis. Or, they may present with various nutrition or malabsorption-related problems such as unintentional weight loss, bloating and gas, ongoing fatigue, lactose intolerance, diarrhea or constipation, iron deficiency anemia, folate deficiency, low serum levels of vitamin B12, magnesium and phosphorous. The length of time with

active but undiagnosed disease, the extent of gut damage and degree of malabsorption will impact the degree of nutritional compromise. Individuals frequently present with various associated extra-intestinal manifestations of CD such as osteopenia or osteoporosis, infertility, neurological problems and dental enamel abnormalities. Another presentation of CD is dermatitis herpetiformis, a symmetrically distributed blistering and itchy rash appearing primarily on buttocks, elbows and knees.

Once thought to be a rare condition, CD is now understood to affect as many as 1:133 people in the US (1) and 1:266 people worldwide (2). However, because its symptoms are common to many other conditions and can range in severity, CD is often overlooked or misdiagnosed, often as irritable bowel syndrome, chronic fatigue syndrome or fibromyalgia. Consequently, individuals may remain undiagnosed and untreated for many years.

TREATMENT: THE GLUTEN-FREE DIET (GFD)

Currently, the only treatment for CD is a life-long gluten-free diet (GFD). Strict avoidance of wheat, rye, and barley and their derivatives (Table 1) will result in intestinal healing and relief of symptoms for the majority of individuals with CD. Although the diet ultimately brings about greater well-being, it requires a significant amount of effort and commitment, especially in the beginning. This is often a difficult change and compliance may be an issue (3, 4). Therefore, it is essential that everyone with CD be referred to a registered dietitian (RD) with expertise in CD and the GFD for nutritional assessment, education and support as soon as possible (5). Family members and/or caregivers should also be included in the initial education so they understand the importance of the diet and offer encouragement to the individual with CD. Although patients may not experience any symptoms if they go off the diet, the intestinal mucosa will be affected. Patients who do not follow the GFD or who follow it haphazardly may develop malabsorption related problems and extra-intestinal conditions described above, as well as increasing their risk of small bowel lymphoma (6).

The GFD is simple in principle, however, completely eliminating all foods and ingredients contain-

ing wheat, rye, barley, and most commercial oats (see oats section below) can be very challenging. In addition to the obvious sources of gluten like breads, pastas, and most common breakfast cereals, gluten is often found in a wide variety of products such as seasonings, sauces, soy sauce, marinades, salad dressings, soups, prepared meats, corn- and rice-based cold cereals, candy and flavored coffee/teas (Table 2).

Individuals with CD not only need to know which foods and ingredients to avoid, but also how to integrate the diet into their day-to-day work and family lives. This includes mastering label reading and becoming familiar with sources of GF foods and basic GF cooking methods. Simply dropping gluten-containing foods from the diet may result in an unbalanced diet lacking in certain nutrients. To have an adequate and nutritious diet, individuals need to become familiar with, and incorporate nutrient-dense (but not necessarily *calorie* dense) GF foods into their diets. In addition, specific strategies for eating in restaurants and while traveling away from home, as well as how to prevent cross-contamination of GF foods with gluten-containing foods and ingredients are important.

Given the complexities of the GFD, several visits with the RD are recommended (7). At follow-up appointments, diet education continues and the RD can assess a patient's/family's understanding and compliance to the diet.

OATS IN THE GLUTEN-FREE DIET

Whether or not oats can safely be included in a GFD has been a subject of debate over the past 50 years. Historically, oats were categorically excluded from the diet because it was thought that avenin (the storage protein found in oats) was also toxic to gluten-intolerant individuals. However, recent research in Europe and the US has revealed that when consumed in moderation, oats are well-tolerated by most children and adults with CD and do not contribute to abdominal symptoms, serological or mucosal relapse, nor prevent small bowel healing (8–12). The majority of these studies used oats that were specially processed to ensure that they were free from cross-contamination

(continued on page 73)

(continued from page 68)

Table 1
Grains: Gluten-free and Gluten-containing Flours and Starches

<i>Gluten-Free Grains, Flours, and Starches</i>	<i>Toxic (Gluten-Containing) Grains, Flours, and Starches</i>
Amaranth	Barley
Arrowroot	Bulgur
Bean flours (garbanzo, fava, romano)	Cereal binding
Buckwheat (pure buckwheat flour, buckwheat bran [Farinetta™], kasha [toasted buckwheat])	Chapatti flour (atta)
Corn (cornstarch, cornmeal, corn bran, corn grits, hominy)	Couscous
Fava	Dinkel
Flax seed	Durum
Garbanzo bean (chickpea, besan, gram, or channa)	Einkorn
Garfava™ flour (garbanzo + fava bean flours)	Emmer
Hominy, hominy grits	Farina
Mesquite flour	Farro (or faro)
Millet	Fu
Montina™ flour (made from Indian rice grass)	Gluten, gluten flour
Nut flours and nut meals	Graham flour
Oats (uncontaminated, if recommended by patient's healthcare team. See "Oats in the Gluten-Free Diet" section.)	Kamut
Pea flour	Malt (malt extract, malt flavoring, malt syrup, malt vinegar)
Potato flour, potato starch	Matzoh meal
Quinoa	Oats (most commercial brands, oat bran, oat syrup. See "Oats in the Gluten-Free Diet" section.)
Rice, all forms (brown, white, sweet, sticky, wild, jasmine, basmati, glutinous rice, rice polish, rice bran)	Orzo (sometimes used as a substitute for rice (orzo is not a grain, but a pasta that looks like rice))
Sago	Rye
Sorghum flour	Seitan (also known as "wheat meat")
Soy (soya) flour	Semolina
Tapioca (manioc, cassava, yucca)	Spelt
Teff (or tef) flour	Triticale
	Wheat (wheat bran, wheat germ, wheat starch)

