

Anti-Wheat Fad Diets Undermine Global Food Security Efforts

Wheat consumption healthy despite claims in self-help publications



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WHEAT DISCUSSION PAPER

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1. Introduction

A recent review paper released by Britain's University of Warwick (Lillywhite and Sarrouy 2014) addresses two fundamental questions regarding wheat: "Are whole grain products good for health?"; and "What is behind the rise in popularity of gluten- and wheat-free diets?"

The paper was commissioned by cereal-maker Weetabix to address reports in the news media that wheat products are the cause of health problems, resulting in an increasing number of consumers switching to low-carbohydrate grain- and wheat- free diets. For many health professionals this is a worrying trend because wheat not only supplies 20 percent of the world's food calories and protein, but has important benefits beyond nutrition, the authors state.

The Warwick paper provides a scientific assessment of the benefits of whole grain consumption, information that the authors note seems to have been lost in media headlines and the reporting of "pseudo-science."

The paper concludes that whole grain products are good for human health, apart from the 1 percent of the population who suffer from celiac disease and another 1 percent who suffer from sensitivity to wheat (Lillywhite and Sarrouy 2014). Eating whole-grain wheat products is positive, improves health and can help maintain a healthy body weight, the authors report.

Scientific evidence regarding wheat- and carbohydrate-free diets is thin and selectively used, they state, and a low cereal and carbohydrate diet "may cost more but deliver less."

Additionally, an economically viable industry has developed around so-called "free-from" diets and may be persuading consumers to switch from staple foods to specialist foods created especially for those who need to avoid gluten, a protein found in wheat and other grains, they add.

This Wheat Discussion Paper serves as a foundation upon which the authors hope further conversation will develop. It aims to highlight unsubstantiated nutritional claims about wheat and shine a spotlight on the important role of wheat and fiber in human

diets. It also seeks to encourage discussion about how non-scientific claims about wheat could affect poor consumers and global food security.

2. About CIMMYT

The International Maize and Wheat Improvement Center (CIMMYT) is an intergovernmental research institute working with an international community of public and private partners to reduce worldwide poverty and hunger by sustainably increasing the productivity of maize and wheat.

CIMMYT, a non-profit organization, plays a key role in providing wheat germplasm – genetic material from wheat – to be tested and improved by government-run national agricultural research systems before its potential release to farmers. Additionally, CIMMYT provides smallholder farmer training and skills development on such topics as crop management and agricultural practices.

Under the direction of Norman Borlaug in the 20th century, CIMMYT led efforts to develop semi-dwarf wheat varieties that are estimated to have helped save more than 1 billion lives in Pakistan, India and other areas of the developing world as global population expanded and arable land became more scarce.

Borlaug started work on wheat improvement in the mid-1940s in Mexico where CIMMYT is headquartered near Mexico City. The country became self-sufficient in wheat production in the early 1960s due to the high-yielding, disease-resistant, semi-dwarf wheat varieties developed by Borlaug and his colleagues.

Borlaug was awarded the Nobel Peace Prize in 1970 for his innovative, life-saving work, which became widely known as the Green Revolution. He used traditional plant-breeding techniques, still used worldwide for producing wheat and other food crops. Farmers prefer short-stalk wheat because it doesn't fall over – or lodge – as easily as taller varieties, which means less grain is lost and harvests are bigger.

As the global population grows from more than 7 billion today to a projected 9.6 billion by 2050, wheat farmers continue to play a crucial role in food security.

Already, U.N. food agencies and the World Health Organization (WHO) estimate that at least 800 million people (WFP) do not get enough food and that more than 2 billion (FAO) suffer from micronutrient deficiency, or “hidden hunger.” Stunting affects more than 160 million children under age 5 and wasting affects more than 50 million children under age 5. Under-nutrition is linked to almost half of all child deaths under age 5, almost 3 million per year. On the other hand, about half a billion people are obese and three times as many are overweight (WHO).

3. Healthy diets

A healthy diet helps prevent malnutrition as well as non-communicable diseases (NCDs) and conditions (FAO). However, increasing production of processed food, rapid urbanization and lifestyles have shifted dietary patterns (WHO). A healthy diet for adults includes fruit, vegetables, legumes, nuts and whole grains. Adults should eat at least 400 grams (14 ounces), or five portions, of fruit and vegetables daily, while less than 10 percent of total energy should come from free sugars and less than 30 percent of total energy from fat, according to the WHO. Unsaturated fats are better than saturated fats, and trans fats should be avoided, the U.N. health agency reports.

Whole grains make up an important part of healthy diets. The 2005 Dietary Guidelines for Americans recommend eating at least three 1-ounce servings of whole grains to reduce the risk of diabetes and coronary heart disease and to maintain a healthy weight. Whole grains are especially important for their fiber content.

Refined grains have benefits in the diet as well, namely, added nutrients, such as B vitamins (thiamin, riboflavin, niacin) and iron. Additionally, important nutrients like copper and iron are more easily absorbed when eaten with refined grains.

For children in particular, good nutrition is vital to prevent the risk of death or developing non-communicable diseases and to ensure healthy growth and development. As well as taking into consideration the guidelines for adults, breastfeeding plays an important role in ensuring a nutritional beginning to life.

The WHO and FAO recommend that governments, public and private sector stakeholders must collaborate to help promote a healthy food environment, which allows people to adopt healthy dietary practices.

In practice, such activities include coordinating trade, food and agricultural policies with the protection and promotion of public health, encouraging consumer demand for healthy food and promoting nutrition in infants and young people.

4. Health benefits of wheat

Wheat grain possesses several components that contribute to good nutrition (Bjork et al. 2012; Fardet et al. 2012; Flight and Clifton 2006; Shewry 2009). The dietary fiber it contains – comprised of polysaccharides, which pass undigested from the small intestine into the large intestine and colon – is a highly beneficial, fermentable prebiotic agent that promotes the growth of beneficial probiotic bacteria in the bowel.

