

Health concerns over cereals and our daily bread

Prof Dr Fred Brouns, “Well on Wheat?” consortium.

How do ancient grains compare with modern grains, and can gluten and wheat lead to obesity and disease? Can we separate the wheat from the chaff in terms of “what is actually true?” In other words, what is based on scientific evidence and what is based on beliefs and assumptions?

In this context, following discussions in the Food and Health working group of the international **Health Grain Forum**, the universities of Maastricht and Wageningen, in collaboration with the Dutch Bakery Centre (Nederlands Bakkerij Centrum) and Leeds University and Rothamsted Research Institute in the UK, have embarked on a major study entitled **Well on Wheat? (WoW?)** (fig 1). In addition to donations from the cereals-processing chain, this project is financed by the Dutch government’s **Top Sector Agri-food** initiative. The question mark after the word ‘Wheat’ is there for a reason. The WoW research primarily focuses on which substances in wheat could cause health problems in some people. Who, when, how and why are key questions in this context. If we know exactly which substances are involved, it may be possible to eliminate them in future using new technologies and targeted seed processing (for details of this project, see the website <http://www.wellonwheat.org>).



fig 1

What should we believe?

Social media and popular books, such as *Wheat Belly* by William Davis and *The Grain Brain* by David Perlmutter, suggest that eating cereals, cereal products and bread, particularly wheat, makes many people ill. They claim that it leads to obesity and diabetes and to adverse effects on the brain, and that eating cereals containing gluten leads to ADHD, epilepsy, autism and even Alzheimer’s disease. All very alarming!
BUT, is it true?

It is also pointed out that we have only been eating cereals for 10,000 years and that this is far too short a time to have become “genetically adapted to them”. They suggest also that today’s bread wheat is the result of genetic engineering, suggesting that it now contains many substances that are harmful to health. In this respect, there is widespread misinterpretation of scientific knowledge in this field. The above-mentioned books have therefore given rise to scientific publications in which the many inaccuracies are discussed. This has led to a great deal of confusion over what is true and what is not.

Nevertheless, these popular, readily accessible books have led to a trend for more and more people to believe that cereal products, particularly those containing wheat, are bad for their health.

In stark contrast to these negative claims about wheat and gluten are the recent recommendations of the World Health Organisation (WHO), the European food watchdog EFSA, the UK's Scientific Advisory Committee on Nutrition (SACN), the Nordic Countries Health Council, the Health Council of the Netherlands, the Dutch Healthy Eating Hub (het Voedingscentrum) and many other international food authorities. Without exception, they all stress that, as well as plenty of fresh fruit and vegetables, people should also be consuming whole-grain products on a daily basis. Since many whole-grain products contain wheat, rye, barley or spelt, all grains that contain gluten, the question arises as to why these bodies would make such recommendations if these products could make people ill?

How celebrities influence the world

The belief that grains make us ill and that the best thing to do is to stop eating bread is reinforced by claims made by celebrities from the world of show business and sport. For many people, these individuals act as role models, and their claims that they feel better if they don't eat cereal products have a huge influence on the public.

The tennis player Djokovic reported that he had gone gluten-free on the recommendation of his coach. Apparently he was sensitive to gluten. When he won the US Open, he said that he had never had so much energy and that it was because he had gone gluten-free. And, as the world number 1, clearly you are always right! He talked about his gluten-free diet on US talk shows, so the news went global. Many people have followed his lead, based on hearsay and belief. "If this gives him so much energy, I must try it myself," thought countless others in the world of sport. Andy Murray, for example, went gluten-free, and a couple of months later he felt exhausted and literally "couldn't hit the ball". That news received virtually no coverage in social media. When Murray started eating normally again and subsequently ousted Djoko from his number 1 position, the score was 1-0 to a normal diet compared with gluten-free. Roger Federer, winner of 20 grand slam titles and, impressively, at 36, on his way to becoming the world number 1 once again, eats bread on a daily basis! It has recently been announced that world champion Dutch sprinter Dafne Schippers is no longer eating bread because her trainer thinks it is better for her. However, many professional cyclists eat large quantities of cereal products on a daily basis to keep themselves in tiptop condition and to aid their recovery on a day-to-day basis. According to studies conducted during the Tour de France, they couldn't do without them. In this context, it's crucial that we understand more clearly what is going on. Particularly since it seems that many people who say that they avoid gluten because it is meant to be good for their health can't explain what gluten is and where exactly it is found. Examples such as rice, olive oil and even wine are incorrectly named as products that contain gluten. There is also a great deal of uncertainty around ancient and new grains. What are grains and what is 'ancient'?

