Scientific Research Timelines Journal (2023), 2(1):07-09
Online Bimonthly Publication Frequency
https://scientificrtj.com/

Review Paper **Open Access**

NUTRITIONAL PROFILING OF PROTEINS IN WHEAT GRAIN

Saba Bashir[1*], Saman Javeed[1], Muhammad Saad Ali[1*]

[1]*Department of Human Nutrition and Dietetics (HND), The Islamia University of Bahawalpur (IUB), Pakistan*

***Corresponding author e-mail:** sababashir0409@gmail.com

ABSTRACT Wheat, a globally cultivated cereal grain, has historically played a crucial role in human nutrition. Rich in proteins like gluten, gliadins, and glutenins, wheat's storage proteins constitute a substantial portion of its nutritional content. The two primary wheat species, *Triticum aestivum* and *Triticum durum* (pasta wheat), have distinct roles in culinary traditions. Protein content, influenced by environmental factors, varies significantly, with hard wheat having higher protein content than soft wheat. Analyzing wheat proteins through techniques like two-dimensional gel electrophoresis reveals a diverse array of proteins, categorized as monomeric (gliadins, globulins, albumins) and polymeric (glutenins). Gluten, comprising 80-85% of wheat protein, exhibits considerable diversity with distinctive characteristics among its components, gliadins and glutenins. Wheat proteins offer numerous advantages, impacting dough quality, grain texture, and human health. However, challenges arise from wheat protein allergies, celiac disease triggered by gluten, and non-celiac wheat sensitivity. Optimal health is best achieved through a balanced diet, recognizing the diverse impacts of wheat proteins on human health.

Keywords: *Wheat; Proteins; glutenins; glidians; albumins, globulins,*

INTRODUCTION

Wheat plays a pivotal role in agriculture and stands as one of the most extensively cultivated cereal grains globally. Throughout history, wheat-based products have served as staple foods, contributing approximately half of the world's food calories (Kumar et al., 2019). The two primary species of wheat, Triticum aestivum L. (commonly known as bread wheat) and Triticum durum L. (known as pasta wheat), are integral to these food traditions (Khalid et al., 2023). Rich in proteins like gluten, gliadins, glutenins, as well as smaller amounts of albumin and globulins, wheat's storage proteins (gliadins and glutenins) constitute about 75% of the overall protein content (Belderok et al., 2000). While albumins and globulins make up 20-25% (Žilić et al., 2011). The protein content, varying from 8-20% in mature wheat grains, is significantly influenced by environmental conditions such as soil moisture, temperature, nitrogen availability, soil fertility, and cultivation methods. Additionally, the type and timing of fertilizer application can also impact protein percentages (Rashid et al., 2021). Wheat varieties are broadly categorized into hard wheat, known for its higher protein content, and soft wheat, which has comparatively lower protein content (Atwell and Finnie, 2016).

Profiling Wheat Proteins: In analyzing wheat grain proteins through two-dimensional gel electrophoresis (2D-GE), up to 1300 proteins have been separated. These wheat proteins are classified into monomeric (such as gliadins, globulins, and albumins) and polymeric (glutenins) proteins (LAFIANDRA, 1997).

Albumins and Globulins: Contrasting the prolamin proteins, albumins and globulins constitute the non-prolamin proteins in wheat. Albumins are water-soluble, while globulins dissolve in salt solutions, collectively making up 15-20% of wheat proteins. Their molecular weights typically range below 25,000, with a notable proportion between 60,000 and 70,000. These proteins possess a more favorable amino acid composition, particularly higher lysine and methionine contents compared to other wheat grain proteins (Veraverbeke and Delcour, 2002).

Gluten Protein: Comprising 80-85% of wheat protein and soluble in water, gluten is composed of numerous protein components present as monomers or linked through intra- and

inter-chain disulfide bonds. This diversity of gluten proteins presents various types with distinctive characteristics (D'Ovidio and Masci, 2004).

Gliadins: Gliadins, as individual proteins, encompass a molecular weight range of 30-80 kDa. They are categorized into four groups—α, β, γ, and ω—based on their molecular mobility at low pH in acid polyacrylamide gel electrophoresis (Wieser, 2007). This classification relies on the sequence, amino acid composition, and molecular weights. The α, β, and γ gliadins contain inter-chain disulfide bonds, whereas ω-gliadins lack cysteine residues and do not form these bonds (Wang et al., 2006).