Wheat grain and flour are also sources of complex carbohydrates, which are important in the diet. Most whole grains are abundant sources of dietary fiber and other nutrients, such as minerals and antioxidants, which have shown beneficial effects on human health including improvement of weight loss, insulin sensitivity, and lipid profile, as well as inhibition of systemic inflammation (Huang et al. 2015; Bjork et al. 2012; Gibson et al. 2014). Evidence from myriad epidemiological studies show that consumption of whole grain products or their effective components, especially dietary fiber found in the grain, i.e., cereal fiber, may reduce the risk of chronic disease, cardiovascular disease and Type 2 diabetes (Huang et al. 2015 and Bjork et al. 2012).

In about 35 percent of countries fortification of milling flours with minerals and vitamins is mandatory. In these cases, the consumption of wheat-based foods helps reduce micronutrient deficiency, particularly in relation to iron, zinc, folic acid and vitamin A. Additionally, many wheat-based foods – bread used for sandwiches or wraps, for example – serve as “vehicles” for the consumption of complementary animal- and vegetable-based foods, contributing to balanced and healthy diets.

5. Wheat and food security

For more than 10,000 years, wheat production and consumption has contributed to the socio-economic development of humankind (Salamini et al. 2002). Wheat is readily adaptable to a range of diverse environments, including marginal and extreme ecosystems. It is cultivated on about 220 million hectares (539 million acres) worldwide, which produce roughly 700 million metric tons a year. The grain provides on average a vital 20 percent of calories and protein for more than 4.5 billion people in 94 developing countries (Braun et al. 2010).

Over the next 35 years, wheat production must grow 60 percent to keep pace with demand as the population grows, according to FAO. However, climate change will have a profound impact on wheat production, affecting crops through such risk factors as increased levels of pests and disease, water shortages and nutrient depletion in soil, jeopardizing production levels. A short supply of wheat, particularly in developing countries, will result in serious nutritional problems and could lead to social unrest (CIMMYT 2011). Therefore, it is vital that the international community accelerate efforts to bolster the production of high-yielding wheat varieties to meet nutritional demands.

6. Wheat and fad diets

It is generally accepted among nutritionists that low-carbohydrate fad diets, which often vilify wheat, can lead to rapid but temporary weight loss.

Although low-carbohydrate diets show more rapid weight loss than other diet types in the first six months, they do not result in greater weight loss over time and lead to more dropouts than more balanced diets, which do not eliminate entire food groups, writes Julie Miller Jones, a nutritionist and professor emeritus of food and nutrition at St. Catherine University in St. Paul, Minnesota (Miller Jones 2012).

Not only do the proponents of anti-wheat fad diets cast aside well-established medical and nutritional advice, they also disregard dietary guidelines and recommendations established by such reputable institutions as the World Health Organization, the U.N. Food and Agriculture Organization, the

U.S. Department of Agriculture, the Whole Grains Council, the Academy of Nutrition and Dietetics, the American Diabetes Association and the American Heart Association.

To a large degree, their arguments are based on a view that imagines what dietary practices were like for early human hunter-gatherers before farmers began to domesticate wild grasses, creating wheat, which led to a more secure food supply and the capacity to develop sedentary societies.

Some authors of anti-wheat diet books claim that wheat varieties grown today are unsuitable for human consumption because they haven't been tested for safety. They take aim at the efforts of wheat breeders at the International Maize and Wheat Improvement Center (CIMMYT), claiming that the conventional breeding methods they use result in wheat that is a drastic departure from what our ancestors consumed as wheat.

Arguments posed in literature and the popular press regarding the dangers of consuming wheat and gluten overlook the key role that wheat plays in nutrition and ensuring global food security. In an effort to mitigate the impact of population growth, land scarcity and climate change, scientists at CIMMYT are developing wheat varieties with higher micronutrient content and reinforcing the capacity of wheat to withstand heat and drought caused by global warming.

Zinc supplementation can help reduce the duration and impact of diarrhea in children, and iron and vitamin A supplements can reduce the risk of anemia and blindness.

Fad-diet hyperbole over the supposed dangers of wheat consumption might cause worry and unnecessary health fears among all sectors of society, but it is the poor and low-waged that may suffer the most from these campaigns. Many families cannot afford such nutrient-rich foods as fresh fruit, vegetables, beans, meat and milk, and rely on bread, rice or maize and legumes – food staples – to supplement their diets.

Socioeconomic factors can make it impossible for many people to afford or in some cases even access specialty food items.

In November, at the Second International Conference on Nutrition (ICN2) in Rome, the WHO, the FAO and 170 governments committed to fight malnutrition in all its forms, including hunger, micronutrient deficiencies and obesity. They laid out a framework for ending hunger, achieving food security and improving nutrition by 2025 (FAO/WHO).

Governments who signed onto the framework are tasked with encouraging a reduction in trans fats, saturated fats, sugar and salt, and to improve the nutrient content of foods through regulatory and voluntary instruments.

7. Anti-wheat books

Grouping the key arguments of anti-wheat books, which link wheat, gluten and carbohydrate consumption with chronic diseases allows the following analysis:

7.1 Wheat and chronic disease

Only 1 percent of people have celiac disease and 1 percent suffer from sensitivity to wheat (Lillywhite and Sarrouy 2014). People with celiac disease have a digestive condition which causes an adverse reaction to gluten resulting in diarrhea, bloating, flatulence, abdominal pain, weight loss and fatigue due to malnutrition. Celiac disease is an autoimmune condition, which means the immune system attacks healthy tissue, damaging the surface of the small bowel and preventing proper nutrient absorption.

