Wheat Improvement: The Truth Unveiled

By The National Wheat Improvement Committee (NWIC)

From wheat farmers to wheat scientists, we know consumers are yearning for more transparency and trust within their food "system." We understand those concerns as consumers ourselves. In an effort to give consumers full scientific knowledge of how wheat has been improved over the years, we have worked together to publish a concise response to recent claims made by Dr. William Davis. The National Wheat Improvement Committee has compiled the following responses to Davis' slander attack on wheat's breeding and science improvements. Responses were developed with a scientific and historical perspective, utilizing references from peer-reviewed research and input from U.S. and international wheat scientists.

Wheat Breeding & Science

The wheat grown around the world today came from three grassy weed species that naturally hybridized around 10,000 years ago. The past 70 years of wheat breeding have essentially capitalized on the variation provided by wheat's hybridization thousands of years ago and the natural mutations which occurred over the millennia as the wheat plant spread around the globe. There is no crop plant in the modern, developed world – from grass and garden flowers, to wheat and rice – that is the same as it first existed when the Earth was formed, nor is the environment the same.

There is no mystery to wheat breeding. To breed new varieties, breeders employ two basic methods:

Conventional crossing involves combining genes from complementary wheat plant parents to produce new genetic combinations (<u>not</u> new genes) in the offspring. This may account for slightly higher yield potential or disease and insect resistance relative to the parents.

The second method is to introduce genes indigenous to ancestral or related species of modern-day wheat and gradually incorporate these genes into a new wheat variety with minimal contribution of DNA (typically <5 percent) from the ancestral species. This method still employs crossing, not genetic engineering.

It is very important to realize that either method capitalizes on variation already found in wheat's lineage.

In the 1960's, developmental efforts, experimental lines and varieties were shared with researchers around the world. In subsequent years, wheat production in Mexico, India and Pakistan increased tremendously and millions of people who otherwise would have likely died of starvation or malnutrition were able to live and have food. Thus remains the primary goal of today's wheat breeders - **to make this ancient plant meet the demands of a rapidly growing human population**. All farmers, including wheat farmers, also rely on plant breeders to develop varieties of seeds that are able to combat constantly evolving pests and diseases and shifting climatic conditions.

In the U.S., scientists working at universities, private companies and the U.S. Department of Agriculture are all committed to research that will help us understand the full breadth of the wheat genome, much like we now have a map of the human genome. This forward motion is desperately needed to find beneficial traits critical to keeping wheat available and affordable. Wheat is not alone, research and breeding are absolutely essential in all food crops because agricultural production must increase by about 66 percent by 2040 to match population growth. Developing healthy plants is necessary to meet the nutritional needs of a growing society.

Wheat breeding utilizes genetic resources previously or currently consumed by the public. New wheat varieties must meet stringent quality standards because wheat is used in such a wide range of products, from breakfast foods like whole grain cereals, to everyday staples such as bread, pizza and noodles, to treats like beer, cake and cookies.

The subsequent Myths & Facts portion will show the inaccuracies of Dr. Davis' claims.

MYTH: All wheat is the same.

- **FACT:** Wheat can be grown in diverse production environments for many uses because of its natural genetic diversity. Wheat can be taller or shorter depending on its growing conditions. From an agronomic perspective, taller wheat varieties have been bred in areas with minimal rainfall or low soil fertility and where harvested straw is important. In contrast, shorter wheat varieties have been bred for higher-fertility, higher-moisture or irrigated conditions[1].
- **FACT:** Some wheat varieties are higher in protein, while others are lower in protein. The broad range of protein functionality is what makes wheat flour unique. In the United States, there are six primary wheat classes. In certain classes of wheat, such as those used in cakes and Asian noodles, weak gluten and low protein content are desired. Other wheat classes have strong gluten that is essential for making certain breads and pasta. Protein content in wheat varies by wheat class, individual variety, fertility levels of the soil and from year-to-year based on the weather[2]. In the U.S., variation in protein content is minimal within each class in a given year[3].

