GSC Advanced Research and Reviews

eISSN: 2582-4597 CODEN (USA): GARRC2

Cross Ref DOI: 10.30574/gscarr

Journal homepage: https://gsconlinepress.com/journals/gscarr/

(Research Article)

Check for updates

Characterization of phytochemical and nutritional composition of wheat flour *(Triticum aestivum)*

Victor- Osanyinlusi Remi [1,*] and Obajuluwa Motunrayo Esther [2]

[1] *Department of pharmaceutical Technology, Rufus Giwa Polytechnic Owo Ondo State Nigeria.*

[2] *Department of Science Laboratory Technology (Biochemistry unit), Rufus Giwa Polytechnic Owo Ondo State Nigeria.*

GSC Advanced Research and Reviews, 2025, 22(01), 031-036

Publication history: Received on 25 November 2024; revised on 01 January 2025; accepted on 04 January 2025

Article DOI: https://doi.org/10.30574/gscarr.2025.22.1.0001

Abstract

Wheat grains are a significant component of the human diet, and their cultivation has expanded over the past few decades to meet the needs of the growing population. This study examined the proximate composition, selected mineral contents, and phytochemical properties of wheat flour, which was produced by drying and grinding wheat grains into powder. The findings reveal that wheat flour contains phytochemicals such as alkaloids, carbohydrates, proteins, and saponins in abundance (++ indicating strong presence) but lacks glycosides, tannins, and others. The proximate analysis indicates the presence of fiber (6.001), protein (7.213), carbohydrates (68.701), and others, alongside mineral elements like sodium (85.800), calcium (52.700), and magnesium (65.300), which contribute to healthy growth. The study also shows that the wheat sample is low in fat (2.907), manganese (0.012), and iron (3.010). The health benefits of whole wheat flour are attributed to its bioactive components, such as phytochemicals and dietary fiber.

Keywords Proximate; Food quality; Mineral; Phytochemical; Human diet; Wheat; Food; Suplement

1. Introduction

Wheat (Triticum aestivum) is the primary staple food for over one-third of the global population, contributing more calories and protein to the world diet than any other cereal crop (Shewry, 2009). It is highly nutritious, easy to store, and transportable, and it can be processed into various food types. Wheat serves as a rich source of protein, minerals, B-group vitamins, and dietary fiber. However, environmental factors can influence the nutritional composition of wheat grains. With its essential bran, vitamins, and minerals, wheat is regarded as an excellent food for promoting health (Shewry, 2007). Wheat is a grass cultivated globally for its seeds, which are staple foods. The genus Triticum includes many species, with common wheat (T. aestivum) being the most widely cultivated. Archaeological evidence suggests that wheat cultivation began in the Fertile Crescent around 9600 BCE. Botanically, the wheat kernel is classified as a caryopsis, a type of fruit (Adams et al., 2002). There are hundreds of wheat varieties classified into six major groups based on factors like rainfall, temperature, soil conditions, tradition, planting, and harvesting periods. Additionally, wheat classes are determined by kernel hardness, color, and shape. Wheat flour is widely used to produce bread, biscuits, confectioneries, noodles, and vital wheat gluten. It also serves as animal feed, a raw material for ethanol production, wheat beer brewing, cosmetics, and meat substitutes. Wheat flour contributes to the prevention and treatment of certain digestive disorders (Simmonds, 2005). Nutritionally, wheat comprises approximately 78% carbohydrates, 14% protein, 2% fat, 2% minerals, and significant amounts of vitamins such as thiamine and vitamin B. It is also a rich source of trace minerals like selenium and magnesium, essential for good health (Fraley, 2003). Wheat grains, scientifically known as caryopses, consist of the pericarp or fruit and the seed. About 72% of the protein is stored in the seed's endosperm, constituting 8–15% of the total grain weight. Wheat grains are also rich in pantothenic acid, riboflavin, minerals, and sugars. Globally, billions of people rely on wheat as a dietary staple. Its nutritional significance is especially critical in less-developed countries, where bread, pastries, noodles, and other wheat-based products form

* Corresponding author: Victor- Osanyinlusi Remi

a substantial part of the diet. This study aims to determine the chemical composition of wheat flour by analyzing its proximate composition, phytochemical profile, and selected mineral contents.

2. Materials and methods

2.1. Sample Collection

Wheat (Triticum spp) seeds were purchased from Oba Market in Owo, located in Owo Local Government Area of Ondo State, Nigeria. The sample was taken to the Chemistry Laboratory at Rufus Giwa Polytechnic, Owo, for proper identification and preparation.