Adapted from Case, *Gluten-Free Diet: A Comprehensive Resource Guide*, 2006 (29)

with gluten-containing grains. It should be noted that the regular oats that are commercially available to consumers are frequently contaminated with wheat or barley. A study by Thompson in the United States and another by Storsrud in Sweden tested multiple commercially available oat products and found varying levels of gluten contamination (13,14). Because uncontaminated oats have not been widely available, most celiac support organizations did not recommend oats in the past as part of a GFD. However, "pure, uncontaminated" oats have recently become available from several companies in the US and Canada (Table

3). These companies process oats in dedicated facilities and test their oats for purity. Many celiac support organizations, research centers, and health professionals have revised, or are revising, their recommendations to allow *moderate* amounts of pure, uncontaminated oats in the GFD. See Table 4 for major organizations' recommendations regarding oats in the GFD.

Concern still remains that some individuals with CD may not respond well to oats. One small study found evidence of intestinal T-cell response to oat ingestion in a few patients with CD (15). Another found evidence of villous atrophy in at least 1 patient

Table 2
Getting Started on the GFD: Basic GF foods and Possible Sources of Gluten

<i>Basic Gluten-Free Foods</i>	<i>Possible Sources of Gluten (check ingredients carefully)</i>
Fruits and Vegetables Fresh, frozen, and canned fruits and vegetables and their juices	Dried fruits (dates) may be dusted with oat flour
Meats and Alternatives Fresh meat, fish, and poultry	Meat marinades and flavorings (may contain hydrolyzed wheat protein, wheat-based soy sauce) Turkey (fresh or frozen) basted or injected with broth (may contain hydrolyzed wheat protein) Meat extenders and vegetarian meat substitutes Deli meats, hot dogs, sausages, imitation seafood products
Eggs	
Dried beans and peas	Baked beans
Nuts and seeds	Seasoned nuts (may contain hydrolyzed wheat, protein, wheat flour or wheat starch)
Tofu	Flavored tofu may contain soy sauce (made from wheat or seasonings with wheat derivatives)
Milk Products Milk, buttermilk, cream Most yogurt (plain, fruited or flavored) Cheese, plain Cream cheese, cottage cheese	Malted milk Cheese sauces, cheese spreads, flavored cheeses
Grains & Grain Products <i>Breads and baked goods</i> made from GF grains and free of other gluten-containing ingredients	Products made with buckwheat (buckwheat is occasionally blended with wheat flour in baking mixes) Some imported foods labeled gluten-free contain starch which is not allowed
<i>Pastas</i> made from rice, beans, corn, potato, quinoa, soy, wild rice, and other GF grains.	
<i>Cold cereals:</i> puffed corn, amaranth, buckwheat, millet, or rice, rice flakes and soy cereals	Cereals may contain barley malt flavoring or barley malt extract
<i>Hot cereals:</i> hominy grits, soy grits, cream of buckwheat, cream of rice, puffed amaranth, rice flakes, quinoa flakes, soy flakes	
<i>Rice:</i> brown, white, basmati, jasmine, or wild rice	Seasoned or flavored rice mixes, rice pilaf
Corn and rice tortillas	
Fats and Oils Butter, margarine, vegetable oil, lard, shortening, cream	
Desserts Cakes, cookies, pastries made from GF flours Many ice creams, sherbet, sorbet, popsicles	Icing and frosting (may contain wheat flour or wheat starch) Some ice creams are made with gluten-containing ingredients (cookie dough, brownies, waffle cone pieces, nuts coated with flour, etc.)
Whipped toppings	
Egg custards	

Table 2 (Continued)

*Basic Gluten-Free Foods**Possible Sources of Gluten (check ingredients carefully)***Desserts (continued)**

Gelatin desserts
GF licorice, most hard candies and most chocolate bars

Chocolate bars and candy may contain barley malt flavoring or wheat flour. Most common brands of licorice contain wheat flour

Miscellaneous*Beverages:*

Cocoa drinks, soft drinks, juices
Most non-dairy soy, rice, potato, and nut beverages
Teas, coffee (instant or ground; regular or decaffeinated)
Distilled alcoholic beverages such as rum, gin, whiskey, vodka, wines, and pure liqueurs
GF beer, ale, and lager

Flavored teas and coffees, herbal teas, and non-dairy beverages may contain barley malt flavoring or barley malt extract
Flavored alcoholic beverages (e.g. ciders and coolers) may have gluten-containing ingredients
Almost all undistilled alcoholic beverages (beer, ale, lager) contain gluten. Only those specially made to be GF may be safely consumed
Cocoa drinks may contain malt or malt flavoring (e.g., Ovaltine and Postum are NOT gluten-free)
Some coffee substitutes are made from gluten-containing ingredients. (Roasted chicory is gluten-free)

Sweets:

Honey, jams, jellies, marmalade, molasses, corn syrup, maple syrup, sugar (white, brown, confectioner's)

Snack Foods:

Plain popcorn, potato chips, corn chips, nuts, soy nuts, rice cakes, corn cakes, rice crackers

