Nutritional Contents and Medicinal Properties of Wheat: A Review

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Abstract

Wheat is considered good source of protein, minerals, B-group vitamins and dietary fiber i.e. an excellent health-building food. Thus, it has become the principal cereal, being more widely used for the making of bread than any other cereal because of the quality and quantity of its characteristic protein called gluten. Gluten makes bread dough stick together and gives it the ability to retain gas. Wheat has several medicinal virtues; starch and gluten in wheat provide heat and energy; the inner bran coats, phosphates and other mineral salts; the outer bran, the much-needed roughage the indigestible portion that helps easy movement of bowels; the germ, vitamins B and E; and protein of wheat helps build and repair muscular tissue. The wheat germ, which is removed in the process of refining, is also rich in essential vitamin E, the lack of which can lead to heart disease. The loss of vitamins and minerals in the refined wheat flour has led to widespread prevalence of constipation and other digestive disturbances and nutritional disorders. The whole wheat, which includes bran and wheat germ, therefore, provides protection against diseases such as constipation, ischaemic, heart disease, disease of the colon called diverticulum, appendicitis, obesity and diabetes. To enhance the quality as well as the quantity of proteins/starches, and the content of vitamins, essential amino acids, minerals and other healthy components of wheat, it is essential to understand the molecular and genetic control of various aspects of plant growth and development.

Keywords: Dietary fiber; Digestive disturbances; Gluten; *Triticum aestivum* L.; Wheat bran; Wheat germ.

1. Introduction

Wheat is the most important stable food crop for more than one third of the world population and contributes more calories and proteins to the world diet than any other cereal crops [2, 3, 42]. It is nutritious, easy to store and transport and can be processed into various types of food. Wheat is considered a good source of protein, minerals, B-group vitamins and dietary fiber [45, 46] although the environmental conditions can affect nutritional composition of wheat grains with its essential coating of bran, vitamins and minerals; it is an excellent health-building food. Wheat flour is used to prepare bread, produce biscuits, confectionary products, noodles and vital wheat gluten or seitan. Wheat is also used as animal feed, for ethanol production, brewing of wheat beer, wheat based raw material for cosmetics, wheat protein in meat substitutes and to make wheat straw composites. Wheat germ and wheat bran can be a good source of dietary fiber helping in the prevention and treatment of some digestive disorders [46]. The antioxidant activity and phytochemical content were studied in milled grain of eleven varieties which included a range of red and white wheat and durum wheat. Whole-wheat bread is good for health. There is no doubt that the adaptability and high yields of wheat have contributed to its success, but these alone are not sufficient to account for its current dominance over much of the temperate world. The key characteristic, which has given it an advantage over other temperate crops, is the unique properties of dough formed from wheat flours, which allow it to be processed into a range of breads and other baked products (including cakes and biscuits), pasta and noodles, and other processed foods. These properties depend on the structures and interactions of the grain storage proteins, which together form the 'gluten' protein fraction. Lutein is the predominant carotenoids present in wheat [1] and the bran/germ fractions of wheat contained greater amounts of carotenoids and antioxidant activity than the endosperm fractions [4]. Lutein, along with zeaxanthin, is important for the health of skin and eyes in humans.

The latest edition of the USDA's Dietary Guidelines for Americans clearly states that all adults should eat at least three servings of whole grains every day. It helps in preventing both heart diseases and cancer, therefore, lower death rates. The protection against heart disease may stem from whole grains, antioxidants, vitamins and phytochemicals, fiber or trace minerals. Apparently, by improving insulin sensitivity and decreasing the disordered insulin function people experience with metabolic syndrome, whole grains help prevent diabetes. The same substances in whole grains that protect against heart disease also seem to help prevent several kinds of cancer. Fiber and certain starches in whole grains ferment in the colon and form substances that may block the cancer-promoting effects of bile acids. Moreover, scientists believe that other substances in whole grains may affect hormone levels and possibly lower the risk of hormone-related cancers like breast cancer. The many

faces of wheat-wheat berries, wheat bran, grouts, cracked wheat, offer a good source of fiber and reduce risk of colon cancer. Wheat also lowers the level of estrogen in the blood which reduces the risk of breast and prostate cancers. John *et al.* (2006) investigated that wheat antioxidants suppress intestinal tumor activity in Min mice. Whole grains contain antioxidants associated with reduced risk of several forms of cancer. Thus, in this review, we cover the nutritional analysis and medicinal properties of wheat.