What are grains and what is gluten?

Grains belong to the grass family (fig 2). Amongst others, this includes wheat, rye, barley, oats and spelt, as well as rice, maize and other grains that are less common here, such as millet (which is mainly eaten in India, Africa and China), sorghum (Africa, USA) and teff (Africa), all grains that grow well in areas with low rainfall. Some of these grains contain gluten, others don't. Quinoa (South America) and chia seeds (South America, Mexico) are in fact not grains at all but are often promoted as gluten-free alternatives. Of all the grains, wheat is the most commonly grown gluten-containing grain.

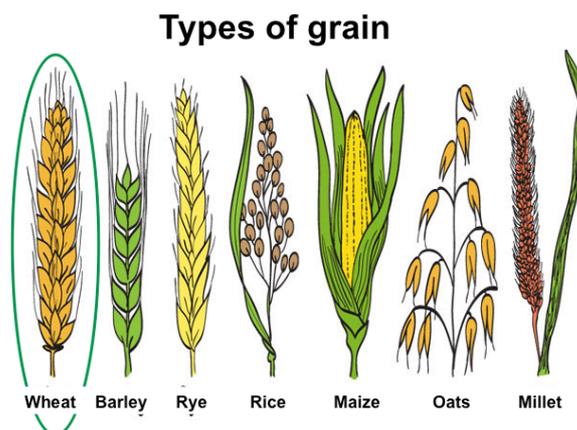
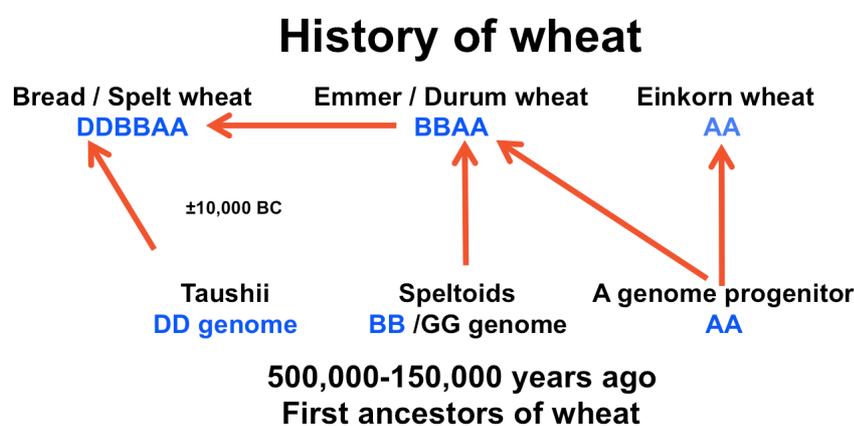


fig 2: Source Cereals-Shutterstock.com

History of wheat

Types of wheat have probably existed for millions of years. The oldest forms are diploid (such as modern einkorn) and tetraploid (such as modern emmer and durum wheats), but modern hexaploid bread wheat only originated about 10,000 years ago. These forms originated from genetically related grass species (with the A, B and D genomes, see fig. 3), with the tetraploid and hexaploidy forms having arisen by hybridizations. These ancestors, and therefore also the genomes of the grains that are cultivated today, are extremely old. They all contain gluten protein. The gluten composition and baking qualities are therefore determined by the genetic characteristics of the A, B and D genomes and combinations thereof.



Source - G.Garnet. Wheat domestication, C.R.Biologies (2011)

(fig 3).