Seasoned and flavored varieties may contain hydrolyzed wheat protein, wheat flour, or wheat starch
Some brands of plain potato chips or potato crisps are made with wheat flour or wheat starch

Condiments:

Salad dressings free of gluten-containing ingredients, plain pickles, relish, olives, ketchup, mustard, tomato paste, pure herbs and spices, pure black pepper, GF soy sauce, vinegars (apple vinegar, Balsamic vinegar, cider vinegar, distilled white, grape vinegar, wine vinegar, spirit vinegar; all but malt vinegar are GF)

Soy sauce is typically made from wheat
Teriyaki sauce is typically made with soy sauce, wheat flour, wheat starch or hydrolyzed wheat protein
Salad dressings may be made with soy sauce.
Malt vinegar
Some brands of Worcestershire sauce contain malt vinegar

Common baking ingredients:

Pure cocoa, baking chocolate, chocolate chips, carob chips and powder, monosodium glutamate (MSG), cream of tartar, baking soda, yeast, brewer's yeast, aspartame, vanilla

Major brands of baking powder are GF, others may contain wheat starch

Soups, Sauces, and Gravies:

Homemade broths, GF bouillon cubes
Cream soups and stocks made from allowed ingredients
Sauces and gravies made from allowed ingredients

Most commercially produced soups and broths contain hydrolyzed wheat protein or wheat flour

Adapted from Case, *Gluten-Free Diet: A Comprehensive Resource Guide*, 2006 (29)

consuming pure oats (16). Further research is needed to establish whether oat intolerance is present in a small percentage of individuals with CD, and if so, to

determine the underlying mechanism. For this reason, some celiac organizations have not revised their recommendations to include oats in the gluten-free diet.

THE CELIAC DIET, SERIES #1

Table 3
Manufacturers Providing Pure, Uncontaminated Oats and Oat Products

<i>Manufacturer (Web site, Contact information)</i>	<i>Notes</i>
<p>Cream Hill Estates (Canada) www.creamhillestates.com ph: 866-727-3628 or 514-363-2066 E-mail: info@creamhillestates.com</p>	<p>Cream Hill Estates oats undergo a three-step purity process (visit their web site for more detailed information). Oat products are routinely tested using the highly sensitive R5 ELISA method and consistently test near or below 2 parts per million Oat products from Cream Hill Estates are available under the name, "Lara's"</p>
<p>Gluten-Free Oats (US) sales@glutenfreeoats.com 307-754-2058</p>	<p>Specific procedures are used to ensure purity (see website for more detailed information) Oat products test under 10 ppm</p>
<p>Gifts of Nature (US) www.giftsofnature.net 888-275-0003</p>	<p>Oats undergo third-party inspection and testing by the Gluten-Free Certification Organization (visit www.gfco.org for more information)</p>
<p>Farm Pure Foods (Canada) www.farmpure.com 306-791-3770</p>	<p>Projected availability late 2006</p>

SHOPPING FOR GF FOODS AND LABEL READING

Grocery stores carry a variety of foods that are naturally GF, such as fresh fruits and vegetables, plain meats, poultry, fish, and dairy products. These foods are typically located on the outer aisles of the store, while the center aisles are usually reserved for prepared and processed foods, which are often made with gluten-containing starches. With this in mind, dietitians recommend that individuals with CD shop the perimeter of the grocery store, where fresh, unprocessed GF foods are typically abundant.

Label reading is a critical skill for successful GF grocery shopping. "Gluten" is not typically listed as an ingredient and can be difficult to recognize on food labels. Individuals must also be aware that products labeled "wheat-free" are not necessarily GF since they could still contain barley, rye, oats, or their derivatives. When shopping for a GFD, specific lists of GF products provided by celiac support groups and individual

food manufacturers may be used, however it is prudent to check the label each time a food is purchased since manufacturers may change or substitute ingredients at any time.

The recently enacted Food Allergen Labeling and Consumer Protection Act in the US has simplified label reading and eliminates the possibility of hidden wheat gluten in most packaged foods. The Act requires products manufactured after January 1, 2006 to indicate the presence of any of the eight top allergens: milk, eggs, peanuts, tree nuts, fish, shellfish, soy and **wheat** on the label. These allergens must be declared even if they are part of secondary ingredients such as flavorings, seasonings or other additives. Barley and rye are not considered top allergens, so it is possible that they could be sources of hidden gluten in flavorings and other additives. This is unlikely with rye, but may occur with barley due to the extensive use of bar-

(continued on page 78)

(continued from page 76)