Glutenins: Wheat's polymeric glutenins are insoluble in water, salt solutions, and alcohol. However, they can be solubilized as monomeric glutenin subunits, for example, under specific conditions like using a reducing agent containing 50% propanol. Two classes of glutenin subunits, HMW-GS and LMW-GS, are present in wheat. These subunits are released upon disulfide bond reduction with reducing agents and further classified into four subgroups (A, B, C, and D) based on electrophoretic mobility on SDS-PAGE (Wang et al., 2006).

Advantages: The positive attributes of wheat proteins primarily revolve around three key protein groups, each significantly impacting wheat quality and usage. Gluten proteins, known for determining dough viscoelasticity, hold the potential to trigger celiac disease in susceptible individuals. Puroindolines play a crucial role in determining grain texture, while amylase/trypsin inhibitors, implicated in triggering celiac disease and non-celiac wheat sensitivity, also act as food and respiratory allergens. Enhanced applications of nitrogen fertilizer in wheat cultivation have shown a correlation with an increased proportion of gliadin proteins, subsequently boosting dough extensibility. Studies have indicated that wheat, being a rich source of dietary fiber concentrated in bran, supports gut health by adding bulk to stool as most bran passes almost unchanged through the digestive system. Furthermore, numerous studies suggest that wheat grain may play a role in reducing the risk of colon cancer. Certain components present in grains, such as protein and B vitamins, contribute significantly to human growth and health. The nutritional quality of wheat protein depends on the proportions of essential amino acids, crucial for various bodily functions. White flour, in contrast to whole grain, contains fewer essential amino acids due to its higher content of lysine-poor prolamin storage proteins, specifically gluten proteins in the starchy endosperm (Shewry, 2007, Shewry et al., 2009).

Disadvantages: Wheat protein, a common food allergen, triggers allergic reactions in many individuals. Consumption of wheat protein can lead to severe allergic reactions, including anaphylaxis, which can be life-threatening for those with food allergies. The most prevalent allergic response to wheat is not just food-related but also includes an allergic reaction to inhaled flour and dust, commonly termed bakers' asthma. This condition predominantly affects workers handling wheat grain in poorly ventilated mills, ranking as the second most common type of occupational asthma in the United Kingdom.

Celiac disease, a well-defined condition, is primarily triggered by glutamine-rich sequences found in gluten proteins. It leads to a harmful immune reaction against gluten, damaging the small intestine and impairing nutrient absorption. This results in various associated symptoms such as weight loss, bloating, flatulence, diarrhea, constipation, stomach pain, and fatigue. Additionally, there are suggestions that gluten might contribute to certain brain disorders in individuals affected by celiac disease, including schizophrenia and epilepsy. In contrast to allergies and celiac disease, wheat sensitivity lacks a clear definition and presents a spectrum of reported symptoms, encompassing gastrointestinal issues, tiredness, headaches, dermatitis, muscle and joint pains, as well as psychological symptoms like depression, anxiety, and anemia (Sapone et al., 2012).

Impact of Wheat Proteins on Human Health: While wheat proteins, including gluten, gliadins, and glutenins, are integral components of wheat, their role in disease prevention is not commonly acknowledged. They can pose challenges for individuals with conditions such as celiac disease, gluten sensitivity, or wheat allergy. Optimal disease prevention and health promotion are better achieved through a well-rounded diet, emphasizing whole grains, fruits, vegetables, lean proteins, and other nutrient-rich foods.

Nutrient Content and Health Benefits: Wheat serves as a significant protein source, primarily through its gluten proteins. These proteins provide essential amino acids crucial for various bodily functions, contributing to overall health (Shewry and Hey, 2015).

Celiac Disease and Gluten Sensitivity: Celiac disease, an autoimmune disorder triggered by consuming gluten-containing grains, particularly wheat, damages the small intestine's lining, leading to diverse gastrointestinal and systemic symptoms (Lebwohl et al., 2018). Non-celiac gluten sensitivity (NCGS) is another condition marked by gastrointestinal and extra-intestinal symptoms in response to gluten, without the autoimmune response typical of celiac disease (Sapone et al., 2012).

