

Critical Analysis of Wheat as Food

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Abstract

Wheat is one of the major cereal crops consumed worldwide, because of its nutrient richness and fitting its consistency to prepare varieties of attractive dishes and desserts. The wheat bran is rich with fibres, anti-oxidants, iron, zinc, copper, magnesium, B group Vitamins and phytonutrients. Wheat germ, the fertilized embryo contains B group vitamins, vitamin E, phytonutrients, antioxidants, and unsaturated fats. In addition, the endosperm contains majorly starchy carbohydrates, proteins and lesser amount of vitamins and minerals. In recent times, wheat consumption has been increased drastically. Although, it is beneficial to consume wheat either as whole wheat or their refined foods, some negative effects were also observed.

Keywords: Wheat; Food; Nutrition; Cereals

Introduction

Wheat is rich in protein and other micronutrients and serves as a major source of vegetable protein in human food than other cereals [1]. In addition, wheat is more adaptable to a wide range of growth conditions compared to other major cereal crops. This property has made the wheat cultivation possible in different parts of the world and made it available globally. As taste, price, availability and nutritive quality influence consumers, meeting almost all these qualities wheat become one of the staple cereal worldwide. A growing economy, concerns about food and health also contributed to the increased wheat consumption. Further, the use of wheat parallels with socio economic and geography of the region. Developing countries use more wheat than developed countries [2]. In Middle East countries, per capita consumption of wheat exceeds 150 kg per year whereas in South Asian countries like India, it is 66-70 kg/per annum. While regions like Central America, Sub Saharan Africa that mainly depends on other cereals, per capita wheat consumption is very less [3,4]. These statistical data represents the worldwide cultivation and consumption of wheat.

Benefits of Wheat Consumption as Food

Wheat grain is made up of three distinct sections namely: outer multilayered fibre rich bran, inner micronutrient rich germ and carbohydrate rich endosperm. The bran contains fibres, anti-oxidants, iron, zinc, copper, magnesium, B group Vitamins and phytonutrients. Germ, the fertilized embryo contains B group vitamins, vitamin E, phytonutrients, antioxidants, and unsaturated fats. While, the endosperm contains majorly starchy carbohydrates, proteins and lesser amount of vitamins and minerals [5]. Wheat is consumed in the form of whole grain and sometimes as white flour which is derived from starchy endosperm cells. Distribution of wheat nutrients is found to be confined to specific part of the wheat. Therefore, it is advisable to consume whole wheat grain foods than white flour alone. Foods made of whole grain wheat are more beneficial, supplying the essential micronutrients required for our body. Further, the wheat protein gluten serve as major source of cereal protein meeting the daily intake recommended levels of essential amino acids [6,7]. In addition, another important group of nutrients present in wheat are minerals. In a study, 44% of the daily intake of iron (15% in wheat bread) and daily intake of zinc (11% in wheat bread) was reported in UK [8]. Another important essential mineral nutrient in cereals is selenium which is present in the form of selenocysteine in a number of enzymes. Though selenium is present in other cereals, wheat serves as the dietary source of selenium in majority of the countries worldwide [9].

In recent past wheat consumption has been increased swiftly. This may be attributed to the increased rice to wheat shift due to adaption to western style of diet, increased rate of diabetes and also cardiac disease. Upon binding to apolipoprotein-B, phenolic antioxidants had showed to inhibit LDL oxidation [10]. Further, fibre in wheat bran was found to reduce the serum cholesterol levels significantly without reducing beneficial HDL-C suggesting the beneficial role of wheat bran on cardio vascular diseases [11]. In addition, wheat is a significant source of tocols, sterols and arabinoxylans [12]. The antioxidant properties of wheat have been primarily attributed to phenolic phytochemicals such as alkylresorcinols, hydroxycinnamic acids found in wheat bran. Generally most of the phenolic compounds are bound to cell wall materials such as arabinoxylans and other indigestible polysaccharides. Upon reaching colon, the intestinal microorganisms ferment the starchy substrate and facilitate the release of phytochemicals freely into the lumen conferring anti-oxidant effects [13]. Wheat bran also increases the production of short chain fatty acids and confers gut health. The carbohydrate content of the wheat undergo fermentation and produces short chain fatty acids which are proven to nourish colonocytes and reduces intestinal pH promoting the growth of beneficial lactic acid bacteria, indicating the prebiotic properties of wheat in improving gut health [11]. Furthermore, feruloyl oligosaccharides a kind of phenolic compound in wheat bran proven to confer protection against free radical-induced oxidative damage in human erythrocytes [14]. In terms of digestive health, consumption of wheat as whole grain confers several health benefits. It improves fecal bulking and delays gastric emptying [15]. Wheat bran has been found to confer protection against colon cancer [16]. Wheat bran has proven as best diluter in animal models compared to pectin, oat bran, cellulose and other fibers, and dilutes the potential carcinogens and their promoters, reducing their access to cells lining the colon. In addition, it has been shown to accelerate the transit of fecal matter through the colon reducing the access of colonic epithelial cells to fecal contents [17]. These studies reveal the importance of wheat as food for human health.