Table 4
Inclusion of Oats in the GFD, Recommendations by Various Organizations

<i>Organization</i>	<i>Position on Oats</i>	<i>Considerations if Oats are Added</i>
Gluten Intolerance Group (GIG)	Patients should work closely with their health care team before deciding whether to include oats and if included, should have antibody levels checked periodically	Limit to 1 cup cooked, uncontaminated oats/day
Celiac Center at Beth Israel Deaconess Medical Centre (BIDMC), Harvard Medical School	Oats not recommended for newly diagnosed patients Oats may be added to the GFD for patients in whom CD is well-controlled, whose symptoms have resolved and who have normal tissue transglutaminase levels (IgA tTG)	Add gradually under a physician's guidance. Limit to 50 grams/day (~1/2 cup rolled oats or 1/4 cup steel-cut oats) from a dedicated gluten-free facility
Celiac Disease Center at Columbia University, New York City	Consumption of gluten-free oats (from companies that claim them to be GF) is recommended	Limit to 50 grams/day. Add gradually to avoid unpleasant GI symptoms associated with sudden increases in dietary fiber
Celiac Clinic (Mayo Clinic)	Oats not recommended for patients whose disease is not well controlled Patients who choose to include gluten-free oats in their diet should be closely monitored for reactions. Individuals who do not react to the ingestion of gluten with outward symptoms should be especially wary of trying oats	Oats must be verified gluten-free by product testing
Celiac Disease Foundation	Patients should work closely with their healthcare team in deciding whether to include oats and, if included, antibody (IgA tTG) levels should be checked on a yearly basis	Limit to 1 cup cooked, pure, uncontaminated oats/day
Canadian Celiac Association	Patients choosing to include oats in their diet should follow up with a physician to ensure that they are not intolerant	Adults: Limit to 50–70 grams. (1/2–3/4 cup) dry rolled uncontaminated oats/day Children: Limit to 20–25 grams (1/4 cup) dry rolled uncontaminated oats/day
Dietitians of Canada	Patients who choose to include oats should do so in consultation with their physician or dietitian and should ensure that their disease is stable prior to adding oats to their diet	Adults: Limit to 50–70 grams. (1/2–3/4 cup) dry rolled uncontaminated oats/day Children: Limit to 20–25 grams (1/4 cup) dry rolled uncontaminated oats/day

Table 4 (continued)

<i>Organization</i>	<i>Position on Oats</i>	<i>Considerations if Oats are Added</i>
University of Maryland Center for Celiac Research	Currently reviewing the literature. Not recommended until a pure source of oats become available and those patients who do not tolerate oats can be identified	
American Dietetic Association	The decision of whether to include oats should be based on individual tolerance and upon the availability of pure oats in consultation with a physician and/or dietitian	Limit intake to 50 grams/day of oats verified to be gluten-free through product testing
Celiac Sprue Association (CSA)	“CSA recommends that excluding oats is the only risk-free choice for those on a gluten-free diet. As always, the individual is responsible to make decisions that he or she deems best for optimum health and well-being”	

*Adapted from Case, *Gluten-Free Diet: A Comprehensive Resource Guide*, 2006 (29)

ley malt and malt extract flavorings. However, most companies declare barley-based flavorings on their ingredient lists as “barley malt flavoring,” “barley malt extract” or “barley malt” rather than “flavoring.” It must be noted that the new food allergy labeling requirements do not apply to the packaged meat, poultry and egg products that are regulated by the U.S. Department of Agriculture.

One criticism of the new food labels is that there are no threshold levels for allergenic ingredients below which they need not be declared. Therefore, any ingredient used in any amount anywhere in the production of a food must be listed. Some ingredients are so highly processed that even when made from wheat-derived starch, the end products do not contain detectable levels of wheat protein (e.g., glucose syrup). These ingredients may now be labeled as containing wheat, causing those on GF diets to unnecessarily avoid many safe foods. A highly publicized example of this situation recently came to light with McDonald’s French fries. Although the new food labeling laws do not apply to food served in restaurants, bakeries, cafeterias or other take-out venues, McDonald’s provides ingredient and allergen listing for their products. For several years McDonald’s had identified their

French fries as GF, but in early 2006 wheat was added to the list of ingredients. This prompted outcry and lawsuits from consumers who were concerned that they, or their children, had been unknowingly ingesting wheat all along. It was revealed that wheat was used in making a flavoring agent that was added in small amounts to the oil used to cook the fries. Ultimately, testing of the fries by independent labs indicated that no detectable levels of wheat gluten were present.

SPECIALTY GF FOOD PRODUCTS

There are thousands of GF specialty products on the market such as breads, cookies, baking mixes, various GF flours, cereals, pastas made from rice, potato and bean flours, desserts, sauces, soups and ready-made frozen GF meals. Many large supermarkets carry some basic GF products such as GF pasta and several GF flours, whereas natural and “health” food stores typically carry a greater variety of these products, as well as GF mixes, GF snack foods and fresh or frozen GF baked goods. The greatest selection of products is available by mail, ordered via Internet websites or from catalogs.

Although GF specialty products made in North America are made without gluten-containing ingredients, significant contamination can occur if the GF grains and foods are transported, processed or packaged by the same equipment used for gluten-containing foods. The Canadian Food Inspection Agency, which conducts random tests of GF foods, has found several instances of unacceptable levels of gluten contamination in specialty GF products. Ideally patients should purchase GF specialty products from the increasing number of companies who manufacture their products on equipment and in environments used solely for GF foods, and/or test their products for gluten contamination (Table 5).

DEFINITION OF “GLUTEN-FREE”

In the U.S., there is no federal regulation defining the term “gluten-free” beyond the general requirement that food labeling not be misleading. However, the FDA is in the process of developing standards for foods labeled “gluten-free.” A proposed definition for the term “gluten-free” will be available fall 2006, with the final ruling by August 2008. The standards will define the amount of gluten contamination that may not be exceeded for a food to be labeled GF. A “zero tolerance” approach, which does not allow even a trace level of gluten—no matter how small—is considered by celiac experts to be unrealistic and unnecessary (17,18).