Recently, some anti-wheat books have emphasized that cereal – in particular wheat – consumption contributes to degenerative diseases and such autoimmune neurological diseases as Alzheimer’s and Parkinson’s. The authors emphasize that they are writing for a U.S. audience – they claim all U.S. consumers will benefit from diets without cereals and cereal products. They state that cereals in general are unhealthy due to their high carbohydrate content, and that wheat is particularly dangerous because of gluten.

Maize, wheat, and rice-based foods are inexpensive, satisfying culinary preferences as well as caloric and essential nutrient needs for billions of people on all continents who consume them as a major food staple. If it were correct that cereals were the cause of Alzheimer’s, arteriosclerosis, Parkinson’s, autism and

loss of cognitive capacity and neurodevelopmental disorders, civilization would have been incapacitated and come to a halt many years ago.

Alarming, anti-wheat and cereals activism continues to gain momentum among consumers who hope to improve their health. However, wheat- and gluten-free diets can in fact be damaging to human health because they may not provide enough fiber and essential micronutrients (Biesiekierski et al. 2014; Lee et al. 2009). The recommended daily intake of dietary fiber is 38 grams (1.34 ounces) and 25 grams for adult men and women respectively, which is achievable by consuming a few servings of wheat foods or other cereals grains (Miller Jones 2012). In contrast, fruits and vegetables supply only 2 to 4 grams per serving, which means an adult male on a wheat-free diet would have to consume approximately 12 to 13 servings of fruit and vegetables a day to get the same amount of dietary fiber (Miller Jones 2012). The exclusion of cereal grains would result in a fiber-intake deficit far below the recommended amount needed to maintain a healthy digestive system.

7.1.1 Autoimmune disorders

Diverse gluten-induced conditions trigger the immune system in a range of ways via gliadin, which is one of two main protein fractions of the gluten protein complex. Sapone et al. (2012) propose a diagram and nomenclature for the spectrum of gluten related disorders (Figure 1).

As can be seen in Figure 1, gluten sensitivity is not an autoimmune condition as claimed by some anti-wheat literacy; it is believed to be innate or congenital.

7.1.1.1 Gluten Intolerance or Celiac Disease. The U.S. Celiac Disease Foundation estimates that 1 in 100 people suffer from the chronic condition of intolerance to gluten. This intolerance manifests itself as celiac disease, a genetic condition mediated by an immune response triggered mainly by small gliadin undigested peptides; among these, a unique 33-mer gliadin fragment is more immunogenic. This peptide is resistant to degradation by gastric, pancreatic and brush border peptidases (Sapone et al. 2012). On the surface of the small intestine, it is the main trigger of bowel inflammation intestinal damage, up regulation of the 47-K Zinulin peptide, responsible for the opening of the intestine wall and entrance of the gliadin protein. The reaction (deamidation) of this gliadin peptide with tissue transglutaminase (tTG) promotes recognition by HLA-DQ2/HLADQ8

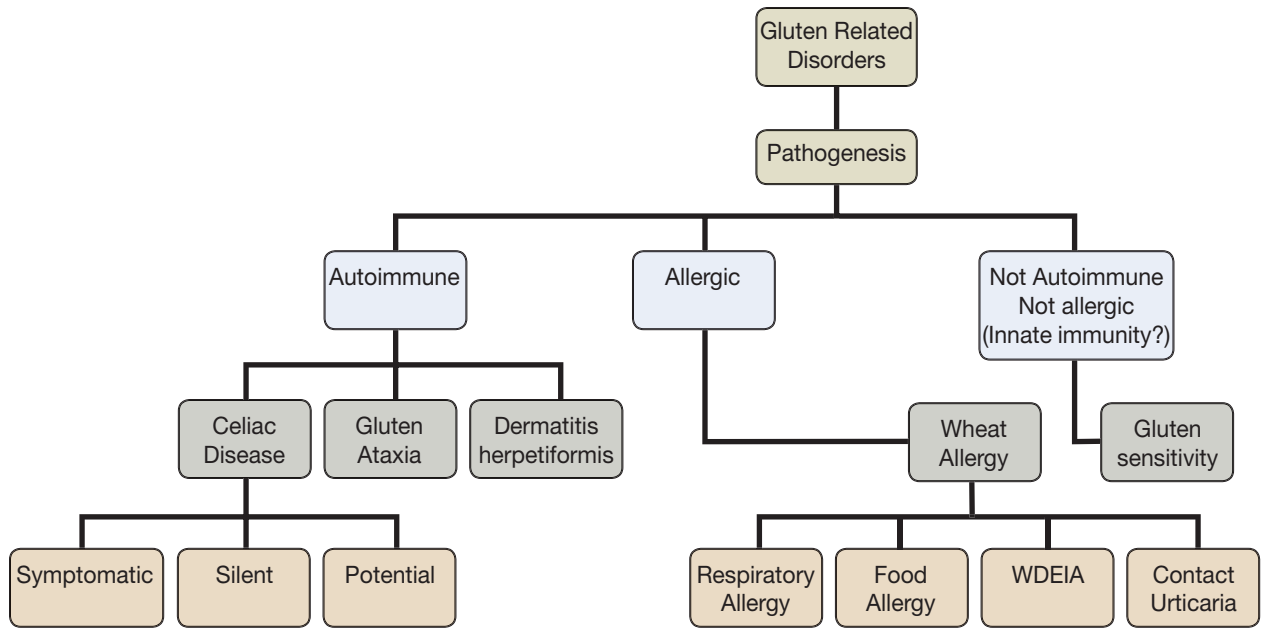


Figure 1. Proposed new nomenclature and classification of gluten related disorders adopted from Sapone et. al. (2012)

antigen presenting cells and triggering the onset of celiac disease and related immune disorders (Fasano 2011; Jackson et al 2012; Lundin 2014; Sapone 2012; Setty et al. 2008; Shan et al. 2002). This chronic enteropathy shows a wide range of manifestations of variable severity.