2. Nutritional Contents

Globally, there is no doubt that the number of people who rely on wheat for a substantial part of their diet amounts to several billions. Therefore, the nutritional importance of wheat proteins should not be underestimated, particularly in less developed countries where bread, noodles and other products (e.g. bulgar, couscous) may provide a substantial proportion of the diet. Wheat provides nearly 55% of carbohydrate and 20% of the food calories. It contains carbohydrate 78.10%, protein 14.70%, fat 2.10%, minerals 2.10% and considerable proportions of vitamins (thiamine and vitamin-B) and minerals (zinc, iron). Wheat is also a good source of traces minerals like selenium and magnesium, nutrients essential to good health [3, 21, 44, 48]. Wheat grain precisely known as caryopsis consists of the pericarp or fruit and the true seed. In the endosperm of the seed, about 72% of the protein is stored, which forms 8-15% of total protein per grain weight. Wheat grains are also rich in pantothenic acid, riboflavin and some minerals, sugars etc. The barn, which consists of pericarp testa and aleurone, is also a dietary source for fiber, potassium, phosphorus, magnesium, calcium, and niacin in small quantities.

The kernel of wheat is a storehouse of nutrients essential to the human diet. Endosperm is about 83% of the kernel weight; it is the source of white flour. The endosperm contains the greatest share of the protein in the whole kernel, carbohydrates, iron as well as many B-complex vitamins, such as riboflavin, niacin, and thiamine. Bran is about 14.5% of the kernel weight [9, 18, 43, 49]. Bran is included in whole-wheat flour and is available separately. Of the nutrients in whole wheat, the bran contains a small amount of protein, larger quantities of the B-complex vitamins listed above, trace minerals, and indigestible cellulose material called dietary flour. Wheat germ is the embryo of the wheat kernel. The germ or embryo of the wheat is relatively rich in protein, fat and several of the B-vitamins [3]. The outer layers of the endosperm and the aleurone contain a higher concentration of protein, vitamins and phytic acid than the inner endosperm. The inner endosperm contains most of the starch and protein in the grain. It is separated from wheat being milled for flour. The nutrient composition of different wheat products is shown in table 1.

Table 1: Composition of wheat products per 100g edible portion[@].

Wheat Product	Protein[1]	Fat[1]	Carbo-hydrate[1]	Starch[1]	Total Sugar	Vitamin E[2]	Thiamin[2]	Riboflavin[2]	Niacin[2]	Folate[3]
Wheat germ	26.7	9.2	44.7*	28.7*	16.0*1	22.0	2.01	0.72	45	?
Wheat bran	14.1	5.5	26.8	2.0	3.8	2.6	0.89	0.36	29.6	260
Wheat flour	12.6	2.0	68.5	66.8	1.7	0.6	0.30	0.07	1.7	51
Whole meal flour	12.7	2.2	63.9	61.8	2.1	1.4	^	0.09	^	57
White flour (plain)	9.4	1.3	77.7	76.2	1.5	0.3	0.10	0.03	0.7	22
White flour (self-raising)	8.9	1.2	75.6	74.3	1.3	0.3*	0.10	0.03	0.7	19
White flour (bread-making)	11.5	1.4	75.3	73.9	1.4	0.3*	0.10	0.03	0.7	31

[@]Data taken from Food Standard Agency (2002); [1]units in g; [2]units are mg; [3]units are µg; *values are estimates; ^unfortified values not given; [?]no data given for amount of nutrient present.

Wheat germ is sodium and cholesterol free, and dense in nutrients. It is rich in vitamin E, magnesium, pantothenic acid, phosphorus, thiamin, niacin and zinc. It is also a source of coenzyme Q10 (ubiquinone) and PABA (para-aminobenzoic acid) [42, 45]. Wheat germ is also high in fiber, and contains approximately 1 gram of fiber per tablespoon. A diet high in fiber can be useful in regulating bowel function (i.e. reducing constipation), and may be recommended for patients at risk for colon disease, heart disease, and diabetes.