Protein Quality" Wheat's protein quality is considered moderate and can be a part of a healthy diet when consumed in appropriate quantities. It is comparatively lower in certain essential amino acids compared to animal-based proteins (Gilani et al., 2012).

Wheat Allergy: Some individuals may encounter allergic reactions to wheat proteins, a distinct issue from celiac disease and gluten sensitivity. Symptoms of wheat allergy might include hives, breathing difficulties, and digestive problems (Nowak-Wegrzyn and Sampson, 2006).

CONCLUSION

Wheat, a foundational cereal grain vital in human agriculture and nutrition for millennia, contains essential proteins such as gluten, gliadins, and glutenins, comprising a significant portion of its nutritional content. While contributing to product quality, these proteins can also trigger conditions like celiac disease, gluten sensitivity, and wheat allergies. A well-balanced diet emphasizing whole grains and nutrient-rich foods remains

pivotal for overall well-being, particularly for those with sensitivities related to wheat consumption.

REFERENCES

Atwell, W. A. & Finnie, S. 2016. *Wheat flour*, Elsevier.

Belderok, B., Mesdag, J. & Donner, D. A. 2000. *Bread-making quality of wheat: a century of breeding in Europe*, Springer Science & Business Media.

D'ovidio, R. & Masci, S. 2004. The low-molecular-weight glutenin subunits of wheat gluten. *Journal of cereal science,* 39**,** 321-339.

Gilani, G. S., Xiao, C. W. & Cockell, K. A. 2012. Impact of antinutritional factors in food proteins on the digestibility of protein and the bioavailability of amino acids and on protein quality. *British Journal of Nutrition,* 108**,** S315-S332.

Khalid, A., Hameed, A. & Tahir, M. F. 2023. Wheat quality: A review on chemical composition, nutritional attributes, grain anatomy, types, classification, and function of seed storage proteins in bread making quality. *Frontiers in Nutrition,* 10**,** 1053196.

Kumar, A., Kapoor, P., Chunduri, V., Sharma, S. & Garg, M. 2019. Potential of Aegilops sp. for improvement of grain processing and nutritional quality in wheat (Triticum aestivum). *Frontiers in Plant Science,* 10**,** 308.

Lafiandra, D. 1997. F. Macritchie. *Food Proteins and Their Applications,* 80**,** 293.

Lebwohl, B., Sanders, D. S. & Green, P. H. 2018. Coeliac disease. *The Lancet,* 391**,** 70-81.

Nowak-Wegrzyn, A. & Sampson, H. A. 2006. Adverse reactions to foods. *Medical Clinics,* 90**,** 97-127.

Rashid, R., Shafiq, I., Akhter, P., Iqbal, M. J. & Hussain, M. 2021. A state-of-the-art review on wastewater treatment techniques: the effectiveness of adsorption method. *Environmental Science and Pollution Research,* 28**,** 9050-9066.

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.

Shewry, P., D'ovidio, R., Lafiandra, D., Jenkins, J., Mills, E. & Bekes, F. 2009. Wheat grain proteins Pp. 223–298 in Khan K. and Shewry PR, eds. *Wheat: chemistry and technology, 4th edn AACC, St Paul, MN, USA.*.

Shewry, P. R. 2007. Improving the protein content and composition of cereal grain. *Journal of cereal science,* 46**,** 239-250.

Shewry, P. R. & Hey, S. J. 2015. The contribution of wheat to human diet and health. *Food and energy security,* 4**,** 178-202.

Veraverbeke, W. S. & Delcour, J. A. 2002. Wheat protein composition and properties of wheat glutenin in relation to breadmaking functionality. *Critical reviews in food science and nutrition,* 42**,** 179.

Wang, Y., Khan, K., Hareland, G. & Nygard, G. 2006. Quantitative glutenin composition from gel electrophoresis of flour mill streams and relationship to breadmaking quality. *Cereal Chemistry,* 83**,** 293-299.

Wieser, H. 2007. Chemistry of gluten proteins. *Food microbiology,* 24**,** 115-119.

Žilić, S., Barać, M., Pešić, M., Dodig, D. & Ignjatović-Micić, D. 2011. Characterization of proteins from grain of different bread and durum wheat genotypes. *International journal of molecular sciences,* 12**,** 5878-5894.