At present there is no cure or therapeutic action that can be taken against celiac disease. Therefore, those suffering from the disease must eliminate gluten from their diets (Cummins and Roberts-Thomson 2009).

Some anti-wheat books indicate it is possible that some of the inflammatory processes provoked by the consumption of gluten may in some cases trigger the increase of inflammatory cytokines levels, which by attacking the brain could contribute to the onset of Alzheimer's, Parkinson's, multiple sclerosis and autism. In addition, these authors speculate that the anti gliadin antibodies (AGA) could combine with similar gliadin-like proteins in the brain, promoting even more production of cytokines, provoking more neuropathies. However, Sofi et al. (2014) indicate that pre-inflammatory cytokines are more related to irritable bowel syndrome (IBS).

These arguments could hypothetically be possible metabolically. However, the authors do not present studies that demonstrate these processes actually occur. Fasano (YouTube, 21 January 2014) indicates that the potential relationship of gluten sensitivity to autism and schizophrenia is still very controversial.

Hadjivassiliou et al. (2010) reported a certain relationship between neuropathies and mainly celiac disease. But these authors actually show that only a small proportion (10 to 22.5 percent) of celiac disease patients have a neurological condition. They also indicate that there are differences in disease etiology in patients whose main manifestation occurs in the nervous system and those whose primary manifestation resides in the gastrointestinal system. At the same time, they indicate that it is unclear whether the central nervous system (CNS) pathology associated with gluten sensitivity (as they refer mainly to celiac disease) results from access of circulating antibodies that react with brain antigens after compromising the blood-brain barrier, or if it relates to a specific T-cell subset that is involved in immune surveillance of the brain. Why gluten presentation should specifically occur at a site distant to the digestive system (CNS, skin) is unclear. Finally (Hadjivassiliou et al. 2010) indicate that not all patients presenting certain neuropathies claimed to be caused or related by celiac disease got better when excluding gluten from their diet.

7.1.1.2 Wheat allergic response. Wheat allergy is an adverse immunologic reaction where IgE antibodies intervene when there is exposure to wheat proteins (gluten but also other proteins), affecting the skin, gastrointestinal tract or respiratory tract, depending on the exposure and the site the immune response resides. Wheat allergy is a classic food allergy, which is wheat-dependent, producing exercise-induced anaphylaxis (WDEIA); baker's asthma and rhinitis; and contact urticaria (Sapone et al. 2012). The incidence of people affected by WA is lower than that affected by celiac disease (Sapone et al. 2012).

7.1.1.3 Non-Celiac Gluten Sensitivity. It is now well known that besides celiac disease and wheat allergies, there are cases of gluten reactions in which neither allergic nor autoimmune mechanisms can be identified. However, gluten sensitivity is still an undefined syndrome, with several unsettled issues despite the increasing awareness of its existence. Only a few double blind, randomized placebo control (DBPC) studies have been performed, showing that in a variable proportion of patients classified as having gluten sensitivity, their symptoms could have been caused by a nocebo (a detrimental effect on health produced by psychological or psychosomatic factors such as negative expectations of treatment or prognosis effect) (Lundin 2014; van Buul and Brouns 2013; Volta et al. 2014).

Gluten sensitivity is an adverse reaction to gluten. Both gluten sensitivity and celiac disease involve an immune system response and may have similar symptoms, but the type of immune response is different (Sapone et al. 2012). People with gluten sensitivity do not develop severe intestinal damage like that seen in patients with celiac disease. These are generally defined as non-celiac gluten sensitivities (NCGS). The symptoms of NCGS are similar to those of patients with irritable bowel syndrome, including abdominal pain, bloating, gas, diarrhea, and constipation (Lundin 2014). Sapone et al. (2012) define NCGS patients as those patients in which celiac disease, wheat allergy and other clinically overlapping diseases (e.g., Type-1 diabetes, inflammatory bowel diseases and *Helicobacter pylori* infection) have been ruled out. In NCGS patients, and in those suffering celiac disease, their symptoms are caused by gluten exposure and eased by gluten withdrawal.

NCGS is not accompanied by the concurrence of anti-tTG autoantibodies or other autoimmune comorbidities. The small intestine of gluten sensitive patients is usually normal (Sapone et al. 2012).

Objective biomarkers to diagnose gluten sensitive condition are not available and may be difficult to develop. Gluten sensitivity may be caused by improper immune responses, intolerance to poorly digestible and fermentable substances in the wheat, or a combination of these.

Although the number of people suffering from NCGS has been estimated much higher than those suffering from celiac disease, some studies have demonstrated that the sensitivity of some of the patients who have been diagnosed with NCGS with inflammation and other gastrointestinal symptoms, were rather affected by the presence of fermentable, poorly absorbed oligo-, di-, monosaccharides and polyols (FODMAPS) or other foods (Biesiekierski et al. 2013b; Biesiekierski et al. 2014; Carroccio et al. 2012; Lundin 2014; Halmos et al. 2014). Future research in the NCGS area should address how much gluten really is involved, using manageable, clinically acceptable, placebo-controlled investigation procedures.

For example, the study of Carroccio et al. (2012) shows a diagram of their clinical design and the response of 920 patients showing irritable bowel syndrome (IBS symptoms and fulfilling the criteria for NCGS (Figure 2). Two groups of patients were identified. One group with 70 patients was suffering from no celiac wheat sensitivity alone and a second group with 206 patients suffering from multiple food hypersensitivity, including wheat sensitivity. Out of the total 920 patients, 644 did not suffer from wheat sensitivity and were excluded from the study (Carroccio et al. 2012).