In a continuous selection process, farmers selected a handful of wheat varieties that were the most attractive in terms of yield and workload from the available species. Ultimately, some 11,000 years ago, the popular bread wheat that we consume today produced the best result. It was simply a natural variant with an excellent yield (i.e. it was not a genetically modified grain). Bread wheat produces a yield that is 2 to 4 times greater than and also has far better baking qualities than other supposed wheat species such as einkorn, emmer and spelt. The rash claim made by many that we have only been eating grains for 10,000 years would appear to be incorrect. Archaeological finds, such as microscopic remains in the holes of millstones found in Ohalo near the Sea of Galilee in Israel, and in the dental enamel of Neanderthals living in Belgium, confirm that, as well as plants, tubers and fruit, people were already eating wheat, rye and barley some 50,000 years ago. (fig 14)



fig 4

The oldest known bread, a kind of pitta bread, was already being baked by hunter-gatherers who lived at the end of the paleolithic age. This type of bread was easy to dry and store for times when food was scarce. So, the claim by many followers of the Paleo diet that our early ancestors ate no grains at all is untrue. Who knows, people may well have been eating ancient wheat varieties far earlier than that but we simply haven't found the evidence to prove it - not yet! But absence of proof that they were eating something does not prove that they weren't.

What is gluten?

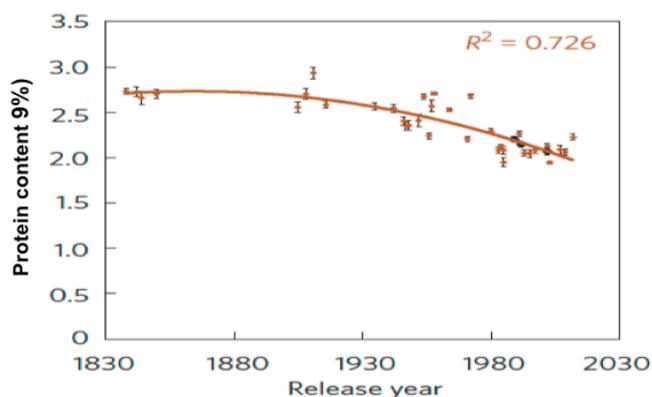
Gluten is a type of protein that belongs to the prolamins group and is contained in wheat, rye, barley and spelt. It comprises of two components, gliadin and glutenin, which, following the addition of water and salt, form an elastic structure as a result of kneading. It's a bit like the elastic skin of a balloon. When you blow air into it, the surface expands but the air can't get out, so the balloon

“rises”. If you burst this skin, the balloon goes down. This is similar to kneaded dough in which yeast and bacteria, in a process called fermentation, form gases that can’t escape through the elastic gluten. As a result, the dough rises. If you then prick the dough with a knife or a fork, it sinks and the gases escape. In fact, gluten is therefore responsible for the good baking qualities of bread, giving it an elastic, aerated structure. Gluten-free grains therefore produce a far smaller and more compact loaf.

Does bread wheat have more gluten?

One question that people often ask is whether it is true that bread wheat contains more gluten than other (older) wheat varieties. The leading European Health Grain Research Consortium has conducted an in depth study into the composition of wheat. In this study, 150 varieties of wheat from seed banks were sown, cultivated and harvested under exactly the same conditions. The results of the analysis indicated that more recent varieties contain less gluten and more starch than older varieties (see fig 5). This dispels the myth that the grains that we eat today contain more gluten than older grains. It is clear, however, that the type and composition of the protein fragments (peptides) vary depending on the genome of the grain. Whether this impacts on the occurrence and severity of health problems is the subject of much international research.

Wheat protein: changes over time



Data from 150 varieties of wheat all cultivated under the same controlled conditions

fig 5

It is also clear that the content of other protein components, such as the natural plant protection protein amylase-trypsin inhibitor (ATI), varies according to the type of grain. ATIs inhibit the digestion of starch and protein in harmful predators such as insects, rendering them harmless. ATIs appear to be resistant to exposure to heat (boiling, baking), gastric acid and digestive enzymes in the gut. Consequently, once the grain product has been consumed, ATIs remain largely intact and can cause immune reactions in the gut of people who are sensitive to them. In addition, it appears that ATIs also have a strong allergenic effect and are partly responsible for asthma symptoms in bakers that occur as a result of the inhalation of flour dust. Wheat has a wide range of ATI types (about

20 iso forms), all of which vary in terms of their biological activity, which is why much research has recently been initiated around the potential role of ATIs in wheat- and gluten -related health problems.