2.2. Sample Preparation

The wheat grains were sun-dried for three days, and defective grains were removed. The dried grains were milled using a milling machine and stored in airtight nylon bags until laboratory analysis.

2.3. Materials

The materials used included HCl, H_2SO_4, a weighing balance, filter paper, heating mantle, crucible, thread, beakers, conical flask, distilled water, reagent bottles, chloroform, water bath, acetic acid, and pipette, among others.

2.4. Proximate Analysis

The proximate composition of the wheat sample was analyzed using the standard methods outlined by the Association of Official Analytical Chemists (AOAC, 2010). Parameters such as moisture content, protein, crude fiber, crude fat, and carbohydrate content were evaluated.

2.5. Phytochemical Screening

Phytochemical screening was conducted to detect the presence of tannins, phlobatannins, saponins, steroids, terpenoids, flavonoids, proteins, alkaloids, glycosides, and carbohydrates. This was carried out following the methods described by Eikeme et al. (2009), Gahan (1984), Evans et al. (1997), and Wagner et al. (1993).

2.6. Determination of Mineral Composition

The mineral composition of the sample, including calcium, magnesium, sodium, manganese, and iron, was analyzed using an Atomic Absorption Spectrophotometer (AAS Model: 2000), as per AOAC (2010) standard.

3. Result

Table 1 Results of proximate analysis in percentage (%)

S. N	NUTRIENTS	WHEAT
1	Moisture	10.080
2	Ash	5.098
3	Crude fat	2.907
4	Crude fibre	6.001
5	Crude protein	7.213
6	Carbohydrate	68.701

Table 2 Result of mineral elements (PPM)

S. N	Nutrients	WH
1	Na	85.800
2	Ca	52.700
3	Mg	65.300
4	Fe	3.010
5	Mn	0.012

Table 3 Result of phytochemical screaning of wheat flour

S. N	NUTRIENTS	WH
1	Alkaloids	++ ve
2	Carbohydrates	++ ve
3	Protein	++ ve
4	Phytosterols	- ve
5	Glycosides	- ve
6	Saponnins	++ ve
7	Tannins	- ve
8	Phlobatannins	- ve
9	Terpenoids	- ve
10	Flavonoids	- ve
11	Steroids	- ve

++ (Very present), - (Absent).

4. Discussion

4.1. Proximate Analysis

Table 1 presents the results of the proximate analysis of wheat powder, including protein, fat, ash, crude fiber, total carbohydrates, and moisture content. Wheat flour was found to contain approximately 7% protein, 10% moisture, 5% ash, 6% fiber, and 3% fat. The protein content aligns closely with results (8.67–12.47) reported by Saeid et al. (2015) and is comparable to the range (7.158–7.964) observed in plantain flour by Remi O. (2023). However, it is lower than the 14.70% reported by Adams et al. (2002) and 12.86% reported by Morris et al. (1999) for wheat flour. Variations in crude protein content are likely due to geographical differences, as nitrogen-rich soils can enhance protein levels (Brown, 1991). The protein content in this study suggests that wheat flour may be valuable in food formulation, as a high-protein diet supports energy production and tissue repair.

Crude fiber, the indigestible portion of food essential for human diets, was recorded at 6% in this study. This value exceeds the 1.2% reported by Abd El-Hafez (2015) and 1.23% and 0.85% reported by Leach et al. (1959) for brown rice flour and refined flour, respectively. High fiber content promotes digestion and bowel cleansing, helping prevent heart diseases, colon cancer, and diabetes. Although the fiber content in wheat flour is relatively low (6%), it can be enhanced by incorporating fiber-rich foods, forming a composite flour to combat constipation and related conditions.

The wheat flour analyzed in this study showed a high carbohydrate content of 68%, classifying it as a starch-rich food. This aligns with the 67% reported by Remi O. (2023) for plantain flour, likely due to their shared role as staple foods. Carbohydrates serve as a vital energy source, making wheat flour suitable for breakfast meals and weaning foods (Butt and Batool, 2010).

The low moisture content (10%) observed indicates that the flour can be stored at room temperature for extended periods without spoilage. Moisture content plays a crucial role in predicting the shelf life of food products. A low moisture level prevents microbial and fungal growth, enhancing storage stability (Remi O., 2023). The 10% moisture content in this study meets the acceptable limit for long-term flour storage (Singh et al., 2005). However, it exceeds the 7.75% reported by Sui et al. (2006).

