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NUTRITIONAL PROFILING OF ANTIOXIDANTS IN WHEAT GRAIN

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ABSTRACT This review thoroughly examines the nutritional analysis of antioxidants in wheat grain, emphasizing their significant impact on human health by reducing the risks of chronic diseases. Wheat, a commonly consumed dietary staple, contains a variety of antioxidants, including phenolic compounds, vitamins, carotenoids, and flavonoids. These antioxidants play crucial roles in combating oxidative stress, capturing free radicals, and preserving the genetic material within cells. Consuming wheat and other whole grains rich in these antioxidants has demonstrated promising connections with a lower susceptibility to conditions like cancer, cardiovascular disorders, type II diabetes, and obesity. Additionally, these antioxidants offer benefits such as improved digestion, increased insulin sensitivity, and potential anticancer properties. This comprehensive review also explores potential drawbacks associated with wheat grain, like its anti-nutrient content and allergenic potential, it underscores that the overall benefits of adding whole grains to one's diet outweigh these concerns. In summary, the abundance of antioxidants in wheat emphasizes its essential role in promoting human health and preventing the onset of chronic diseases.

Keywords: *Wheat; grain; antioxidants; diseases; health; Nutrition*

INTRODUCTION

Wheat has relieved as a staple food for humans since the late Stone Age, dating back to approximately 6700 BC (Arshad et al., 2017). Wheat encompasses a broad spectrum of biologically active compounds that contribute to its anti-oxidative capacity. The distribution of antioxidants in wheat is primarily concentrated in the bran fraction, with varying quantities depending on the wheat variety. Wheat bran emerges as a valuable source of phenolic acids, significantly contributing to the overall antioxidant potential of wheat (Leváková and Lacko-Bartošová, 2017). The most prevalent phenolic acid in cereals, ferulic acid, is found in the aleurone layer, the kernel husk, and the grain endosperm, with 75% of the total being found in each. When it comes to the antioxidant activity of the main phenolic acids derived from cereals, they can scavenge free radicals in the following order: p-coumaric, vanillic, ferulic, gallic, caffeic, benzoic, sinapic, syringic, and 4-hydroxybenzoic (Horvat et al., 2020). The ability of wheat to utilize oxygen provides the benefit of metabolizing fats, proteins, and carbohydrates for energy (Dolas Ashadevi and Gotmare, 2015). Additionally, wheat bran demonstrates the capacity to inhibit lipid oxidation induced by peroxyl or iron radicals. Studies highlight the varying total phenolic contents and antioxidant activity in different parts of wheat, emphasizing the importance of ferulic acid as the primary contributor to wheat's antioxidant activity. Ferulic acid, with concentrations ranging from 99-231 µg/kg, has even been suggested as a potential marker for wheat antioxidants.

Antioxidants, compounds with the capacity to postpone or prevent oxidative stress. Notably, the antioxidant action of whole grain flour surpasses that of refined flour, with wheat bran standing out for its impressive 76.47% antioxidant activity (Leváková and Lacko-Bartošová, 2017). The cultivation of cereals, particularly wheat, has a long tradition in Europe, where it accounts for more than half of the total cereal production in the European Union (Horvat et al., 2020). Scientific evidence suggests that whole grains, as commonly consumed in the United States and Europe, reduce the risk of chronic diseases, including cancer and heart disease (Miller et al., 2000).

Composition: Current research in the field of epidemiology has established a clear link between regular consumption of meal based on whole grains, and a reduced chances of chronic diseases. These include diseases such as cardiovascular disease, cancer, diabetes, and obesity (Okarter et al., 2010). The beneficial effects of whole grain flours are largely due to their rich antioxidant composition. These antioxidants include well-recognized ones like vitamins C and E, tocopherols, tocotrienols, and carotenoids and variety of phyto-antioxidants, such as

phytochemicals. Predominantly phenolic acid present in the bran and germ of whole grains, phenolic acids are the most prevalent antioxidants in these foods. However, the refining process often strips these beneficial components from flour (Miller et al., 2000). Phenolic acids are present in various forms: free, esterified, and insoluble-bound (Jung et al., 2002). An important aspect of phytochemicals is their resistance to digestion and absorption in the upper gastrointestinal tract, which enables them to reach the colon where they may impart health benefits. In cereals, a large number of phenolic compounds are present in cell wall polymers, making up 80% to 95% of the total content of phenol. An example of this is ferulic acid, available in conjugated, bound and free form at a ratio of approximately 0.1:1:100 (Adom and Liu, 2002). It is also important to acknowledge that releasing these cell wall-bound phenolics requires alkali labile conditions (Waldron et al., 1996)

Benefits of Antioxidants in Wheat Grain: Oxidative byproducts generated during normal metabolic processes can cause significant damage to fats, proteins, and DNA. This damage is a key factor in ageing and degenerative illness linked to aging, such as cancer, cardiovascular disorders, weakened immunity, brain disease (Dolas Ashadevi and Gotmare, 2015). Antioxidants are essential to neutralize the harmful effects of reactive oxygen and nitrogen species produced in the body, safeguarding DNA, lipids, proteins, and other biomolecules from damage (Halliwell, 1996). Antioxidants work by scavenging and reducing the quantity of oxidants near cells, thus inhibiting the reach of ROS to their biological targets. They stabilize or neutralize free radicals before they cause cellular damage. Diseases like cancer, rheumatoid arthritis, heart disease, eye disorders, brain disorders have been associated with free radicals (Dolas Ashadevi and Gotmare, 2015).

