



Case Report

Copyright© Hamid Kheyroodin

Food Systems and Micronutrients in Wheat Grain

Hamid Kheyroodin*

Assistant professor, Semnan University, Iran

*Corresponding author: Hamid Kheyroodin, Assistant professor, Semnan University, Iran.

To Cite This Article: Hamid Kheyroodin*. Food Systems and Micronutrients in Wheat Grain. Am J Biomed Sci & Res. 2025 25(2) AJBSR. MS.ID.003322, DOI: [10.34297/AJBSR.2025.25.003322](https://doi.org/10.34297/AJBSR.2025.25.003322)

Received: 📅 January 3, 2025; **Published:** 📅 January 09, 2025

Abstract

Deficiencies of micronutrients such as iron, zinc, and vitamin A afflict over three billion people. Currently there is an increasing preference among consumers for foods that contain not only traditional nutrients but also provide other compounds that are beneficial to health and well-being. Food systems that feed the world must be changed in ways that will insure that balanced nutrient supplies are available continuously to all people in adequate, affordable amounts. This paper reviews about the most important wheat grain components and their nutritional value. The opportunities of plant breeding and other technologies to improve the nutritional quality of wheat are also discussed.

Keywords: Micronutrients, Proteins wheat, Zn, Fe at grain

Introduction

Wheat is a grass widely cultivated for its seed, a cereal grain which is a worldwide staple food. The many species of wheat together make up the genus *Triticum*; the most widely grown is common wheat (*T. aestivum*). The nutritional value of wheat is extremely important as it takes an important place among the few crop species being extensively grown as staple food sources. The importance of wheat is mainly due to the fact that its seed can be ground into flour, semolina, etc., which form the basic ingredients of bread and other bakery products, as well as pastas, and thus it presents the main source of nutrients to the most of the world population. A huge increase in demand for cereals is predicted if the food needs for the estimated world population growth are to be met. But there is another potentially great benefit to these communities and that is the possibility to ensure such staple crops are nutritionally-balanced and help remove the millions of cases of nutritionally-related deficiency disease that afflict them. It should be emphasised that in the past there has not been a single instance where plants have been bred to improve their nutritional content. If this has occurred it is purely by accident not design [5-7]. Wheat grains are generally oval shaped, although different wheats have grains that range

from almost spherical to long, narrow and flattened shapes. The grain is usually between 5 and 9mm in length, weighs between 35 and 50mg and has a crease down one side where it was originally connected to the wheat flower. The wheat grain (Figure 1) contains 2-3% germ, 13-17% bran and 80-85% mealy endosperm (all constituents converted to a dry matter basis [1].

There are large differences between the levels of certain amino acids in the aleurone layer and those in flour. Glutamine and proline levels are only about one half, while arginine is treble and alanine, asparagine, glycine, histidine and lysine are double those in wheat flour [3]. The endosperm is surrounded by the fused pericarp and seedcoat. The outer endosperm, the aleurone layer, has a special structure: it consists of single layer of cubic shaped cells. The aleurone layer is rich in proteins and enzymes, which play a vital role in the germination process. The inner endosperm, i.e., the endosperm without the aleurone layer, is referred to as mealy or starchy endosperm. The endosperm mainly contains food reserves, which are needed for growth of the seedling, it is rich in energy-yielding starch. Apart from carbohydrates, the mealy endosperm contains fats (1,5%) and proteins (13%): albumins, globulins and the major

proteins of the gluten complex- glutenins and gliadins. - proteins that will form the gluten at dough making. The contents of minerals (ash) and of dietary fibers are low; 0,5% and 1,5%, respectively [1]. The germ lies at one end of the grain. It is rich in proteins (25%) and lipids (8-13%). The mineral level is also rather high (4,5%). Wheat germ is available as a separate entity because it is an important source of vitamin E. Wheat germ has only one half the glutamine and proline of flour, but the levels of alanine, arginine, asparagine,

glycine, lysine and threonine are double [3]. Bioactive wheat proteins Another limitation of plant proteins is that they can be poorly digested by animals or can cause allergic reactions. Wheat allergy is the result of abnormal immunological reactions to certain wheat proteins. It has totally different mechanism from that in coeliac disease and the proteins involved are not gliadins but albumins and globulins.