Ash content, representing the inorganic residue after burning organic matter, was found to be 5%. This value exceeds the 2.53% reported for mung bean and chickpea flour (Arawande and Borokini, 2010) and the 1.40% for refined wheat flour (Leach et al., 1959). The higher ash content in this study may result from processing differences. Ash content reflects mineral presence, suggesting that wheat flour can serve as a mineral source. This can be further enhanced by incorporating mineral-rich flours.

The fat content of wheat flour was recorded at 2%, higher than the 1.5% reported by Akpapunam and Sefa-Dedeh (1997). Differences in fat content may be due to variations in location and wheat species (Moss et al., 1987). Although fat contributes significantly to energy needs, the low fat content in wheat flour suggests that fortification may be necessary for applications like pastries, snacks, or traditional dishes like amala (Remi O., 2023).

4.2. Mineral Composition

Table 2 reveals that manganese (Mn) had the lowest content (0.012), while sodium (85.800), magnesium (65.300), and calcium (52.700) were abundant, meeting dietary requirements without fortification. These values align with those reported by Cara et al. (1992). The iron content (3.010) was low, consistent with the 2.1% reported by Abd El-Hafez (2015). Wheat flour is a good source of sodium, magnesium, and calcium but may require fortification to meet daily iron requirements. Comparatively, plantain flour, with iron content ranging from 0.6–0.8% (Remi O., 2023), also has low iron levels. Minerals, being non-volatile, are essential for maintaining health and cannot be destroyed by heat.

4.3. Phytochemical Analysis

Table 3 indicates that alkaloids, proteins, carbohydrates, and saponins were abundantly present, while terpenoids, flavonoids, steroids, tannins, phlobatannins, glycosides, and phytosterols were absent. These findings are consistent with Olubunmi et al. (2023), who reported similar results for wheat samples. Alkaloids exhibit antimicrobial, anti-inflammatory, and analgesic properties, while saponins contribute to hypolipidemic, antioxidant, and anticancer activities. They also assist in treating heart failure and cardiac rhythm disorders. Though flavonoids and tannins were absent, they are recognized for their anticancer properties. Terpenoids and cardiac glycosides, known for their analgesic, antibiotic, and anti-inflammatory effects, offer significant therapeutic benefits (Ludwiczuk and Georgiev, 2017; Firn, 2010).

5. Conclusion

This study demonstrates that wheat is a nutrient-rich plant-based food containing fiber, carbohydrates, minerals, and protein. These nutrients make it suitable for supplying energy, repairing tissues, and offering storage stability due to its low moisture content (10%).

Recommendation

Given wheat flour's high carbohydrate, fiber, protein, sodium, and calcium content, it can play a role in preventing and managing health conditions such as cancer, cardiovascular diseases, and diabetes. Incorporating mineral-rich flours can enhance its ash content and fortify it with iron. Further studies are recommended to explore the relationship between wheat flour and other edible flours from diverse sources.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] A. M. M. Abd El-Hafez (2015)Chemical Nutritional and Sensory Properties of Wheat Flour Balady Bread Fortified by the Mixture of Wheat Germ and Doum Fruit Powders. International journal of science and research. Vol.4 issue 3

[2] A.Saeid, S.Hoque, U.Kumar, M.Das, N.Muhammad, M.M.Rahman and M.Ahmed., Comparative study on nutritional quality of commercial wheat flour in Bangladesh. Bangladesh j.sci.Ind. R. s. 50(3),180-188 2015

[3] Adams, M.L., Lombi, E., Zhao, F.J. and McGrath, S.P. (2002).Evidence of low selenium concentrations in UK bread-making wheat grain. *Journal of the Science of Food and Agriculture,* 82: 1160–1165.

[4] Adams, M.L., Lombi, E., Zhao, F.J. and McGrath, S.P. "Evidence of low selenium concentrations in UK bread-making wheat grain" Journal of the Science of Food and Agriculture, Vol. 82 pp. 1160–1165, 2002.

[5] Akpapunam, M.A. and Sefa-Dedeh, S., "Jack bean (Canavalia ensiformis) Nutrition related, Aspects and Needed Nutrition Research", Journal of Plant Food for Human Nutrition, Vol. 10 pp. 123-127, 1997.

[6] Alverson, L., Elwers, S., Zambrano, A., Rohsius, C. and Lieberei, R. (2009). Survey of Ghanaian cocoa farmer fermentation practices and their influence on cocoa flavor*. Food Chem* 51: 425–431.

[7] AOAC (2000). Official Methods of Analysis. Association of Official Analytical Chemists, Washington D.C.