3.0 Types of Wheat Flours and its uses

3.1 All-Purpose Flour

All-purpose flour is the finely ground endosperm of the wheat kernel separated from the bran and germ during the milling process. All-purpose flour is made from hard wheat or a combination of soft and hard wheat from which the home baker can make a complete range of satisfactory baked products such as yeast breads, cakes, cookies, pastries and noodles. Enriched All-Purpose Flour has iron and B-vitamins added in amounts equal to or exceeding that of whole-wheat flour. Bleached Enriched All-Purpose Flour is treated with chlorine to mature the flour, condition the gluten and improve the baking quality. The chlorine evaporates and does not destroy the nutrients but does reduce the risk of spoilage or contamination. Unbleached Enriched All-Purpose Flour is bleached by oxygen in the air during an aging process and is off-white in color. Nutritionally, bleached and unbleached flour are the same.

3.2 Bread Flour

Bread flour, from the endosperm of the wheat kernel, is milled primarily for commercial bakers but is also available at retail outlets. Although similar to all-purpose flour, it has greater gluten strength and generally is used for yeast breads.

3.3 Self-Raising Flour

Self-rising flour is all-purpose flour with salt and leavening added. One cup of self-rising flour contains $1^{1/2}$ teaspoons baking powder and 1/2 teaspoon salt. Self-rising flour can be substituted for all-purpose flour in a recipe by reducing salt and baking powder according to those proportions.

3.4 Whole Wheat Flour

Whole-wheat flour is a course-textured flour ground from the entire wheat kernel and thus contains the bran, germ and endosperm. The presence of bran reduces gluten development. Baked products made from whole-wheat flour tend to be heavier and denser than those made from white flour are.

3.5 Other Flours

Cake Flour - Milled from soft wheat. Especially suitable for cakes, cookies, crackers and pastries. Low in protein and gluten.

Pastry Flour - Milled from soft, low gluten wheat. Comparable in protein but lower in starch than cake flour.

Gluten Flour - Used by bakers in combination with flours having a low protein content because it improves the baking quality and produces gluten bread of high protein content.

Semolina - Coarsely ground endosperm of durum wheat. High in protein. Used in high quality pasta products.

Durum Flour - By-product of semolina production. Used to make commercial U.S. noodles.

Farina - Coarsely ground endosperm of hard wheat. Prime ingredient in many U.S. breakfast cereals. Also used in the production of inexpensive pasta which has very low saturated fat; No cholesterol; Very low in sodium; Very low in sugar; High in dietary fiber; Very high in manganese and high in phosphorus.

4. Medicinal Properties

The wheat, as produced by nature, contains several medicinal virtues. Every part of the whole-wheat grain supplies elements needed by the human body. Starch and gluten in wheat provide heat and energy; the inner bran coats, phosphates and other

mineral salts; the outer bran, the much-needed roughage the indigestible portion which helps easy movement of bowels; the germ, vitamins B and E; and protein of wheat helps build and repair muscular tissue. The wheat germ, which is removed in the process of refining, is also rich in essential vitamin E, the lack of which can lead to heart disease. The loss of vitamins and minerals in the refined wheat flour has led to widespread prevalence of constipation and other digestive disturbances and nutritional disorders. The whole wheat, which includes bran and wheat germ, therefore, provides protection against diseases such as constipation, ischaemic, heart disease, disease of the colon called diverticulum, appendicitis, obesity and diabetes [28]. There are many reports of the association of wheat, and particularly wheat proteins, with medical conditions, ranging from improbable reports in the popular press to scientific studies in the medical literature [16]. Not surprisingly, they include autoimmune diseases such as rheumatoid arthritis which may be more prevalent in coeliac patients and relatives [36]. It is perhaps easier to envisage mechanisms for relationships between such diseases which have a common immunological basis [30] than to explain a well-established association between wheat, coeliac disease, and schizophrenia [33] other reported associations include ones with sporadic idiopathic ataxia (gluten ataxia) [27], migraines [25], acute psychoses, and a range of neurological illnesses [26].

Soluble fibre is considered to have health benefits that are not shared by insoluble fibre and these may therefore be reduced by the phenolic acid cross-linking. However, insoluble fibre may also have benefits in delivering phenolic antioxidants into the colon: these benefits may include reduction in colo-rectal cancer [5, 9, 54]. An association with autism has also been reported with some physicians recommending gluten free; casein-free diet [20]. Some of these effects may be mediated via the immune system but effects that are not immune-mediated are notoriously difficult to define and diagnose. However, they could result from the release within the body of bioactive peptides, derived particularly from gluten protein. Thus, gluten has been reported to be a source of a range of such peptides including opioid peptides (exorphins) [54] and an inhibitor of angiotensin I-converting enzyme [35]. However, these activities were demonstrated in vitro and their in vivo significance has not been established. Natural medicines are often tried for many conditions based on tradition, anecdotes, or marketing, but not all of these uses are supported by reliable or credible scientific research. Below, we discuss the different parts of wheat which have the medicinal properties.

