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AMINO ACID PROFILING OF WHEAT GRAIN

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ABSTRACT Amino acids are important molecules and also used as Osmo protectants. They are crucial for our bodies and immune function. Deficiency can weaken the immune system, but supplementing specific amino acids may help boost immunity. The amino acid profiles in wheat grains at various developmental stages, ranging from early stages to maturity. High-performance liquid chromatography (HPLC) is employed to quantify the levels of specific amino acids, including glycine and arginine, indicative of the synthesis of distinct proteins. There is also impact of temperature variations on protein stability in wheat grains. Correlation is also seen between amino acid imbalances and skin and central nervous system issues. The findings underscore the critical role of amino acids in wheat grains, not only as essential nutrients but also as contributors to global nutrition. The study elucidates the multifaceted impact of wheat on human health, emphasizing its role as a vital source of energy and essential nutrients.

Keywords: *Wheat; protein; amino acid; Nitrogen metabolism; Immune function*

INTRODUCTION

Amino acids are important molecules for the synthesis of structural proteins and stress proteins. Amino acid can be used as Osmo protectants to resist abiotic stress and they can also adjust the nitrogen metabolism of plants. Low temperature could decrease the protein accumulation and shorten protein active accumulation. Wheat products has contributed to more than 40% of the global protein supplyHu et al. (2022). One of the most important parameters of grain quality is the quantitative content of essential amino acids. The essential amino acid parameter is not stable, and may change depending on wheat variety, weather conditions and agro technology (Hospodarenko et al., 2018). Protein composition significantly affects wheat quality and can be influenced by nitrogen levels and temperature. Gluten storage proteins, including gliadins and glutenin subunits (HMW-GS and LMW-GS), play a crucial role in bread making properties. Higher grain protein content due to nitrogen fertilization or high temperatures might impact the proportions of gliadins and glutenin's, although existing reports vary and raise several unanswered questions. Moreover, the protein synthesis in wheat grain is constrained by its nutrient source, and it accumulates protein based on the amino acids supplied by the phloem. Research indicates there's no limitation in the balance of amino acids and sugars transported through the phloem. However, when certain amino acids like glutamine are abundant in the plant, the transporters responsible for their uptake are reduced (Barneix, 2007).

Profiling: The grains of wheat sample were sieved to eliminate various impurities like rocks and hay following that, the ground sample were placed in dehydrated, sanitized containers for analysis. Wheat protein is Deficient in certain essential amino acids, such as Lysine, isoleucine, threonine, tryptophan, methionine and histidine but abundant in glutamic acid and proline which are dominating nonessential amino acids.

Suggested amount of crucial amino acids for adult humans in comparison to those present in wheat's grain (expressed as mg per gram of protein).

Amino Acids are present in wheat grain but its composition changes in grains as they develop correspond to the increase in storage proteins. Early stages show a higher proportion of glycine, indicating lower gliadin levels. Later, closer to maturity, there's a rise in arginine, suggesting increased synthesis of proteins abundant in this amino acid free glutamate, proline and arginine decrease significantly 15 days after anthesis, potentially limiting protein synthesis (Panozzo et al., 2001) **(**In the free fraction, certain amino acids show similar developmental patterns: Aspartate, arginine, histidine, alanine, valine, leucine, isoleucine, threonine phenylalanine and tyrosine. Both categories show an inverse correlation. Glycine and lysine exhibit a direct association whereas their relationship with glutamate is inversely correlated (Khan et al., 2014).

Table 1: Profiling of amino Acid in wheat grain

Amino acid protein	Grain
Histidine	23
Isoleucine	37
Leucine	68
Lysine	28
Methionone	12
Cysteine	23
Phenylalanine+tyrosine	64
Threonine	29
Valine	44
Total indispensable amino acids	339

Calculated from literature values as described in (Shewry, 2009)

Benefits for human health: Amino acids are super important for our bodies! They help make hormones and other important stuff. It's crucial to have the right balance of amino acids for our overall health. Some specific ones, like arginine, cysteine, glutamine, leucine, proline, and tryptophan, are known as functional amino acids. They have special roles in our body. and immune function. Protein or amino acid deficiency weakens the immune system, making humans and animals more susceptible to infections. Recent research revealed that amino acids play a crucial role in immune response by influencing cell activation, gene expression, and the production of vital immune substances. Supplementing specific amino acids like arginine, glutamine, and cysteine precursors has shown promise in boosting immune status and reducing illness and mortality in malnourished individuals.