In the absence of federal standards, one national patient support group (Gluten Intolerance Group) has developed an independent and voluntary program of testing and monitoring GF food products. Manufacturers who meet certain standards, including product testing using a standard of less than 10 ppm gluten, may use the Gluten-Free Certification mark (see www.gfco.org). Internationally, there is no agreed upon definition for the term “gluten-free.” In Canada and several other countries, foods may be labeled GF only if they are made without any gluten-containing grains and do not contain any detectable levels of gluten. Currently, the Canadian Food Inspection Agency uses a testing method that has an analytical limitation of 20 ppm gluten. The International Codex standard, used in much of Europe, allows the use of low-gluten wheat starch in specialty GF food products

as long its gluten content is below 200 ppm. This standard has been in place since 1983 and currently the Codex Commission is working towards a revised definition of GF (19).

PREPARING MEALS AT HOME

Many favorite recipes can be modified to replace gluten-containing ingredients with GF ones. A variety of cookbooks are available to help individuals and families expand their GF options and provide recipes for GF baked goods and many other foods that typically require wheat flour. See Table 1 for examples of gluten-free grains, starches and cereals that can be used in GF cooking. Patients need to be aware of cross-contamination that can occur at home and learn practices to minimize its occurrence. These include maintaining separate “GF” containers for condiments that can be easily contaminated by a crumb-filled knife, such as sticks of butter, margarine containers, jars of jelly, peanut butter, or mayonnaise, etc. Designated “GF” toasters and pasta colanders should be used as it is difficult to completely rid these of wheat bread crumbs and pasta residue.

EATING OUT

Eating out is frequently cited by patients as one of the most difficult environments for maintaining a GFD. Many individuals with CD do not want to draw attention to themselves at a restaurant by asking the chef or serving staff about menu items or ingredients. A recent study by Green reports that 26% of patients admitted to eating unacceptable foods when dining out (20). The social and emotional implications of staying strictly GF in this setting can be extremely challenging. However, individuals must understand that making wise selections at restaurants is critical to their long-term health.

Menu items that appear safe are often prepared with gluten-containing ingredients. Sauces, gravies, basting, croutons, and a long list of other preparation methods and accompaniments can introduce gluten into a seemingly GF meal. Patients must be aware of the possible cross contamination and learn to ask the right

(continued on page 82)

THE CELIAC DIET, SERIES #1

(continued from page 80)

**Table 5
Specialty GF Food Manufacturers Using Dedicated Production Environments and Equipment and/or Testing for Gluten***

<i>Manufacturer (Web Site Address)</i>	<i>Types of GF Products Sold</i>	<i>Dedicated Environment and Equipment</i>	<i>Tested for Gluten</i>	<i>Only Sells GF Products</i>
Amazing Grains www.amazinggrains.com	Montina™ (Indian Rice Grass) flour and baking mixes	✓	✓	✓
Authentic Foods www.authenticfoods.com	Flours (garbanzo, sorghum, almond), baking mixes, supplies	✓		✓
Birkett Mills www.theBirkettmills.com	Buckwheat flour and baking mixes	✓	✓	
Bob's Red Mill www.bobsredmill.com	Flours (millet, amaranth, bean, quinoa, teff, buckwheat, hazelnut), baking mixes	✓	✓	
Dietary Specialties www.dietspec.com	Baking mixes, frozen GF meals, pizza, pie shells	✓		
Ener-G Foods www.ener-g.com	Very large selection of baked goods, mixes, pasta, snack foods	✓		
Enjoy Life www.enjoylifefoods.com	Baked goods, snack bars	✓	✓	✓
EnviroKidz www.naturespath.com	Cereals, snack bars, cookies		✓	
Foods By George www.foodsbygeorge.com	Fresh and frozen baked goods, pizza, lasagna	✓		✓
Glutino www.glutino.com	Baked products (bagels, breads, cakes, cookies, pretzels), mixes, flours, pasta, soups, sauces	✓		✓
Kinnikinnick Foods www.kinnikinnick.com	Baked products (bagels, breads, cakes, cookies, donuts, pizza crusts), baking mixes, flours, pasta	✓	✓	✓
Miss Roben's www.allergygrocer.com	Baking mixes, distributes other GF products	✓		✓
Mr. Ritt's Bakery www.mrritts.com	Freshly baked cakes, breads, cookies, pizza crusts	✓		

Table 5 (continued)

<i>Manufacturer (Web Site Address)</i>	<i>Types of GF Products Sold</i>	<i>Dedicated Environment and Equipment</i>	<i>Tested for Gluten</i>	<i>Only Sells GF Products</i>
Northern Quinoa Corporation www.quinoa.com	Quinoa grain, flakes, pasta, amaranth, buckwheat, millet	✓		
Nu-World Amaranth www.nuworldfoods.com	Amaranth-based products (breads, flour, snacks)	✓		✓
Pamela's Products www.pamelasproducts.com	Cookies, baking mixes	✓		
Pastariso www.maplegrovefoods.com	Organic rice pastas, potato/rice pastas		✓	✓
Purfoods/Gluten-Free Meals www.glutenfreemeals.com	Ready-to-heat prepared meals (entrees, pizza, pancakes)		✓	
Rampo Valley Brewery www.rampovalleybrewery.com	GF Honey Lager	✓		
Really Great Food Company www.reallygreatfood.com	Mixes for baked goods	✓		✓
Schar www.schaer.com	Mixes, baked products (breads, cakes, pizza crusts), cereal, pasta	✓		✓
Sterk's Bakery www.sterksbakery.com	Baked goods (bagels, breads, cakes, cookies, pizza crusts)	✓		✓
Sylvan Border Farm www.sylvanborderfarm.com	Baking mixes (vacuum packed for long shelf life)	✓	✓	✓
The Teff Company www.teffco.com	Teff grain and flour	✓		✓
Tinkyada www.tinkyada.com	Rice pasta (made from brown and white rice)	✓		✓
Twin Valley Mills www.twinvalleymills.com	Sorghum grain, flour	✓		✓

*Information based on company's stated manufacturing process.