A major limitation in studying NCGS is diagnosis, which remains highly presumptive. Therefore, at present a proportion of patients classified as suspected NCGS might improve after commencing a gluten free diet (GDF) because of elimination of gluten or simply by a placebo effect (Volta et al. 2014). Although, according to Lundin (2014) there are no conclusive studies demonstrating the benefits of a GDF in NCGS patients.

7.1.1.4 Wheat toxicity. Fasano, in a seminar transmitted on YouTube (21 January 2014) based mainly on a review article by Sapone et al. (2012) and by results and new findings reported during the second Meeting of Experts on Gluten Sensitivity (Catassi et al. 2013), explained his research group's work of more than 15 years. Fasano indicated that three major elements are involved in celiac disease and NCGS. Genetic factors (an individual's genes), environmental factors (food or intruder), and gut

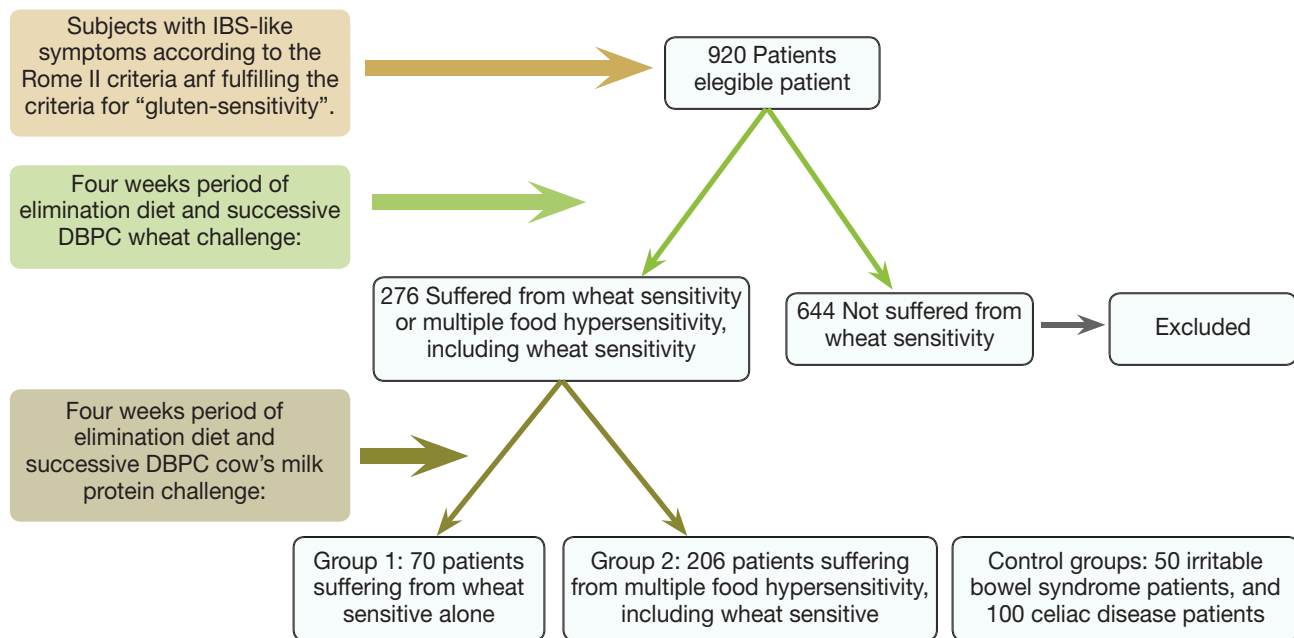


Figure 2. Clinical study design and results from the study (Adopted from Carroccio et. al. 2012)

permeability. In his discussion of the food factor, Fasano indicated rightly that humankind was not meant to eat wheat or gluten. During 2.5 million years of evolution humankind has been 99.99 percent gluten-free. Humankind started eating wheat only about 10,000 years ago. Therefore, gluten is toxic for everybody, but not everybody gets sick. Don't get confused, he said, explaining that "the vast majority of people will clean up the fragments of gliadin and nothing happens. Only a very small percent of people lose this battle and the gluten fractions crossing the intestine will cause problems. The gluten fragments are taken as bacteria that can harm us. Some of the ones that lose the battle bear at least some of the factors that make them prone to acquire the disease."

It is inaccurate and dangerous to label wheat and gluten a wholesale danger for the human population—especially for the billions of people that need wheat to survive or for basic nutrients. The small numbers of people that cannot tolerate gluten should embrace a gluten-free diet, and that will solve most of their health conditions and discomfort.

7.1.1.5 Inflammation, Zonulin and Tight Junction (TJ). Gliadin peptides in the gut promote production of the protein zonulin, which opens the gut and increases permeability allowing the entry of undesirable peptides and other unwanted simple components. Hence gliadin is the trigger that

activates zonulin signaling irrespective of the genetic expression of autoimmunity, leading to increased intestinal permeability and unwanted macromolecules (Drago et al. 2006). Fasano (2001) developed an illustrative diagram showing the pathological and therapeutic implications of the passage of macromolecules through the tight junction (Figure 3). The diagram shows how many different conditions can occur if a person has a "leaky gut," a proposed condition some health practitioners say causes a range of long-term health problems, including chronic fatigue syndrome and multiple sclerosis. The human gut must be protected and for that it needs gut microbiota, which can protect against infectious bacteria, inflammation and gut permeability (Frazier et al. 2011) and contribute enzymatic complexes that help to completely digest food. Additionally, a Zonulin blocker drug has been developed to reduce or prevent gut permeability (Fasano, YouTube, 21 January 2014). The drug Larazotide Acetate consistently reduced gastrointestinal symptoms in three gluten challenge clinical trials by preventing leaky gut.