Are ancient grains more nutritious?

The claim that ancient wheat varieties have a higher nutritional value in terms of fibre, antioxidants (polyphenols), vitamins and minerals was investigated in the Health Grain project. The indication was that there are minor differences between them that are not likely to have a significant impact in terms of nutritional value and health.

The research also indicated that the annual variation in climate and growing conditions has a greater impact on grain composition than the grain type itself. So, reverting to ancient grains would not be beneficial. And in terms of sustainability, it would be a retrograde step! In this respect, researchers from the University of Hohenheim in Germany studied the yield of “ancient grains” as currently available and grown on experimental plots with the same soil, and climatological conditions. Nitrogen fertilizer load was adapted for each wheat type to help avoid the risk of lodging (**Lodging** is the bending over of the stems near the ground level in **grain** crops, which makes them very difficult to harvest and can dramatically reduce yield). The research group irrefutably demonstrated that the yield of ancient wheat types were considerably lower than that of bread wheat. Spelt, Emmer and Einkorn yielded 40-70% less (see fig 6).

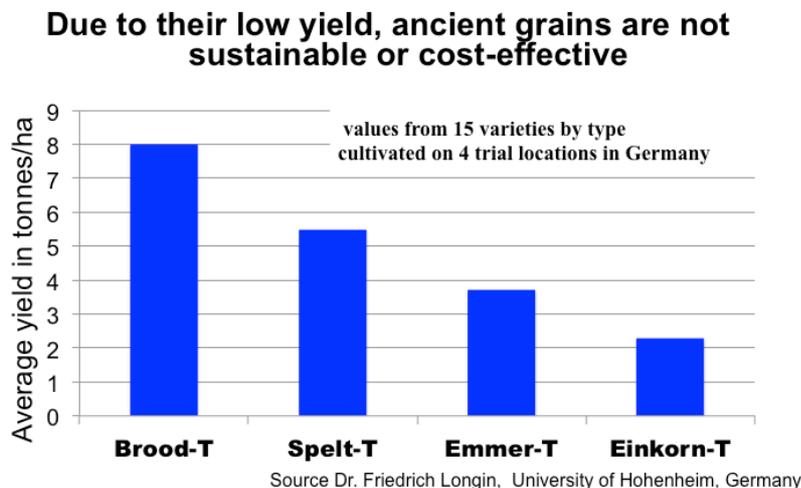


fig 6

Intolerance and hypersensitivity

Can wheat lead to intolerance or hypersensitivity reactions? The answer to this question is definitely YES. For example, coeliac disease, a chronic immune reaction to the presence of undigested gluten fragments (peptides), which causes damage to the small intestine. The intestinal villi lose their structure, which results in a “flat” intestinal surface (see fig 7). This leads to a significant decrease in the ability to digest and absorb, which in turn leads to bowel problems,

diarrhoea and nutrient deficiency. Coeliac disease only occurs in people with a specific hereditary predisposition.

Coeliac disease

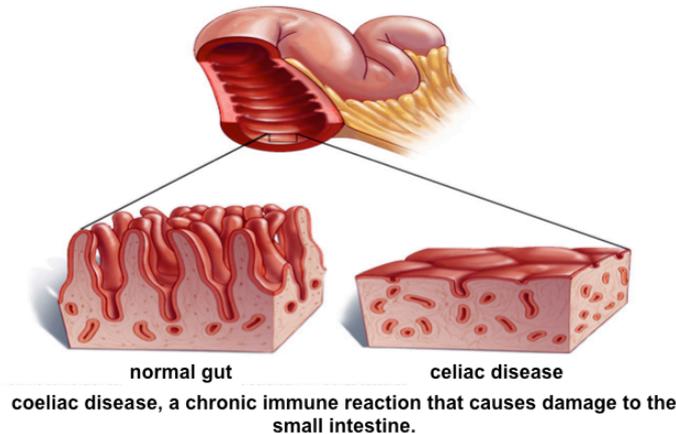
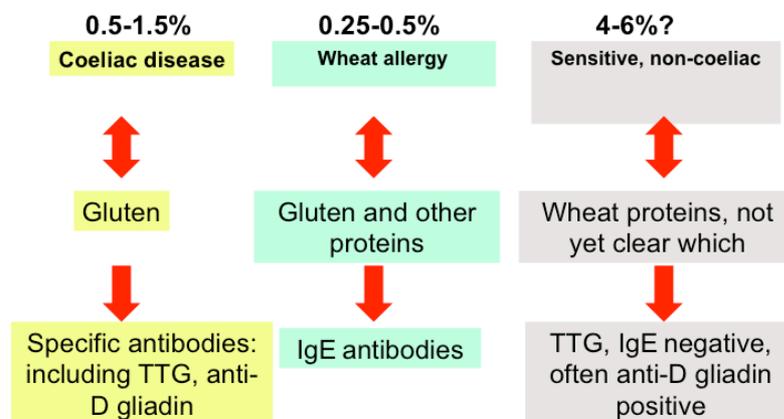