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The information given above glorifies the advantages of wheat consumption. However, the bioavailability of wheat nutrients and some of their adverse effects on health is on debate in scientific community. Let's discuss the unlikable side of wheat consumption. The problems associated with wheat consumption spin mainly around the bioavailability of its nutrients and allergies.

Negative Impact of Wheat Consumption on Health

Anti-nutrient phytic acid in wheat

Phytic acid is an organic compound present in cereals in the form of myoinositol hexaphosphate. 90% of phytic acid is present in aleurone layer and 10% in embryo of the grain [18]. Phytate in cereals bind strongly with iron, magnesium, zinc, calcium and other minerals, changing their solubility, functionality, digestibility and absorption, making these nutrients unavailable to the body. Phytic acid in wheat ranges from 200 to 400 mg/100 g in refined flour, 3000 to 5000 mg/100 g of dry weight of bran and 600 to 1000 mg/100 g in whole flour [19]. There is a potential public health nutrition problem of iron, zinc and calcium deficiency in population mainly dependent on cereal based diet. However, the degree of anti-nutrient effect of phytic acid on mineral nutrients depends on the several food and host-related factors. Further, improving wheat varieties with the expression of phytase would be considered for enhancement of bioavailability of wheat nutrients.

Wheat respiratory and food allergies

Other problems associated with wheat consumption are respiratory and food allergies. Bakers' asthma has considered as one of the most important forms of occupational allergy and has been known since Roman times. In UK, it is the second most prevalent occupational allergy, while in Poland, exposure to wheat dough for only 2 years during their training affected nearly 8% of apprentice bakers [20]. In a review, Tatham and Shewry discussed the reaction of immunoglobulin E (Ig E) in sera of bakers' asthma patients with wheat components: glutenin, gliadin, serpins, thioredoxin, agglutinin, and a number of enzymes such as α - and β -amylases, peroxidase, acyl CoA oxidase, glyceraldehyde-3-phosphate dehydrogenase and triosephosphate isomerase yielding respiratory allergy [21].

Further, dietary intolerance to wheat known as Celiac disease (CD) is another negative effect of wheat consumption. Celiac disease is more prevalent than wheat mediated respiratory allergy. Celiac Disease (CD) is a form of chronic enteropathy affecting the small intestine in genetically predisposed individuals and is precipitated by the ingestion of gluten containing foods. It is also referred as gluten sensitive enteropathy, celiac sprue and non-tropical sprue. Presence of Human Leukocytic Antigens mainly HLA-DQ2 or HLA DQ-8 molecules, trigger from gluten protein of wheat and related cereal, and the generation of circulating autoantibodies to tissue transglutaminase (tTG) are essential to precipitate the disease [22]. Immune mediated damage to the small intestine with altered histology like partial and subtotal villous atrophy with hyperplastic crypts, increased intra epithelial lymphocytes and mononuclear infiltration in lamina propria, chronic diarrhea, weight loss, iron deficient anemia, vitamin deficiency, abnormal fat excretion, delayed puberty, malnutrition are the characteristic symptoms of the disease [23]. According to World Gastroenterology Organization (WGO) data, the prevalence of CD in a healthy adult population varies between roughly 1 in 100 and 1 in 300 in most parts of the world and female to male ratio was 2:1. In Middle East, North Africa and South Asian countries, prevalence of CD at risk population ranges between 3% and 20%. Further, in patients with type I diabetes, prevalence rate

is nearly 3% to 5% [24,25]. The only therapy available for CD is life time exclusion of gluten from diet. Biotechnological approaches like breeding wheat varieties with less gluten content and treating of wheat with gluten hydrolyzing probiotics are in practice to develop foods for Celiac patients. In the authors' laboratory, development of probiotic treated gluten reduced wheat foods and their probiotic action on restorative effect of impaired intestinal tight junction barrier is under study. These studies evidence the negative impact of wheat on health.

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