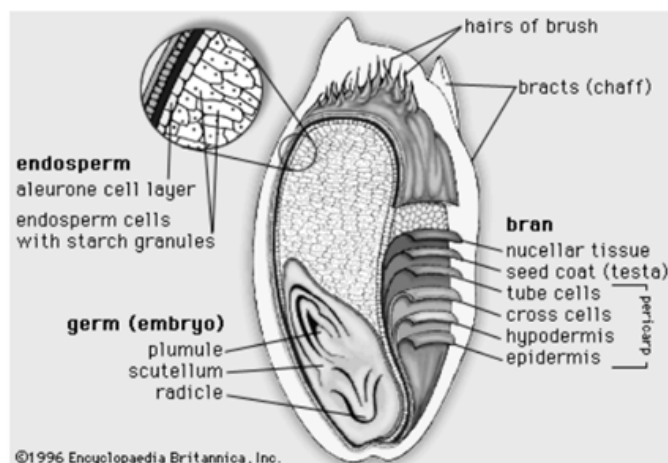


Figure 1: Wheat grain (from Encyclopaedia Britannica).

Starch

Cereal grains store energy in the form of starch. The amount of starch contained in a wheat grain may vary between 60% and 75% of the total dry weight of the grain. Starch occurs in seed in the

form of granules. Wheat has two types of starch granules: large (25-40µm) lenticular and small (5-10µm) spherical ones. The lenticular granules are formed during the first 15 days after pollination. The small granules, representing about 88% of the total of granules, appear 10-30 days after pollination [1] (Figure 2).

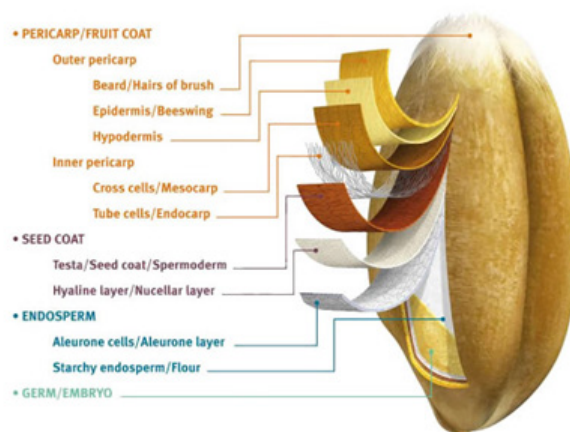


Figure 2: Wheat seed structure.

Lipids

Lipids are present only in a small extent in cereals but they have a significant effect on the quality and the texture of foods because of their ability to associate with proteins due their amphipathic nature

and with starch, forming inclusion complexes. In wheat, the maturing seed synthesises fatty acids at different rates. The biosynthesis of lipids depends upon acetyl coenzyme A. this important compound is involved in synthesis of the acyl lipids such as glycerides,

phospholipids, waxes, sphingosine lipids as well as the isoprenoid series.

Fiber

Numerous studies have demonstrated the beneficial effects of fiber consumption in protection against heart disease and cancer;

normalization of blood lipids, regulation of glucose absorption and insulin secretion and prevention of constipation and diverticular disease. Dietary fiber is defined as lignin plus the polysaccharide components of plants which are indigestible by enzymes in the human gastrointestinal tract [2] (Figure 3).

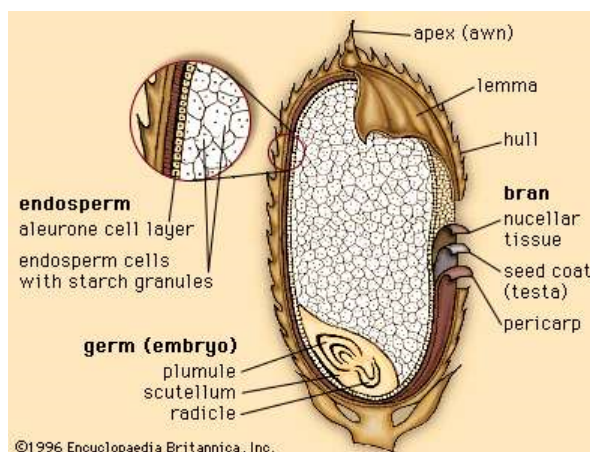


Figure 3: Endosperm in seed wheat.

Vitamins

Vitamins are defined as a diverse group of food-based essential organic substances (relatively small molecules but comparable in size to amino acids or sugars) that are not synthesized by the human body, but by plants and microorganisms. Therefore, vitamins are nutritionally essential micronutrient for humans and function in vivo in several ways, including: (1) as coenzymes or their precursors

(niacin, thiamin, biotin, pantothenic acid, vitamin B6, vitamin B12 and folate), (2) in specialized function such as vitamin A in vision and ascorbate in distinct hydroxylation reactions; and (3) as components of the antioxidative defense systems (vitamin C and E and some carotenoids), and as factors involved in human genetic regulation and genomic stability (folic acid, vitamin B12, vitamin B6, niacin, vitamin C, vitamin E and D) (Figure 4).