MYTH: The increase in celiac disease is due to wheat breeding.

- **FACT:** It is true that celiac disease has increased in the past 50 years, as have other autoimmune diseases and the prevalence of allergies. The relationship between celiac disease and wheat was not clearly established until the late 1940s[4]. There continues to be research aimed at determining why the incidence of celiac disease is increasing. The 2004 National Institutes of Health's (NIH)Consensus Development Conference on Celiac Disease theorized that one cause could be the increasing use of serologic screening, leading to diagnosis in milder cases. Other theories suggest that increases in celiac disease, as well as food allergies and sensitivities, are tied to the human environment[5,6,7]. Gluten-free diets are only appropriate for individuals in a small subset of the population that suffers from celiac disease or has diagnosed gluten sensitivity.

MYTH: There is a new protein in wheat called gliadin.

- **FACT:** Gliadins are not new. Gliadin is the name of a protein stored in the seed found in not only wheat, but other cereals like rye and barley. They have always been a component of wheat protein and were even present in ancient wheat and the wild species that gave rise to modern wheat. Wheat seed storage proteins are made up of about 100 different protein components[4]. Gliadin was actually purified from wheat and described in a journal more than 100 years ago[8].
- **FACT:** Much variation naturally exists in wheat gluten proteins. Protein content also varies due to the environment, including fertility of the soil and weather patterns. Generally, modern wheat possesses less gluten protein but improved gluten function than historical wheat. A lower gliadin to glutenin ratio is a wheat protein characteristic that some wheat breeders may seek to improve the finished product performance[9].

MYTH: "Everybody…is susceptible to the gliadin protein that is an opiate. This thing binds into the opiate receptors in your brain and in most people stimulates appetite, such that we consume 440 more calories per day, 365 days per year."

- **FACT:** Gliadin is present in modern wheat as well as ancient wheat including emmer and einkorn. In contrast, an opiate is an alkaloid found in the sap of the opium poppy plant. Gliadin is not an opiate. **There is no clinical evidence that gliadin stimulates appetite**.
- **FACT:** In *Wheat Belly*, Davis references an NIH study to bolster this claim, but omits that the study was a lab analysis of peptides and did not include actual feeding studies of any foods. Other foods in the study that have these peptides include milk and spinach[10].
- **FACT:** If someone ate 440 more calories per day, as Davis claimed, he or she would gain about 46 pounds per year.

MYTH: Wheat has been genetically modified.

- **FACT:** Today's wheat is the product of the painstaking process of crossing parents and selecting offspring, a process called conventional breeding.
- **FACT:** Wheat breeding has always involved crossing two or more parents followed by selection for improved and recombined traits that improve yield, increase resistance to diseases or improve baking characteristics. The wheat varieties that have been developed through breeding have taken advantage of the natural variation that exists in wheat and wheat ancestors and relatives. There are no commercially-available wheat varieties in the world today that were genetically engineered with genes from unrelated species.

MYTH: Wheat causes obesity.

- **FACT:** The composition of modern wheat is not the main cause of the overweight-obesity problem in humans. A combination of factors (genetics, diet, life style, environment) are all, in combination, what triggers weight gain.
- **FACT:** Wheat is one component in the diverse diet of U.S. consumers. Per capita wheat consumption in the U.S. has declined in recent years, while obesity rates have increased[11]. Wheat is consumed in 118 countries and the European Union, as measured by USDA. In many other countries with lower levels of obesity, wheat plays a larger role in the diet than in the U.S. For example, the Japanese population has a relatively high daily consumption of wheat (131 g/per capita), yet not a very high prevalence of overweight-obesity (3.2 percent)[12]. According to the World Health Organization 2010 data, there is no correlation between a country's per capita wheat production and its obesity rate.

MYTH: Wheat is bad for you.

- **FACT:** Wheat has been a staple of the human diet for thousands of years. Wheat grain is an important source of starch and protein, both of which provide energy for the human body. Wheat also provides dietary fiber, resistant starch and antioxidants and other phytochemicals. All of these factors contribute positively to health by preventing cardiovascular disease, diabetes and colon cancer. Wheat flour is a vehicle for micronutrients (inherent or added vitamins and minerals) that prevent nutritional and health problems, particularly in infants and women[13,18].