Table 6
Nutrient Dense GF Foods

Whole GF Grains*: Teff, amaranth, buckwheat, Montana™ (Indian Rice Grass), millet, rice bran, quinoa, sorghum, brown rice, wild rice, uncontaminated oats if allowed (see oats section)

Enriched or Fortified Grains: Enriched white rice, enriched corn meal or corn flour

Fresh fruits and vegetables*: Particularly those that are deeply colored orange, red and green; fruits with edible skins and seeds; vegetables ideally served raw or lightly cooked

Legumes*: All dried beans (black beans, Great Northern, Pinto, etc), lentils, peas, soybeans and bean flours including chick pea flour, Garfava™ flour (chickpea and fava bean flour mix), soy flour

Nuts and seeds*: Walnuts, almonds, peanuts and other nuts, nut butters, nut flours, flax seeds, sesame seeds and all other seeds

Specialty GF Foods made with whole grains or bean flours*: Pasta made from brown rice, lentils or quinoa, GF breads and mixes made with bean flours, hot cereal made from buckwheat, cold cereals made with amaranth and soy flakes

Specialty GF Foods fortified with B vitamins and iron: Includes Pastariso and Pastato Fortified Spaghettis; Enjoy Life Chewy Snack Bars, Cereals and Bagels; Ener-G Foods fortified bread products (e.g., brown rice, Seattle brown rice, tapioca, breads, hamburger rolls and hot dog rolls and Kinnikinnick fortified bread products such as brown sandwich bread, tapioca hamburger buns and bagels

*Good sources of fiber

Table 7
Gluten-Free Fiber Supplements

Metamucil
www.metamucil.com
800-832-3012

- Powder and capsules
- Powder thickens in liquids
- Made from psyllium
- Wafers are not GF

Fibersure
www.fibersure.com
800-832-3012

- Powder
- Dissolves completely in liquids, non-thickening
- Made from inulin (from chicory root)

Citrucel
www.citrucel.com
800-897-6081

- Flavored powder mix, Clear mix, Caplets
- Powder dissolves completely in liquids
- Made from methylcellulose

FiberCon
www.fibercon.com
800-282-8805

- Caplets
- Made from calcium polycarbophil

Konsyl
www.konsyl.com
800-356-6795

- Powder, Easy Mix, Capsules, Tablets
- Powder thickens in liquid
- Made from psyllium (except tablets which are made from calcium polycarbophil)

available for patients will be addressed in depth in a future article in this series on celiac disease.

NUTRITIONAL QUALITY OF THE GFD

The nutritional adequacy of the GFD can vary considerably among individuals with CD. Without a conscious effort to choose nutritious foods, the GFD may be lack-
(continued on page 87)

questions about ingredients, preparation methods, and how their meal will be served. Guidance in this area is especially important for patients whose schedules do not allow for regular meal preparation at home or whose professions require extensive business travel. The topic of keeping GF while eating out and resources

(continued from page 84)

Table 8
GF Calcium Supplements: Calcium Content, Manufacturers Contacts

Citracal Products (calcium citrate)

www.missionpharmaceutical.com

- *Citracal Caplet + D* (315 mg Ca, 200 IU D),
- *Citracal 250 + D* (250 mg Ca, 200 IU D)
- *Citracal Plus with Magnesium* (250 mg Ca, 200 IU D, 40 mg Mg)
- *Citracal UltraDense Calcium Citrate Petites* (250 mg Ca, 200 IU D)

Viactiv Products (calcium carbonate)

www.viactiv.com

- *Viactiv Soft Calcium Chews with Vitamin D and K* (500 mgs Ca, 100 IU D, vitamin K)

Caltrate Products (calcium carbonate)

www.caltrate.com

- *Caltrate 600* (600 mg Ca)
- *Caltrate 600 + Vitamin D* (600 mg Ca, 200 IU D)
- *Caltrate 600 Plus, Tablet or Chewables* (600 mg Ca, 200 IU D, 40 mg Mg, plus zinc, copper, manganese and boron)
- *Caltrate 600 + Soy* (600 mg Ca, 200 IU D, 25 mg soy isoflavones)

Table 9
Suppliers of GF Vitamin and Mineral Supplements

Freeda Vitamins: Entire line is GF

www.freedavitamins.com; 800-777-3737

Nature Made: Entire line is GF

• www.naturemade.com; 800-276-2878

Solgar: Most vitamins are GF

• www.solgar.com; 877-SOLGAR4

Twin Lab: Most vitamins are GF

• www.twinlab.com; 800-645-5626

Whole Foods 365 Vitamins: Most vitamins are GF

• www.wholefoods.com

Table 10
National Celiac Support Groups

Gluten Intolerance Group (GIG)

www.gluten.net

Celiac Disease Foundation (CDF)

www.celiac.org

Canadian Celiac Association (CCA)

www.celiac.ca

Celiac Sprue Association (CSA)

www.csaceliacs.org

ing in certain nutrients. Recent dietary surveys have found that adults with CD on GF diets often consume less than the recommended amounts of folate, B vitamins, iron, calcium, fiber and total grain servings (20–22). In a regular diet these nutrients are primarily provided by wheat-based fortified breakfast cereals, breads and pasta. However, because many GF products