Disadvantages: Certain amino acids, when consumed in excess, led to increased levels in both the blood and the brain, with the brain having a barrier that regulates this flow. High glutamic acid diets didn't notably affect other brain amino acid levels, but excessive methionine, tryptophan, histidine, leucine, or phenylalanine decreased other necessary small units of proteins in CNS part brain. High threonine and high lysine diets reduced isoleucine, leucine, and/or arginine levels in the main part of CNS. This suggests multiple transferring ways for units of protein in the CNS (Peng et al., 1973). Imbalance of small units of protein in a diet, leading to reduced food intake or growth. This can be fixed by supplementing the least available essential small units of protein in the meal. Two types of imbalances occur: one arises from a protein or amino acid mix lacking an essential amino acid in a moderately protein-rich diet, while the other stems from adding a small amount of amino acids to a low-protein diet (Harper, 1964).

An old man (47-years) with a glucagonoma, had elevated glucagon, reduced plasma small units of protein, experiencing severe skin issues. Intravenous amino acid supplementation led to mild improvement, while total parenteral nutrition normalized amino acids, swiftly resolving the skin rash, indicating it's likely linked to amino acid deficiency in glucagonoma, reversible via parenteral nutrition (Norton et al., 1979) Small units of protein synthesis defects, despite involving different anabolic and catabolic pathways, often exhibit similar clinical features. In children, these defects primarily damaging brain and spinal cord. Results came like small-sized skull, early seizures, and various type of mental disability. Additionally, skin issues like Cutis laxa in proline synthesis faults, same as a collodion skin and ichthyosis in small unit of protein like serine deficient. Necrolytic erythema in glutamine insufficiency are observed alongside brain abnormalities (de Koning, 2017)**.**

Impacts on human health: While wheat is commonly recognized as a significant source of energy (carbohydrates), it also contains essential nutrients such as proteins, fiber, lipids, vitamins, minerals, and phytochemicals. According to (Shewry and Hey, 2015), wheat plays a crucial role in global nutrition due to the rising demand for wheat-based products. Amino acids, the building blocks of proteins, contribute to various bodily functions. Alanine, for example, is involved in inhibiting pyruvate kinase, hepatic autophagy, gluconeogenesis, and the glucose–alanine cycle. Arginine participates in motor signaling activation, acts as an antioxidant, and regulates gene expression and hormone secretions. Citrulline, Glutamate, Glutamine, and Glycine play roles in arginine synthesis, osmoregulation, bridging the urea cycle with the Krebs cycle, ammonia detoxification, regulation of protein turnover, gene expression, immune function, and acting as a major fuel for rapidly proliferating cells (Wu, 2009). Amino acids contribute significantly to cellular metabolism, nutrition, and various physiological functions. Proline, for instance, is involved in the formation of collagen structure and neurological functions (Lopez, 2020).

When the body doesn't get enough of the important amino acids, like when someone is unable to eat due to issues like vomiting or low appetite, it can lead to various health problems. These problems might show up as feeling down, anxious, having trouble sleeping, feeling very tired, weak, or in children, having trouble growing. This happens because the body can't make essential things like neurotransmitters, hormones, or build and repair muscles when it doesn't have enough of these amino acids. This issue is commonly seen in poorer parts of the world or in older adults who might not be getting the care they need. Kwashiorkor and marasmus are serious health conditions caused

by not eating enough and not getting the right amino acids. Kwashiorkor shows up as swollen body parts, dry flaky skin, problems with the liver and the immune system, anemia, and changes in muscle composition. It happens when the diet lacks protein but has enough carbohydrates. Marasmus, on the other hand, leads to severe weight loss and overall poor nutrition due to not eating enough protein and not getting sufficient calories.

Celiac disease affects around 1% of people in the UK and Western Europe. It's caused by consuming wheat gluten, barley, and rye, containing over 30 specific amino acid sequences that trigger the disease. Gluten proteins, divided into gliadins and glutenin's, contain these triggering sequences. Research shows that gliadins, especially α-gliadins, have more of these sequences compared to glutenin (Sharma et al., 2020).

CONCLUSION

Wheat, a key source of energy and various nutrients, including proteins and amino acids, significantly impacts human health. The amino acid composition in wheat affects grain quality, but variations exist due to factors like temperature and nitrogen levels, influencing protein synthesis. Deficiencies in specific essential amino acids in wheat, such as lysine and tryptophan, can impact human health, leading to issues like impaired growth and overall nutrition. While amino acids play crucial roles in various bodily functions, imbalances or deficiencies can result in conditions like kwashiorkor, marasmus, and even disorders like celiac disease, affecting a significant percentage of the population in some regions. Understanding and addressing these nutritional aspects are vital for promoting better health outcomes.

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