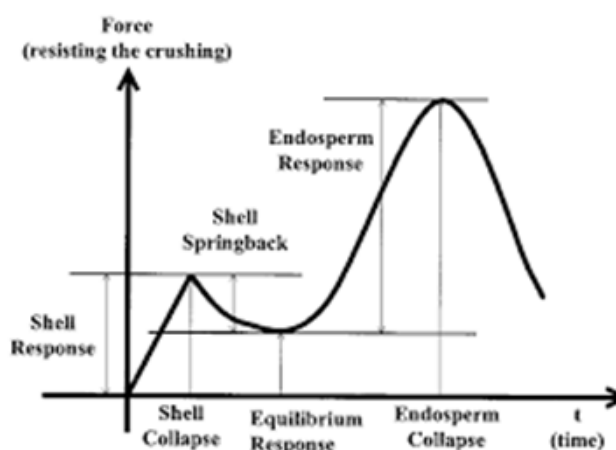


Figure 4: Generic structure of the crush-response profile of a wheat seed.

Tocols

Tocopherols (T) and tocotrienols (T3), collectively called tocols, are composed of a chromanol ring with an attached phytyl side chain. Tocotrienols differ from tocopherols in that their phytyl

side chain is unsaturated, containing three double bonds. There are four isomers in both T and T3 based on the number and positions of methyl groups on the chromanol ring; α -(5,7,8 trimethyl), β -(5,8 dimethyl), γ -(7,8 dimethyl) and δ -(8 methyl). The biological activi-

ty of vitamin E has generally been associated with its well-defined antioxidant property in biological membranes. α -T has long been considered to be the most active form in the vitamin E complex for preventing destructive oxidation in cell membranes.

Carotenoids

Vitamin A (retinol) is a fat-soluble micronutrient and is mainly contained in eggs, liver and butter. Vitamin A precursors such as β -carotene, and other carotenoids, are produced in green and yellow vegetables. After uptake, β -carotene and the other carotenoids are oxidatively cleaved in the intestinal mucosal brush border or liver to form the isoprenoid retinol.

Minerals

Micronutrient malnutrition ("hidden hunger") now afflicts over 40% of the world's population and is increasing especially in many developing nations. Today, deficiencies of iron and iodine are of most concern to the nutrition community and healthcare officials although other nutrient deficiencies, including zinc, selenium, calcium and magnesium may be prevalent in some global regions. The consequences of malnutrition create immense economic and societal costs to nations. Micronutrient malnutrition greatly increases mortality and morbidity rates, diminishes cognitive abilities of children and lowers their educational attainment, reduces labor productivity, stagnates national development efforts, contributes to continued high population growth rates and reduces the livelihood and quality of life for all those affected.

Iron (Fe) and Zinc (Zn)

Increasing the Zn and Fe concentration of food crop plants, resulting in better crop production and improved human health is an important global challenge. Among micronutrients, Zn deficiency is occurring in both crops and humans. Zinc deficiency is currently listed as a major risk factor for human health and cause of death globally. According to a WHO report on the risk factors responsible for development of illnesses and diseases, Zn deficiency ranks 11th among the 20 most important factors in the world and 5th among

the 10 most important factors in developing countries. *Hotz and Brown* (2004) [4] reported that Zn deficiency affects, on average, one-third of world's population, ranging from 4 to 73% in different countries. Zinc deficiency is responsible for many severe health complications, including impairments of physical growth, immune system and learning ability, combined with increased risk of infections, DNA damage and cancer development

Selenium

(Se) Selenium (Se) is an integral component required for normal cell metabolism in humans and animals. Selenium (Se) is an essential micronutrient for humans and animals, with antioxidant, anti-cancer and anti-viral effects (*Arthur*, 1999). Soils are frequently low in available Se, and hence the food systems of many countries are deficient in Se. Wheat is an important dietary source of Se.

Acknowledgement

We thank Semnan University director from grant and assistant in this work.

References

1. Belderok B, Mesdag H, Donner DA (2000) Bread-Making Quality of Wheat. Springer, New York.
2. Bermink MR (1994) In: Nielson SS (ed) Introduction to the Chemical Analysis of Foods, pp. 169-180, Jones and Bartlett Publishers, Boston.
3. Cornell H (2003) In: Cauvain SP (ed) Bread Making: Improving Quality. Woodhead Publishing, Cambridge.
4. Hotz C, Brown KH (2004) International Zinc Nutrition Consultative Group (IZiNCG) Technical Document No. 1. Assessment of the Risk of Zinc Deficiency in Populations and Options for Its Control. Food Nutr Bull 25: 94-203.
5. Graham RD, Senadhira D, Beebe S, Iglesias C, Monasterio I (1999) Field Crops Res 60: 57-80.
6. Lindsay DG (2002) Phytochem Rev 1: 101-111.
7. Kheyroodin H (2014) Effect of climate change on soil global microorganisms Important of soil quality and soil agriculture indicators. JBCR 29(2): 310-310.