Table 11
If Your Patient Does Not Respond to the GFD or Relapses

Review diet for possible causes of inadvertent gluten ingestion:

- New foods recently introduced
- Poor understanding of diet and need for lifelong, strict adherence
- Misconception about wheat alternatives (i.e., spelt)
- New medication (prescription or over-the-counter)
- Change of staff or cooking procedures at a restaurant patient frequents
- Communion wafers

Consider possible causes of poor compliance:

- Patient is not comfortable adhering to the diet in social situations (at restaurants, at other's homes, in dating situations, etc.)
- Changes in home situation or living arrangement (i.e., student now in college, new roommate, loss of companion who shopped or prepared GF meals)
- Inadequate support from family

Table 12
Diagnoses Which May Account for Persistent Symptoms in CD (27)

- Autoimmune enteropathy
- Bacterial overgrowth
- Cavitating lymphadenopathy
- Collagenous colitis
- Eosinophilic gastroenteritis
- Giardiasis
- Inflammatory bowel disease
- Intestinal lymphoma
- Irritable bowel syndrome
- Lymphocytic colitis
- Pancreatic cancer
- Pancreatic insufficiency
- Protein-losing enteropathy
- T-cell lymphoma
- Tropical sprue
- Ulcerative jejunitis

are not fortified and frequently made with white rice or other highly refined flours, these foods are often poor sources of iron, folate, thiamin, riboflavin, niacin and fiber (23). These nutrients can be obtained in the GFD with the use of nutrient dense GF foods listed in Table 6.

FIBER

The elimination of wheat products from the typical American diet reduces the fiber content significantly. The fiber content of the GFD can be increased by the addition of fiber-rich GF foods (Table 6). If necessary, a GF fiber supplement can be used as well (Table 7).

Fiber intake should be gradually increased and adequate fluid intake should be encouraged. Individuals who are newly diagnosed and are still experiencing GI symptoms (diarrhea, bloating, gas) should wait until symptoms have begun to resolve before increasing their intake of high fiber foods.

CALCIUM AND VITAMIN D

Individuals who present with lactose intolerance at diagnosis may have a history of poor intake of calcium

Table 13
Resources for Patients—Publications on Celiac Disease and the Gluten-Free Diet

Gluten-Free Diet: A Comprehensive Resource Guide by Shelley Case. Case Nutrition Consulting, 2006
www.glutenfreediet.ca \$24.95

Celiac Disease: A Hidden Epidemic by Peter Green, MD and Rory Jones. HarperCollins Publishers, 2006.
www.harpercollins.com \$22.95

Wheat-Free, Worry-Free by Danna Korn. Hay House, Inc., 2002 www.hayhouse.com \$14.95

Gluten-Free Living magazine. Published quarterly by Ann Whelan. \$29/year www.glutenfreeliving.com

Living Without magazine. Published by Peggy Wagener. \$23/year www.livingwithout.com

Pocket Dictionary: Acceptability of Foods and Food Ingredients for the Gluten-Free Diet. Published by the Canadian Celiac Association. www.celiac.ca \$9.95

Clan Thompson: Products include pocket guides to foods, restaurants, over the counter drugs and prescription drugs as well as software programs listing gluten status for thousands of foods and medications.
www.clanthompson.com

and vitamin D due to avoidance of milk products. Although lactose tolerance often improves once the gut heals on a GFD, intolerance may persist for some patients, and some patients never resume significant dairy intake regardless of their tolerance. Given the significant risk of bone disease in patients with CD, an adequate intake of calcium and vitamin D is essential. Lactose-free, GF sources of calcium include fortified soy and rice milks, calcium-fortified juices and canned salmon and sardines with bones. Individuals with mild to moderate lactose intolerance may not have any difficulty tolerating some of the lower lactose, calcium-rich dairy foods such as hard cheeses, yogurt with live cultures and lactose-reduced milk.

(continued on page 90)

(continued from page 88)

Table 14 GF Cookbooks

The Gluten-Free Gourmet Bakes Bread: More Than 200 Wheat-Free Recipes, by Bette Hagman, Owl Books, 2000 \$18.00

The Gluten-Free Gourmet Cooks Comfort Foods: Creating Old Favorites with the New Flours, by Bette Hagman, Henry Holt and Co., 2004 \$27.50

The Gluten-Free Gourmet Cooks Fast and Healthy: Wheat-Free and Gluten-Free with Less Fuss and Less Fat, by Bette Hagman, Owl Books, 2000 \$18.00

The Gluten-Free Gourmet Makes Dessert: More Than 200 Wheat-Free Recipes for Cakes, Cookies, Pies and Other Sweets, by Bette Hagman, Owl Books, 2003 \$18.00

Cooking Gluten-Free: 200 Flavorful Recipes for People with Food Allergies and Multiple Food Sensitivities, by Carol Fenster, Avery, 2005 \$18.00

Gluten-Free 101: Easy Basic Dishes Without Wheat, by Carol Fenster, Savory Palate, 2003 \$19.95

Wheat-Free Recipes and Menus: Delicious, Healthful Eating for People with Food Sensitivities, by Carol Fenster, Avery, 1995 \$16.95

Incredible Edible Gluten-Free Foods for Kids by Sheri L. Sanderson, Woodbine House, 2002 \$18.95

The Best Gluten-Free Family Cookbook by Donna Washburn and Heather Butt. Robert Rose Inc., 2005 \$18.95

Sharing our Best! A Collection of Recipes by the West End Gluten Intolerance Group Send a check or money order for \$5.95 plus \$2.00 for shipping and handling per book to: The West End Gluten Intolerance Group; 10900 Brunson Way; Glen Allen, VA 23060; Contact: Madelyn Smith, twegig@comcast.net.