Antioxidants play a role in averting various significant human illnesses, and their activity stands as a crucial factor influencing the quality of food items and their components (Halliwell, 1996 L., & Alena, S. (2020). Free radicals are produced during routine metabolic activities, radiation exposure, and certain environmental toxins. The body combats free radicals through effective systems like antioxidant enzymes and antioxidant molecules (Esrefoglu, 2012). Oxidative stress is often a contributing factor in the development of liver damage and causes inflammation of liver like acute and chronic hepatitis. Administering antioxidants has a promising treatment for hepatitis (Esrefoglu, 2012). Studies indicate that both types of diabetes mellitus are linked with increased free radical formation and diminished antioxidant capability, resulting in oxidative damage to cellular components (Golbidi et al., 2011).

Disadvantages of Antioxidants in Wheat Grain: Wheat grains contain phytic acid, an antioxidant that can bind minerals and reduce their absorption. This anti-nutrient effect might lead to deficiencies in minerals like iron, zinc, and calcium in people with diets high in phytic acid-rich foods (Lopez et al., 2002). Another disadvantage of wheat grain, however not directly linked to antioxidants, is its potential to cause allergic reactions or intolerances in some individuals. Wheat contains gluten, a protein that can trigger celiac disease or non-celiac gluten sensitivity (Sapone et al., 2012). While antioxidants are typically seen as beneficial, there's a inconsistency in the field of redox biology where too much of certain antioxidants can lead to pro-oxidant effects, potentially causing oxidative stress rather than preventing it (Halliwell, 1996). Certain antioxidants in wheat grain might interact with medications, altering their effectiveness. This is a broader concern with dietary antioxidants and not specific to wheat grain alone (Galati and O'brien, 2004).

Impact of Antioxidants on Human Health: Phenolic compounds, found abundantly in wheat products, are particularly noteworthy. Their potent antioxidant activity has been highlighted in numerous studies, underscoring their ability to counteract the deleterious effects of free radicals, which, if unchecked, can pave the way for a myriad of chronic conditions and escalate the risk of severe diseases (Vadim et al., 2020). Many studies have shown that diabetes mellitus is associated with increased formation of free radicals and decreased antioxidant potential, leading to oxidative damage of cell components (Golbidi et al., 2011). These compounds have role in the body's natural defense arsenal, efficiently neutralizing Reactive Oxygen Species and safeguarding the cellular genetic apparatus from potential harm (Vadim et al., 2020). The abundance of antioxidants in wheat extends beyond phenolic compounds. Wheat contains essential vitamins such as ascorbic acid and vitamin E, carotenoids, phytochemicals, all of which contribute to its wide range of health benefits. These antioxidants play significant roles in various aspects of health. For example, they reduced the risk of chronic disease and disorders linked with age caused by oxidative stress. These conditions not limit 100 percent production of carcinogenesis, cardiovascular diseases, type II diabetes, and obesity (Arshad et al., 2017).

In a study conducted among post-menopausal women diagnosed with heart conditions, whole grains were associated with a slower build-up of artery-narrowing plaque among the post-menopausal women and in lowering the overall risk of mortality associated to CVDs (Jideani et al., 2014). Furthermore, these antioxidants contribute to improved digestion, primarily through the release of bound phenolics in the colon. They also enhance insulin sensitivity, reduce or stop the production of the cytokine which cause inflammation and tumor necrosis factor alpha, leading to noticeable reductions in serum cholesterol, fasting glucose, and triglyceride levels. Additionally, some antioxidants found in wheat have demonstrated potential anticancer effects, particularly against breast cancer cell lines like MCF-7 and MDA-MB-231 (Arshad et al., 2017). Specifically, β-glucan, which is present in oats, barley, and wheat, is gaining recognition for its capacity to reduce blood cholesterol levels and its role in managing weight. Drawing from epidemiological insights, it becomes evident that a consistent dietary pattern that includes whole grains, oil of seeds, dried fruit and nuts, and legumes, rich in phytochemicals, is associated with lower serum and bad cholesterol concentrations. This dietary choice can, therefore, serve as a defense against chronic disorders such as heart problems, diabetes mellitus, and various types of cancer. With this compelling evidence in mind, adopting a diet abundant in fruits, vegetables, and whole grains isn't merely a culinary

adventure but a strategic health decision, steering us away from the risks of chronic diseases (Jideani et al., 2014).