Inflammatory processes and gut permeability are the two major elements for the initiation of immune and autoimmune events. Triggers could involve such factors as peptides from wheat and other food, short chain carbohydrates, sugars, good and bad bacteria and a lack of certain hydrolyzing enzymes. They could also be due to innate predisposition or to variations during childbirth, diet in the early months, childhood and adulthood. Antibiotics and other medical drugs

may also lead to a favorable predisposition for triggers resulting in a permeable gut. These factors may act on an individual or complementary basis to cause the problem (Fasano 2011; Halmos et al. 2014). Arthur Agatston and Natalie Geary, in their book. “The South Beach Diet Gluten Solution” (2013) explain in detail the signs of non-celiac gluten sensitivity and whether inherited or external factors made the person NCGS. They also emphasize that being NCGS does not necessarily mean you cannot eat gluten. They explain that it is important to determine tolerance levels to gluten-containing foods.

7.1.1.6 Microbiome. Fasano queries: “What happened to these people that suddenly lose their capability to eat gluten?” What other factors must be considered? (Fasano, YouTube, 21 January 2014). Perhaps, he suggests, the age at which a baby was introduced to gluten and, or, the changes of the microbiome composition as we age, or changes in our dietary habits, environment and lifestyle could affect the human ability to properly digest gluten.

It is important to consider that bacteria within the human body express 100 times more genes than we, as humans, do. Human beings are made up of genomes as well as microbiomes. The microbiome is inherited from the mother, which means babies delivered through the birth canal receive her microbiomes. Some have suggested that babies born

by caesarean might have a higher risk of developing celiac disease or other diseases because they did not get all the microbiomes and microbiome-related enzymes present in the mother, which contribute to digestion of food in the small intestine.

Agatston and Geary (2013) also ask why those who are NCGS do not have the ability to digest gluten at a manageable level. There are other factors that could be related to the microbiome and immune system affecting the capacity to perform better in the presence of gliadin or other protein or even bacteria. To list some:

- Not enough enzymes to digest excessive amounts of ingested food.
- Excessive concentration of gluten in our food (gluten is added to some baking products, soups, dressings, sausages, etc.).
- Digestive track congestion with resulting inflammation from very low traffic and gut damage (and permeability).
- Abuse of pain relievers and anti-inflammatory drugs such as non-steroidal anti-inflammatory medications (NSAID), including aspirin, naproxen, indomethacin and ibuprofen (30 billion doses of NSAIDs are taken in the United States each year). These drugs can damage both the stomach and small intestine, contributing to the capacity of gliadin peptides to leak through the intestinal lining causing diverse immune reactions.

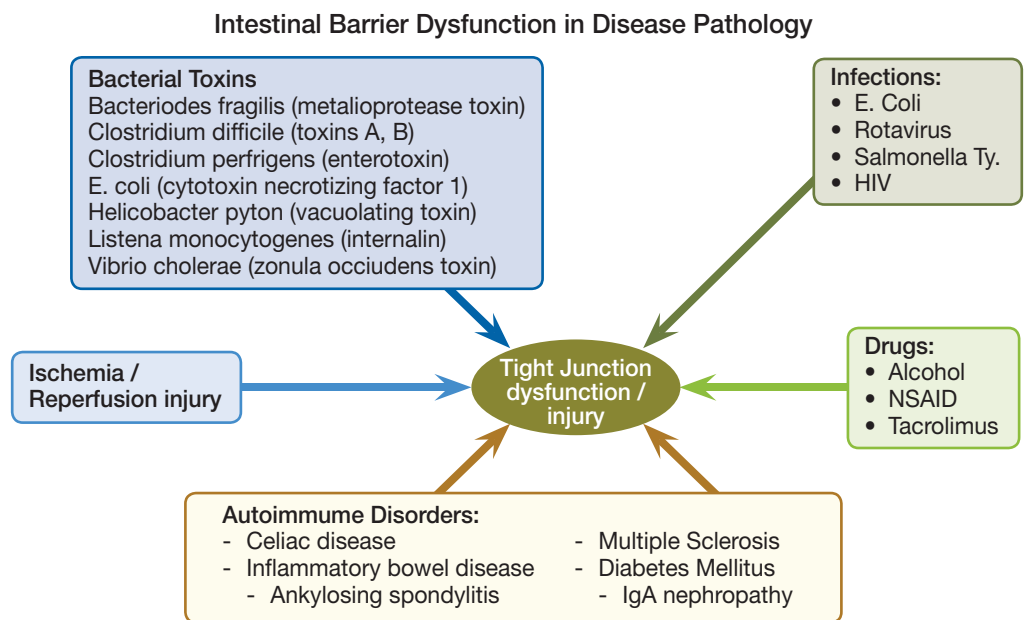


Figure 3. Pathological and therapeutic implications of macromolecules passage through the tight junction (adopted from Fasano, 2001)

- Abuse of antibiotics may also contribute to our gluten-related problems.
- Overuse and over-prescription of antibiotics is very high in the United States today. Medical doctors often unnecessarily prescribe antibiotics for bronchitis and flu, starting in childhood. Antibiotics kill both bad and good bacteria (microbiome) in the intestine, reducing their ability to aid the digestion of gluten.
- The human body needs good bacteria. Throughout life good bacteria is affected by medications, diet, lifestyle and environment. A study (De Filippo et al. 2010) has shown that eating a high-fiber diet in rural Africa generates different gut flora than that found in Western children who eat a low-fiber diet heavy in meat and starch. The gut flora of African children is protective against diarrhea and inflammatory disease, while the gut flora of Western children from industrialized countries is associated with a higher incidence of Western diseases such as diabetes, allergies, inflammatory bowel disorder, and obesity (De Filippo et al. 2010).