MYTH: Modern wheat has not been tested for health effects.

- **FACT:** Wheat is one of the main reasons humans evolved from living as nomads to form communities and eventually cities. Wheat foods have been a healthy part of the human diet for **thousands** of years. Currently, wheat provides 21 percent of all food calories in the world. For

4.5 billion people in 94 developing countries wheat provides 20 percent of their protein intake[2,9,14].

- **FACT:** Testing of ALL conventionally bred crops is not required because the components and composition of the plant are unchanged in this process. However, food companies have a multitude of processes in place to ensure the safety and wholesomeness of their products.

MYTH: In Davis' book he references a study claiming "Wheat gluten proteins, in particular, undergo considerable structural change with hybridization. In one hybridization experiment, *fourteen* new gluten proteins were identified in the offspring that were not present in either parent wheat plant"[15].

- **FACT:** None of the wheat cultivars grown in the U.S. were developed via the somatic cell fusion hybridization process referenced in *Wheat Belly*.
  Additional information: The variation in high-molecular-weight glutenin-subunit (HMW-GS) sequences reported in this article was induced by somatic cell fusion hybridization, which was performed by isolation of protoplasts of somatic cells, treatment of protoplasts with UV light, fusion of protoplasts, induction of callus and regeneration of plants from the callus tissue[16]. Both cell culture and UV radiation are procedures used experimentally in a laboratory and can cause genome variation. However, somatic cell hybridization is not a conventional hybridization approach used by wheat breeders[17].
- **FACT:** Conventional breeding produces gluten proteins in the progeny that are present in one of the parents. "Plants can only express proteins they have the DNA code to produce. Environmental conditions can cause or inhibit the expression of certain proteins, but they cannot code for proteins that aren't in the genome."[10]
- **FACT:** Many variations naturally exist in wheat gluten proteins. The different combinations of the these proteins can have many different effects on how the proteins are expressed. This is another example of the great genetic diversity that has existed in wheat over the millennia.

MYTH: Wheat is the grain most tied to agribusiness.

- **FACT:** Because wheat is so important to the global diet, it is grown throughout the world and is traded like many other crop commodities. The wheat supply chain involves businesses as well as federal and state public entities.
- **FACT: Not-for-profit public universities and the USDA have worked together to develop varieties planted on more than 70 percent of U.S. acres.** The 55 million planted wheat acres in the U.S. use hundreds of different varieties. Agribusiness investment in wheat breeding in the U.S. is a very small fraction of that devoted to corn and soybean breeding, and most of the private company investment in wheat breeding has emerged in just the past three years.

Overall, wheat is an essential, safe, healthy and wholesome source of energy and essential nutrients. Globally, 21 percent of the world's calories come from foods made with wheat. Wheat provides an estimated 4.5 billion people in 94 developing countries 20 percent of their protein intake. In the future, wheat consumption is expected to rise worldwide due to global income growth and urbanization.

The science behind wheat breeding is not a mystery. For decades wheat breeders have been working to improve the integrity and sustainability of the crop. This science has saved millions of lives throughout the world. We encourage consumers to continue learning more about the food they eat and the peer-reviewed science behind the stories and books written. We encourage a constructive dialogue that is based on truth rather than fiction.

About The National Wheat Improvement Committee (NWIC)

The National Wheat Improvement Committee is comprised of 24 members representing regional public and private sector researchers, growers and the food processing industry. The goals of the NWIC are to identify and advocate for research priorities of national significance to the wheat community and to provide science-based education on issues which connect wheat improvement with wheat utilization and consumption. Brett Carver, PhD, Regents Professor, Wheat Genetics Chair in Agriculture, Wheat Breeding and Genetics, Oklahoma State University Department of Plant and Soil Sciences serves as the current chair of the NWIC. To learn more about the NWIC, visit http://www.wheatworld.org/research

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