Conclusion

The nutritional assessment of antioxidants in wheat grain highlights its crucial role in improving human well-being and lowering the vulnerability to chronic diseases. The diverse range of antioxidants present, including phenolic compounds, vitamins, carotenoids, and flavonoids, contribute significantly to its robust antioxidant properties. These antioxidants act as protective shields against oxidative stress, counteracting harmful free radicals, and preserving integrity of genetic material of cell. The consumption of wheat and other whole grains has been linked with a reduced risk of disease or disorders conditions such as cancer, heart diseases, diabetes mellitus, and obesity. Additionally, these antioxidants deliver supplementary advantages, including enhanced digestive health, improved insulin sensitivity, and potential anticancer effects.

While it is also important to acknowledge potential drawbacks of wheat grain, such as its anti-nutrient content and allergenic potential, it is clear that the overall benefits of adding whole grains into one's diet far outweigh these considerations. Consequently, wheat emerges as an invaluable component of a balanced diet, reinforcing the timeless wisdom that "food is medicine." Embracing a diet enriched with antioxidants from wheat and other whole grains represents a practical health choice, shielding individuals from the risks associated with chronic diseases and promoting overall vitality.

REFERENCES

Adom, K. K. & Liu, R. H. 2002. Antioxidant activity of grains. *Journal of agricultural and food chemistry,* 50**,** 6182-6187.

Arshad, M. S., Joong-Ho, K., Faqir, M., Muhammad, S., Farhan, S., Muhammad, I., Zaid, A., Muhammad, N. & Shahzad, H. 2017. Wheat antioxidants, their role in bakery industry, and health perspective. *Wheat Improvement, Management and Utilization; Wanyera, R., Ed.; IntechOpen: London, UK***,** 365-381.

Dolas Ashadevi, S. & Gotmare, S. 2015. The health benefits and risks of antioxidants. *Pharmacophore,* 6**,** 25-30.

Esrefoglu, M. 2012. Oxidative stress and benefits of antioxidant agents in acute and chronic hepatitis. *Hepatitis monthly,* 12**,** 160.

Galati, G. & O'brien, P. J. 2004. Potential toxicity of flavonoids and other dietary phenolics: significance for their chemopreventive and anticancer properties. *Free radical biology and medicine,* 37**,** 287-303.

Golbidi, S., Alireza Ebadi, S. & Laher, I. 2011. Antioxidants in the treatment of diabetes. *Current diabetes reviews,* 7**,** 106-125.

Halliwell, B. 1996. Antioxidants in human health and disease. *Annual review of nutrition,* 16**,** 33-50.

Horvat, D., Šimić, G., Drezner, G., Lalić, A., Ledenčan, T., Tucak, M., Plavšić, H., Andrić, L. & Zdunić, Z. 2020. Phenolic acid profiles and antioxidant activity of major cereal crops. *Antioxidants,* 9**,** 527.

Jideani, A., Silungwe, H., Takalani, T., Anyasi, T. A., Udeh, H. & Omolola, A. 2014. Antioxidant-rich natural grain products and human health. *Antioxidant-Antidiabetic Agents and Human Health. Oguntibeju O ed., InTech Publisher. Rijeka, Croatia***,** 167-87.

Jung, M. Y., Jeon, B. S. & Bock, J. Y. 2002. Free, esterified, and insoluble-bound phenolic acids in white and red Korean ginsengs (Panax ginseng CA Meyer). *Food Chemistry,* 79**,** 105-111.

Leváková, Ľ. & Lacko-Bartošová, M. 2017. Phenolic acids and antioxidant activity of wheat species: A review. *Agriculture (Pol'nohospodárstvo),* 63**,** 92-101.

Lopez, H. W., Leenhardt, F., Coudray, C. & Remesy, C. 2002. Minerals and phytic acid interactions: is it a real problem for human nutrition? *International journal of food science & technology,* 37**,** 727-739.

Miller, H. E., Rigelhof, F., Marquart, L., Prakash, A. & Kanter, M. 2000. Antioxidant content of whole grain breakfast cereals, fruits and vegetables. *Journal of the American college of Nutrition,* 19**,** 312-319.

Okarter, N., Liu, C.-S., Sorrells, M. E. & Liu, R. H. 2010. Phytochemical content and antioxidant activity of six diverse varieties of whole wheat. *Food chemistry,* 119**,** 249-257

Sapone, A., Bai, J. C., Ciacci, C., Dolinsek, J., Green, P. H., Hadjivassiliou, M., Kaukinen, K., Rostami, K., Sanders, D. S. & Schumann, M. 2012. Spectrum of gluten-related disorders: consensus on new nomenclature and classification. *BMC medicine,* 10**,** 1-12.

Vadim, P., Igor, L. & Alena, S. 2020. Biological role and health benefits of antioxidant compounds in cereals. *Biological Communications,* 65**,** 53-67.

Waldron, K. W., Parr, A. J., Ng, A. & Ralph, J. 1996. Cell wall esterified phenolic dimers: identification and quantification by reverse phase high performance liquid chromatography and diode array detection. *Phytochemical analysis,* 7**,** 305-312.