4.1 Wheat Bran

Wheat bran is used as a supplemental source of dietary fiber for preventing colon diseases (including cancer), preventing gastric cancer, treating Irritable Bowel Syndrome (IBS), reducing the risk of hemorrhoids and hiatal hernia, hypercholesterolemia, hypertension, reducing the risk of breast cancer and gallbladder disease, and type 2 diabetes [26, 28, 39, 22]. Wheat bran helps constipation by speeding up the colon and increasing stool output and bowel frequency. Wheat is an excellent source of iron and phosphorous. The outer layer of the barn provides fiber that gives bulk and regulates the absorption and excretion of nutrients from the body.

4.2 Wheat Germ

The germ contains riboflavin, thiamine, vitamin E and trace minerals such as zinc, copper, iron and magnesium. Wheat is the best nourishing food that can be easily given to patients and even babies. Wheat has antibilious, antihydrotic, antipyretic, antivinous, sedative, skin and stomachic properties. Wheat germ oil is a highly rich unrefined oil, richest sources of vitamin E, A and D. It also has a high content of proteins and Lecithin. This oil is widely used for external application, as it helps a great deal in getting rid of skin irritation including skin dryness and cracking. Wheat germ oil is increasingly finding its way in the making of skin care products. The oil extracted from wheat germ has a shelf life of near about 6-8 months. It is a good source of fatty acids that are very vital for the healthy growth of the body. The germ forms only 3% of the weight of a wheat grain; nonetheless, contains about 25% of the protein, vitamins and minerals. Wheat germ oil is known for its antioxidant properties and this explains the reason why it is added to other carrier oils. When applied on the skin, it improves the circulation of blood and helps to repair the skin cells destroyed by the scorching heat of sun. It keeps away the symptoms of dermatitis, thereby preventing the skin from being victimized by various kinds of problems. Thick in consistency, its independent use for massaging the body is not usually preferred. Since it has exceptional nourishing qualities, it is used in lesser quantities for preparing the carrier oil blend.

4.3 Wheat Stem, Fruit and Seed

The young stems are used in the treatment of biliousness and intoxication. The ash is used to remove skin blemishes. The fruit is antipyretic and sedative. The light grain is antihydrotic. It is used in the treatment of night sweats and spontaneous sweating. The seed is said to contain sex hormones and has been used in China to promote female fertility. The seed sprouts are antibilious, antivinous and constructive. They are used in the treatment of malaise, sore throat, thirst, abdominal coldness and spasmic pain, constipation and cough. The plant has anticancer properties also [18].

5.0 Ways to Treat Some Common Aliments

5.1 Internal Rejuvenation

Wheat protein, which comprises up to eight per cent of the grain, has a special benefit as it has eight of the essential amino acids in delicately balanced proportions. A complete internal rejuvenation takes place when Wheat protein is metabolized into health-building amino acids. These amino acids build a resilient muscle that comes back to its original form after stretching and bending, healthy skin and hair and clearer eyesight and nourish the heart and lungs, tendons and ligaments, brain, nervous system and glandular network.

The B-complex vitamins, especially thiamin, riboflavin and niacin offered by natural brown Wheat promote youthful energy and nourishment to skin and blood vessels. An abundance of minerals in natural brown Wheat help to nourish the hormonal system, heal wounds and regulate blood pressure. Wheat also offers iron to enrich the bloodstream and phosphorus and potassium to maintain internal water balance along with other nutrients. Wheat thus helps restore internal harmony [3, 5].

5.2 Tooth Disorders

Wheat is valuable in the prevention and cure of pyorrhea. It takes time to eat wheat and as it is generally taken with other foods, it compels the chewing of other foods also. This not only provides the needed exercise for the teeth and gum but also a great aid to digestion. Wheat grass juice acts as an excellent mouth wash for sore throats and pyorrhea. It also prevents tooth decay and tooth aches. Therefore, it is beneficial to chew wheat grass which draws out toxins from the gums and thus checks bacterial growth.