fig 7-: source: "Mayo Foundation for Medical Education and Research"

Depending on the country in which data are collected, this occurs in approximately 20-40% of the population. Of this group, 2-3% will go on to develop the disease. In the total population, this equates to about 1 %, although the actual percentage may be slightly higher because far from everyone is diagnosed. However, diagnosis is straightforward using specific antibodies that can be detected in the blood. Contrary to what is often suggested in the media, coeliac disease is not an allergy! It is an immune response related disease condition that develops over many months. In an allergy, the symptoms usually develop within a few hours of exposure, e.g. asthmatic conditions (generally in combination with physical effort) or skin irritations. About 0.2-0.5% of the population are allergic to wheat proteins. This is demonstrated by the formation of IgE antibodies, which can be detected in the blood. (see fig 8).

Wheat and Gluten Intolerances



Catassi et al. Nutrients 2015, Fasano et al Gastroenterol 2015, Catassi et al. Nutrients 2017,.

fig 8

Recently, another type of intolerance known as non-coeliac gluten sensitivity, or sometimes wheat-sensitive irritable bowel syndrome, has been described. This can give rise to specific bowel problems but also to general malaise, headaches and muscle and joint pain. It is not yet clear which substance or substances in wheat play a key causative role in this. Nor, as yet, is there an effective diagnostic test. Consequently, if a person feels that specific health problems may be caused by the consumption of wheat or gluten, it is crucial that they consult a doctor in the first instance in order to exclude the presence of coeliac disease. If the diagnosis is negative, they can then take steps to completely avoid wheat and other gluten-containing grains for a period of between three and six months to establish whether their health problems disappear. It is necessary to do this over a long period of time because significant nocebo effects (the opposite of placebo effects) can occur, and these generally take several months to subside. If their health problems do indeed disappear, they can then double check by eating grains once again for a short period of time. If their health problems come back, it is an indication that they would be better off avoiding wheat and gluten on a lifelong basis. If, however, their health problems don't come back, they don't need to do this!

FODMaPs

As well as proteins, indigestible, rapidly fermentable carbohydrates (FODMaPs) such as fructans, which are present in grains, can lead to the formation of gas. This is particularly difficult for people who suffer from irritable bowel syndrome. For these individuals, avoiding FODMaPs can have a beneficial effect on the severity of their condition and the associated sense of wellbeing.

However, this does not apply to everyone. The formation of gas through fermentation does not cause illness, allergies or inflammation. In fact, carbohydrate fermentation in the large intestine is a process that generally offers health benefits.

Wholegrain recommendations

So, to get back to the beginning of this story. According to international recommendations, people should be eating more wholegrain products, the majority of which contain wheat and gluten. Wholegrain means the entire grain, e.g. grains of wheat, rye, barley, brown rice and maize kernels.