7.1.2 Carbohydrates, obesity, diabetes and neuropathy

Most of these books do not present any nutritional information that is not already well known with regard to general causes of weight gain, obesity and related health problems. It is generally accepted by nutritionists that lowering daily caloric intake from more than 3,000 kilocalories to recommended levels of below 2,500 kilocalories will result in weight loss.

Most of the arguments that relate to wheat and obesity have already been analyzed, discussed and often refuted on scientific grounds (Miller Jones 2012, the National Wheat Improvement Committee of the United States in collaboration with several universities and research institutes from the United States and Europe, CIMMYT and by several other scientific studies [Biesiekierski et al. 2013a; Brouns et al. 2013; Kasarda 2011; Shewry 2009]).

Other arguments indicate that high carbohydrate foods are the main cause of brain dysfunction and diseases or conditions such as depression, epilepsy or anxiety, among others. Sugar levels close to the high limit tend to make the brain shrink, one author argues. High glycemic index, refined flours, glucose, and fructose, all cause diabetes and inflammatory reactions affecting the brain and natural antioxidants promote Alzheimer's, atherosclerosis, dementia and reduce cognitive capacity.

These arguments are taken beyond the caloric load of wheat and include all cereal grains as well as fruit with high starch and glucose concentration. In general, the recommendation is to consume low carbohydrate foods, and the elimination from our diet of wheat, rye and barley because these contain gluten.

There is no doubt the scientific and therapeutic communities agree that excessive caloric intake is related with high glucose in blood, promoting Type 2 diabetes and obesity and cardiovascular diseases. We also know that it affects hormones and the capacity for the metabolism to operate normally.

Researchers at Australia's Monash University have proven that a diet low in FODMAPS is an effective strategy for managing symptoms (diarrhea, bloating, abdominal pain, and flatus) of Irritable Bowel Syndrome caused by poor absorption, osmotic activity, and rapid fermentation of short chain and simple sugars (Barrett 2013). Up to 86 percent of patients with IBS have achieved relief of overall gastrointestinal symptoms and, more specifically, bloating, flatus, abdominal pain, and altered bowel habit from the approach (Barrett 2013).

Although wheat is high in FODMAPS, hundreds of other foods are also high in FODMAPS. Therefore, a high FODMAPS diet does not exclude wheat. A balanced diet can regulate the amount of FODMAPS, avoiding inflammation and loss of cognitive capacity (Gómez-Pinilla 2008).

Excessive eating causes people to become overweight and even morbidly obese, which is associated with Type 2 diabetes and cardiovascular diseases. The solution to these problems is in the reduced caloric intake of a balanced diet with sufficient dietary fiber and good amount of antioxidants accompanied by physical exercise.

It is also known that changes in microbiota may also be a factor in becoming obese. Round and Mazmanian (2009) showed that the microbiome (gut flora) of overweight individuals was different from the microbiome of thin individuals.

On the other hand, Cho and Blaser (2012) in an experiment with mice, showed that excessive use of antibiotics affects our good microbiome, causing metabolic changes, possibly affecting the metabolism of fatty acids, increasing digestion of fat, enhancing caloric intake and an increase in accumulated fat

of approximately 10-15 percent higher than the control mice. Trasande et al. (2013) postulated that microbes in our intestines may play a critical role in caloric intake from food. Exposure to antibiotics early in life may kill off healthy bacteria that influence the absorption of nutrients. In a study, Trasande et al. (2013) found that administering babies antibiotics before the age of six months increased the chance of being overweight by age 3 by 22 percent. These studies contribute to evidence of the effect of antibiotics on gut bacteria, contributing to obesity.

Contrary to what anti-wheat books claim, people consuming three servings of whole grains throughout the day are less likely to acquire Type 2 diabetes (Venn and Mann, 2004) than those that consuming a smaller number of servings. In a survey of children and adolescents, those who ate breakfast, which included wheat, maize, oats or rice, were associated with low saturated fat or cholesterol intake and high intake of carbohydrates, dietary fiber and various micronutrients, had a lower prevalence of obesity than those that did not eat cereal at breakfast or that skipped the meal altogether. Those who skipped breakfast showed higher body mass than those that had any of the two types of breakfast: ready-to-eat cereal (RTEC) and non RTEC breakfasts (Deshmukh-Taskar et al. 2010). Additionally, Rampersaud et al. (2005) in a similar study found that those children and adolescents that had breakfast including regular milk and cereal-based food showed better scholastic performance than those skipping breakfast.

Thus, a balanced breakfast should have a good, but balanced, load of cereal grains including wheat, milk and some polyunsaturated fat.

In an essay published in April 2014 on the CIMMYT website¹, nutritionist Miller Jones refers to statements indicating that the increase in obesity and diabetes in the United States directly correlates with the increase in the sales of wheat-based products. But wheat is not the real culprit.

“Food available for consumption increased in all major food categories from 1970 to 2008. The number of average daily calories consumed per person increased approximately 600 calories during that period,” Miller Jones reported, referring to data from the President’s Council on Fitness, Sports and Nutrition and statistics from the U.S. Census Bureau.

Weight-loss diets that advocate the elimination of an entire food group such as wheat may cause initial weight loss, but, like many fad diets, rarely show long-term maintenance of weight loss.

In fact, studies confirm that the easiest diets to maintain are those that deviate least from normal eating patterns. They are also much more likely to be associated with long-term weight loss and maintenance of the loss. Further, diets that include a balance of foods and do not have “forbidden” or excluded foods are associated with the greatest success in sustaining the weight loss.

Elimination of wheat and gluten can result in problems because wheat is a major contributor to dietary fiber, B vitamins and other nutrients.

7.2 Modern wheat vs old wheat and health

People first began eating grains about 75,000 years ago in western Asia (National Geographic 2014). These grains, including *T. boeoticum* (an ancestor of einkorn) and wild emmer (*diccocooides*), were ancestors of today’s wheat. People harvested the grasses that grew naturally near their communities. They began cultivating, or growing, grain more recently and ancient people ate grains in much the same way we do today. Wheat grains were made into flour and used in breads.