5.3 Constipation

The bran of wheat, which is generally discarded in milling of the flour, is more wholesome and nourishing than the flour itself. It is an excellent laxative. The laxative effects of bran are much superior to those of fruits or green vegetables as cellulose of the latter is more easily broken down by bacteria while passing through the intestine. The bran is highly beneficial in the prevention and treatment of constipation due to its concentration of cellulose which forms a bulk-mass in the intestines and helps easy evacuation due to increased peristalsis.

5.4 Skin Diseases

It has been scientifically proved that chlorophyll arrests growth and development of harmful bacteria. Wheat grass therapy can be effectively used for skin diseases and ulcerated wounds as by retarding bacterial action, it promotes cell activity and normal re growth. By drinking wheat grass juice regularly, an unfavorable environment is created for bacterial growth. Poultice of wheat grass juice can be applied on the infected area, as it is an able sterilizer. Externally, wheat flour is useful as a dusting powder over inflamed surface as in burns, scalds and various itching and burning eruptions, Whole wheat flour, mixed with vinegar, boiled and applied outwardly removes freckles.

5.5 Digestive System Disorders

Wheat grass juice used as an enema helps detoxify the walls of the colon. The general procedure is to give an enema with lukewarm or Neem water. After waiting for 20 minutes, 90 to 120 ml of wheat grass juice enema is given. This should be retained for 15 minutes. This enema is very helpful in disorders of the colon, mucous and ulcerative colitis, chronic constipation and bleeding piles [31].

5.6 Circulatory Disorders

The chlorophyll content present in wheat enhances heart and lung functions. Capillary activity also increases while toxemia or blood poisoning is reduced. Due to increased Iron content in the blood and hemoglobin, lungs function better. Oxygenation improves and the effect of carbon dioxide is minimized. It is for this reason that wheat grass juice is prescribed for circulatory disorders [32].

5.7 Wheat for Treating Boils

Boils having pus can be easily treated at home without the help of a surgeon's knife. Pound a little Alse (available at shops) to a fine powder. Take a tablespoon of wheat flour and fry it in a little oil to a golden color. Add ground Alse along with tablespoon of water. Keep on stirring until the mixture turns thick. Remove from fire and place it on a clean strip of cloth. When the mixture turns bearably hot, spread it over the cloth and bandage the boil. Within a day or two, the boil will burst giving instant relief. Clean the boil with warm water to which a little boric has been added and then apply sulphur ointment and bandage. Clean the wound and apply the ointment daily until the wound heals.

5.8 Wheat for Treating Scars

To remove scars roast wheat on fire until it turns black. Grind to paste. Put in a thin cloth and squeeze out the oil. Apply on the scars regularly for relief. Even itching disappears with this oil.

5.9 Wheat for Curing Chest Pain

Mix together wheat, barn and coarse salt in equal quantities, heat the mixture, put on a clean cloth and foment the chest for relief.

5.10 Wheat for Tonsil Pain

Prepare a halwa with wheat flour and water, put in a cloth and foment the tonsils with it to get relief from pain.

5.11 Wheat for Treating Acne or Pimples

Make a fine paste of whole wheat. Apply this paste on pimples. Keep for 1 hour. Then wash off. Do this regularly.

In 1998, scientists at Wayne State University in Detroit conducted a meta-analysis of data from more than 30 well-designed animal studies measuring the anti-cancer effects of wheat bran, the part of grain with highest amount of the insoluble dietary fibers cellulose and lignin. They found a 32 percent reduction in the risk of colon cancer among animals fed wheat bran; now they plan to conduct a similar meta-analysis of human studies. Whole-wheat flours are a good source of wheat bran. Wheat bran (WB) appears to inhibit colon tumorigenesis more consistently than do oat bran or corn bran. Reddy *et al.* (2000) suggested an inverse relationship between the intake of dietary fiber, particularly fiber from cereal grains, and colon cancer risk**.**