Wholegrain flour means that all the substances present in the intact grain of cereal are also present in the flour (fig 9). When, way back when, grains were "ground" by hand and millstone, the ultimate result was wholegrain flour. Everything that was in the grain was also in the flour. With modern milling technology however, this has totally changed. Nowadays, you can separate the various components of the grain during the milling process. This has advantages in that the unsaturated fats in the germ are subject to oxidation (turn rancid), so wholegrain flour has a relatively short shelf life. Refined flour, i.e. flour without the germ and bran (white flour), therefore has a far longer shelf life. By adding fresh germ and bran to the refined white flour at a later stage, a wholegrain composition can still be achieved. Another benefit of these separate milling flows

is that a far greater range of products can be produced. One disadvantage is that many tasty products made from white flour, such as white bread and cookies, no longer contain many of the nutrients that are present in high concentrations in the germ and bran. Consequently, white flour comprises mainly of starch and protein. So, from a health perspective, it is better to choose products made from refined white flour less often, and to opt instead for wholegrain products.

The wheat kernel

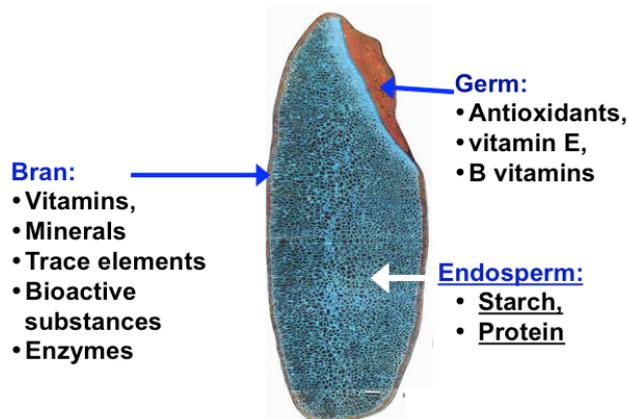


fig 9

Two recent expert meetings on grains, whole grains and carbohydrates (the International Carbohydrate Quality Consortium in Rome and the International Whole Grain Summit in Vienna, at the end of 2017) gave rise to two important press releases. These press releases made the following statements:

- The consumption of wholegrain products is associated with a significant reduction in the risk of overweight and obesity, type II diabetes, heart and vascular diseases and possibly colon cancer.
- What's more, it appears that these effects are even stronger than the long known beneficial effects of fruit and vegetables.
- For this reason, experts now recommend that the most effective change to our everyday diet is to consume wholegrain foods in combination with plenty of fresh fruit and vegetables.

Summary

- Grains are the world's number ONE food source.
- Ancient wheat varieties are not demonstrably healthier than bread wheat, nor are they more sustainable.
- Bread wheat has not been genetically modified, it is the result of a natural cross-fertilisation in the wild.
- Some people develop health problems as a result of eating wheat and other gluten-containing grains. The role of ATIs, which are always present together with gluten protein, requires further research.
- It is estimated that a couple of per cent of the population suffer from wheat-sensitive irritable bowel syndrome. It is not yet known which substance or substances cause this primarily and as yet there is no effective test and diagnosis.

- As a result of fermentation, indigestible, rapidly fermentable carbohydrate fibres (FODMaPs) may give rise to the formation of gas, which is particularly difficult for people who suffer from irritable bowel syndrome.
- People who have been diagnosed as wheat and/or gluten intolerant must avoid wheat and gluten completely. They must choose gluten-free, fibre-rich alternatives such as brown rice, wild rice, oats, buckwheat, quinoa, teff, amaranth, millet, sorghum and maize.
- **Well on Wheat?** conducts research into the correlation between wheat types, growing methods and dough making techniques and the composition of proteins and FODMaPs, and the potential correlation with the occurrence of health problems.
- The impact on health of consuming whole grains appears to be relatively stronger than the impact of consuming fruit and vegetables. Thus, eating fruit, vegetables and wholegrain products on a daily basis will do the majority of the population good!
- The majority of the population can eat wheat and gluten without any problems. Bread will therefore remain on the menu, in the future too.
- Persons with intolerance to grains need special attention.

Disclaimer: some images have been obtained through GOOGLE/www. and used solely for educational purposes.

Acknowledgement: I greatly thank the following persons and researchers participating in the project “well on Wheat?” for their inputs.

Dr Luud Gilissen, NL, Dr Twan America NL, Dr Peter Shewry UK, Dr Daisy Jonkers, NL, Drs Gonny van Rooij, NL, Mrs Zsuzsan Proos, NL, Dr Friedrich Longin, DL and Ellen Brouns for editorial assistance

<http://www.wellonwheat.org>