Modern bread wheat is the most widely cultivated type of wheat today, making up more than 90 percent of global production. It is the product of natural hybridization among several grasses (Figure 4). One parent is *Triticum urartu*, a wild grass that still grows in the Middle East. *Triticum urartu* spontaneously hybridized with *Aegilops speltoides* and formed wild Emmer (*Triticum dicoccocoides*). The cultivated form (*T.dicoccum*) was consumed by the ancient Egyptians and Romans and is still consumed today in India. Durum wheat, derived from emmer (*Triticum durum*), is used today for pasta and semolina products. Around 10,000 years ago, emmer crossed naturally with goat grass (*Aegilops tauschii* (Peng et al. 2011) and formed the ancestor of modern bread wheat (*T. aestivum*). Wheat was wild at the outset until our ancestors started to cultivate and domesticate it.

¹ www.cimmyt.org/en/wheat-matters/item/of-wheat-weight-gluten-and-food-intolerances

Modern wheat (*Triticum aestivum*, or bread wheat, and *Triticum durum*, or pasta wheat), and other varieties such as *Triticum spelt* (spelt wheat) and *Triticum turgidum* subsp. *Turanicum*, commercially known as Kamut wheat, has not changed in its fundamental genetic composition.

The nutritional and protein composition of durum and bread wheat eaten today varies very little from the wheat consumed 8,000 to 9,000 years ago. Ancient wheat had the same genetic base that wheat breeders still use today to generate improved wheat cultivars. The genes are the same, although recombined in diverse ways through cross-breeding (Cavanagh et al. 2013).

Alessio Fasano, an internationally recognized researcher of celiac disease pathology, immunology and related disorders at Massachusetts General Hospital, asserted in a seminar that modern wheat is no different from old wheat in its constitutional make up and grain composition (YouTube, 21 January 2014). In support of this, several biochemical genetic, and genomic studies (Akhunov et al. 2010; Cavanagh et al. 2013; Kasarda 2011; Naghavi et al. 2013;

Peng et al. 2011; Shewry 2009) have shown that the cultivars of different varieties consumed today – including bread and durum wheat, emmer, spelt and kamut have their origin in the diploid and tetraploid ancestors (*T. Urartu*, *Ae. tauschii*, and wild emmer, among others.).

In addition, the gluten proteins found in modern wheat have their origin in the diploid species *T. urartu*, *Ae. speltooides*; and *Ae. tauschii*, i.e. also the diploid ancient wheats contain gluten (Dhanapal et al. 2010; Gutierrez et al. 2010; Molberg et al. 2005; NWIC, 2013; Salentijn et al. 2012). The protein content of wheat we eat today is similar to that consumed at least 100 years ago (Kasarda 2011). Some studies have found that the species *T. monococcum* (cultivated einkorn), and other landraces, or “old modern wheat”, of *T. aestivum*, *T. compactum* and *T. spelta* in which the wheat we eat today originated also contain gliadins (gluten proteins) similar to those in modern wheat that generate the gliadin peptides (epitopes) that provoke celiac disease (Colomba and Gregorini 2012; Molberg et al. 2005; van den Broek et al. 2010; Salentijn et al. 2012; Suligoj et al. 2012; Vaccino et al. 2009).

8. Conclusion

Wheat and other cereals should always be part of a healthy and nutritious balanced diet for most of the population. Its consumption is highly recommended to ensure an appropriate intake of dietary fiber, minerals, vitamins, and other beneficial bio- compounds present in the wheat grain. The approximately 1 percent of the population suffering from congenital immunological celiac disease incapacity should not consume wheat products or any product containing gluten. However, these groups should be aware that the gluten-free food they are going to consume has a composition that will not necessarily positively affect their health, starting with calorie intake from carbohydrates and sugar. For those with gluten sensitivity, it is important to be aware if they are truly gluten sensitive and, if so, to what degree, to determine whether they should eat gluten-containing foods.

The media hype around the supposed “dangers of wheat” is detrimental to the important and ongoing research agenda to sustainably increase wheat production for nutritional needs of the global population.

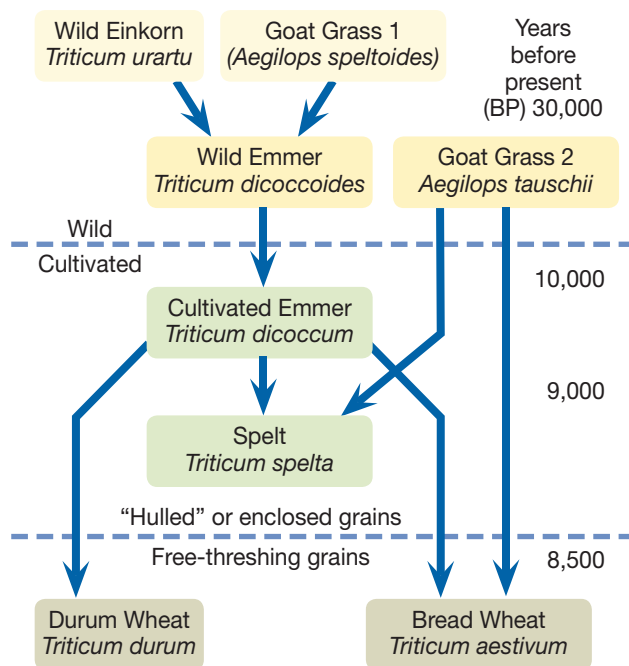


Figure 4. The evolution of wheat from the prehistoric Stone Age grasses to modern macaroni wheat and bread wheat (reproduced from <http://www.newhallmill.org.uk/wht-evol.htm>)

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