Glutenfreeda.com An on-line monthly cooking magazine. \$30/year

Some individuals may not be able to meet the Recommended Daily Intakes for calcium through diet alone (21) and the use of supplements is often necessary. Vitamin D intake is also frequently low, and patients may have low serum levels due to malabsorption (24). Table 8 lists supplements that are reported by the manufacturer to be GF. Most provide both calcium and vitamin D.

VITAMIN AND MINERAL SUPPLEMENTS

The use of a standard multivitamin with minerals is recommended for all newly diagnosed patients (25). Their use should also be considered for previously diagnosed patients who may have increased needs or simply have difficulty getting in adequate amounts of nutrient dense foods to meet normal needs (e.g., children who are finicky eaters, elderly patients with small appetites). Women of childbearing age may have difficulty obtaining the recommended 400 mcg of folic acid per day without the use of fortified foods. A standard multivitamin/multimineral supplement that provides approximately 100% of the RDI can be used, with consideration of the patient's age and gender in deciding the appropriate iron content. Care must be taken to ensure the supplement is GF (Table 9).

NATIONAL SUPPORT GROUPS

Although awareness of CD is increasing, many people often still feel alone with their diagnosis and find the restrictions of the GFD socially isolating. Without support and access to accurate information, compliance to the GFD may suffer. All individuals with CD should be encouraged to join a national and local celiac support group. Contact with group members can be especially beneficial for newly diagnosed patients who may be overwhelmed by the diagnosis and the diet. In addition to the emotional support, local group meetings and newsletters typically provide information on regional sources of GF foods and "GF friendly" restaurants. National groups offer newsletters and conferences that include medical updates on CD, new information on GF products and the GFD. Table 10 lists several of the key national support groups.

Table 15
On-Line Sources of Information on CD and the GFD

**Children's Digestive Health and Nutrition Foundation:
Celiac Disease**

www.celiachealth.org

American Celiac Disease Alliance

www.americanceeliac.org

Celiac Disease and Gluten-Free Diet Support Center

www.celiac.com

**Celiac Disease Center at Beth Israel Deaconess
Medical Center**

www.bidmc.harvard.edu/ceciaccenter

Celiac Disease Center at Columbia University

www.celiacdiseasecenter.columbia.edu

University of Chicago Celiac Disease Program

www.celiacdisease.net

University of Maryland Center for Celiac Research

www.celiaccenter.org

University of Virginia Health System Celiac Page

www.healthsystem.virginia.edu/internet/digestive-health/nutrition/ceciacsupport.cfm

Table 16
Professional Resources

Cel-Pro

A Celiac listserv that has a specific list for healthcare professionals. Send an e-mail with name and your professional interest to mjones@digital.net

Dietitians in Gluten Intolerance Disease (DGID)

A specialty practice group of the American Dietetic Association (must be a member)
800-877-1600 www.eatright.org (see Practice section)

**Food Allergen Labeling and Consumer Protection Act
of 2004 (FALCPA)**

www.cfsan.fda.gov/~dms/alrgact.html

NIH Celiac Awareness Campaign

<http://celiac.nih.gov/>

**NIH Consensus Development Conference on
Celiac Disease**

<http://consensus.nih.gov/2004/2004celiacdisease118html.htm>

RESPONSE TO THE GFD

Those with newly diagnosed CD often wonder how soon they will start to feel better once they adopt a GFD. Patients who present with diarrhea may experience improvement within a few weeks, but for many adults, particularly those with longstanding, symptomatic disease, it may take considerably longer for symptoms to resolve. The response in some adults has been described as "slow and incomplete" despite years of adherence to a GFD (26). However, the most common cause of poor symptomatic or clinical response is ongoing gluten ingestion, either intentional or accidental (27). Review of the diet by an experienced RD can help identify possible sources of gluten exposure, such as cross-contamination, medications, or poor under-

standing or compliance to the diet (Table 11). Other possible causes of ongoing GI symptoms include food intolerances such as lactose or fructose or other medical conditions (Table 12). A small percentage of patients have refractory celiac disease, a condition broadly defined as failure of a strict GFD to restore normal intestinal architecture and function (27,28).

CONCLUSION

The GFD is necessary for intestinal healing and recovery for people diagnosed with CD. Implementing the diet requires significant change and commitment from patients and comprehensive diet education from a skilled dietitian in CD is necessary. Although many common foods must be eliminated, the GFD can be both healthful and enjoyable. Numerous practical resources, including GF diet books and reliable websites are available to help clinicians provide critical diet education to their patients (Tables 13–16). The use of GF cookbooks and GF specialty foods, the inclusion

of nutritious alternative grains, including uncontaminated oats if appropriate, periodic follow-up with a registered dietitian, and participation in local and national support groups can improve dietary compliance and quality of life for individuals with CD. ■

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A gluten-free diet (GFD) is a diet that strictly excludes gluten, which is a mixture of proteins found in wheat (and all of its species and hybrids, such as spelt, kamut, and triticale), as well as barley, rye, and oats. The inclusion of oats in a gluten-free diet remains controversial, and may depend on the oat cultivar and the frequent cross-contamination with other gluten-containing cereals.