6. Other Uses

The straw has many uses, as a biomass for fuel, for thatching, as mulch in the garden, etc. A fiber obtained from the stems is used for making paper. The stems are harvested in late summer after the seed has been harvested; they are cut into usable pieces and soaked in clear water for 24 hours. They are then cooked for 2 hours in lye or soda ash and then beaten in a ball mill for 1½ hours in a ball mill. The fibres make a green-tan paper. The starch from the seed is used for laundering, sizing textiles, etc. Chappatis are the common form in which wheat is eaten in India, Pakistan and Iran. They are made from whole-wheat flour, called dalia. Wheat taken in the shredded form called dalia is extremely wholesome. It has been a very favorite Indian dish in olden days. It is cooked by soaking two tablespoonful of crushed or shredded wheat for half an hour and then cooking it on slow fire until the water nearly dries up. Thereafter, milk and honey may be added to taste. It is a nourishing morning breakfast food item. Early in 1999, however, new data from the long-running Nurses' Health Study at Brigham Women's Hospital/Harvard University School of Public Health showed that women who ate a high-fiber diet had a risk of colon cancer similar to that of women who ate a low-fiber diet. Because this study contradicts literally hundreds of others conducted over the past 40 years, researchers are awaiting confirming evidence before changing dietary recommendations.

7. Future Prospects

The identification and cloning of HMW-GS genes, along with success in the genetic transformation of wheat, have provided new opportunities to improve the bread-making qualities of wheat by the introduction of HMW-GS genes that are known to be associated with better bread-making qualities into otherwise superior cultivars. A number of HMW-GS as well as low-molecular-weight glutenin subunit (LMW-GS) genes have been introduced into bread and pasta (*Triticum turgidum*) wheat by genetic transformation [6, 7, 10, 8, 11, 13, 14, 29, 38, 41]. It should be possible, therefore, to introduce such genes into a cultivar which

is agronomically desirable but which has poor bread-making qualities. This would avoid or minimize the necessity of blending flour from different cultivars in milling operations.

A quantitative trait locus (Gpc-B1) have been characterized and cloned [49] from wild emmer wheat that is associated with increased levels of grain protein, zinc and iron as a result of accelerated senescence and increased nutrient mobilization from leaves to the developing grains. Modern cultivated wheat varieties have a non-functional NAM-B1 allele while in ancestral wild wheat the allele encodes a NAC transcription factor (NAM-B1). Delayed maturation and reduced grain protein, iron and zinc content by more than 30% is achieved by RNAi to NAM transcript in transgenic plants. ''The cloning of Gpc-B1 provides a direct link between the regulation of senescence and nutrient remobilization and an entry point to characterize the genes regulating these two processes. This may contribute to their more efficient manipulation in crops and translate into food with enhanced nutritional value'' [49]. Phosphate, which is stored in the form of phytic acid in plant seeds (including wheat), is indigestible in monogastric animals including humans due to the fact that they lack phytases which degrade phytic acid in the digestive tract. Transgenic wheat plants expressing the *Aspergillus niger* phytase encoding gene phyA accumulate phytase in their seed [14]. Further improvement in the expression and thermostability of phytases in transgenic wheat plants has the potential to increase the bioavailability of Zn^{2+} Ca^{2+} and Fe^{2+} by breaking down their otherwise indigestible complexes with phytic acid.

For a long time, there has been much interest in developing high-amylose wheat as a source of resistant starch (RS), which is one of the major sources of dietary fiber and its many related benefits (e.g., prevention of coronary heart disease, cancers of the colon and rectum, diabetes) to humans. Suppression of starch branching enzyme II (SBEIIa and SBEIIb) expression by RNA interference was used to produce high-amylose wheat which was shown to be healthful for rats [40]. Extension of these studies to humans is awaited. The (1,3;1,4)-b-D-glucans, found exclusively in the cell walls of cereal and grass species, are important components of dietary fiber and ''highly beneficial in the prevention and treatment of serious human health conditions, including colorectal cancer, high serum cholesterol and cardiovascular diseases, obesity and non-insulin-dependent diabetes'' [15]. Genes responsible for (1,3;1,4)-b-D-glucan synthesis in grasses have been identified and provide an excellent opportunity to enhance the dietary fiber content of cereal and other food crops through transformation [15]. One of the continuing criticisms of transgenic crops that have been commercialized thus far is that although they do have many desirable attributes, none of them offers any direct, tangible benefits to the consumer. This situation is changing rapidly with increasing understanding of the molecular and genetic control of various aspects of plant growth and development, which has made it possible to enhance the quality as well as the quantity of proteins/starches/oils, and the content of vitamins, essential amino acids, minerals and other healthful components of plants [12, 17, 20, 23, 34, 37, 47, 48, 50, 52, 53]. Although not much work of this nature has been carried out in wheat, there is no reason why the success which has been achieved in crops such as rice, maize and soybean, or demonstrated in model species such as *Arabidopsis*, cannot be extended to wheat.

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