[8] AOAC. Official Methods of Analyses, Food Compositions; Additives, Natural Contaminants). Association of Official Analytical Chemist (15th Ed; 980.13), Arlington, USA, 1990.

[9] Arawande .J.Olalekan and Borokini .F. Bosede, "Comparative Study on Chemical Composition and Functional Properties of Three Nigerian Legumes (Jack Beans, Pigeon Pea and Cowpea)" Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS) 1 (1): 89-95, 2010. © Scholarlink Research Institute Journals

[10] Blechl, A., Lin, J., Nguyen, S., Chan, R., Anderson, O.D. and Dupont, F.M. (2007). Transgenic wheats with elevated levels of Dx5 and/or Dy10 high molecular weight glutenin subunits yield doughs with increased mixing strength and tolerance. *Journal of Cereal Science*, 45: 172–183

[11] Brown, K. H., "The importance of Dietary Quality versus Quantity for weanlings in the developed countries", A Framework for Discussion. Food and Nutrition Bulletin. 13 (2): 86-93, 1991.

[12] Butt and MS Batool R., "Nutritional and Functional Properties of Some Promising Legumes Protein Isolates", Pak, J. Nutri. 9(4): 373-379, 2010.

[13] Cartera, J.W., Madlb, R. and Padulac, F. (2006). Wheat antioxidants suppress intestinal tumor activity in Min mice. *Nutrition Research*, 26 (1): 33-38.

[14] Drankham, K., Carter, J., Madl, R., Klopfenstein, C., Padula, F., Lu, Y., Warren, T., Schmitz, N. andTakemoto, D.J.(2003).Antitumor activity of wheats with high orthophenolic content.*Nutrition and Cancer*, 47: 188–194.

[15] Ekikeme CM, Ezeonu CS, Eboatu AN. " Determination of physical and phytochemical constituents of some tropical timbers indigenous to Niger Delta Area of Nigeria", European D.C. USA 15th Edn, 807-928.

[16] Evans WC. "Treaseand Evans Pharmacognosy", Harcourt Brace and company. Asia Pvt. Ltd. Singapore, 1997.

[17] Firn, R. (2010): Nature's Chemicals. Oxford University Press, Oxford. Pp 74-75.

[18] Fraley, R.T.(2003). Improving the nutritional quality of plants. In: Vasil IK (ed) Plant biotechnology 2002 and beyond. Kluwer, Dordrecht, pp 61–67.

[19] Gahan PB. "Plant Histochemistry and Cytochemistry: An Introduction. Academic Press, Florida, U.S.A, 1984.

[20] Goldberg G. (2003). Plants: diet and health. Report of a British Nutrition Foundation Task Force, Oxford, UK: Blackwell Science. Grant, E.C. (2009). Food allergies and migraine.Lancet, 1: 66–69.

[21] Hadjivassiliou, M., Grunewald, R.A. and Davies-Jones, G.A.B. (2002).Gluten sensitivity as a neurological illness.*Journal of Neurology, Neurosurgery and Psychiatry*, 72: 560–563.

[22] Hadjivassiliou, M., Grunewald, R.A., Sharrack, B., Sanders, D., Lobo, A., Williamson, C., Woodroofe, N., Wood, N. and Davies-Jones, A. (2003). Gluten ataxia in perspective: epidemiology, genetic susceptibility and clinical characteristics. *Brain*, 126: 685–691.

[23] He, Y.Z., Milford, A.H., Yusuf, A. and Nan L. (1996).Yellow nut-sedge (*Cyperusesculentus L.*) tuber oil as a fuel. 5: 177-181.

[24] Jacobs, D.R., Meyer, K.A., Kushi, L.H. and Folsom, A.R. (2008b). Whole-grain intake may reduce the risk of ischemic heart disease death in postmenopausal women: the Iowa women's health study. *American Journal of Clinical Nutrition*, 68: 248–257.

[25] L.A. Cara, P. Borel, M. Senft, H. Protucel, A. Pauli, H. Lafont and D. Lairon, "Long-term wheat germ intake beneficially affects plasma lipids and lipoproteins in hyper cholestrolemic human subjects", J. Nutr., 122- 317, 1992.

[26] Leach HW, McCowen LD, Scoch T.J., "Structure of starch granule Swelling and solubility patterns of various starches", Cereal chem., 36: 534-544, 1959.

[27] Ludwiczuk and Georgiev (2017). Fundamentals, Applications and Strategies. Pharmacognosy 233- 266. DOI: https://doi.org/10.1016/B978-0-12-8021040.00011-1.

[28] Morris, M.L., Tripp, R. and Dankyi. A. A., "Adoption and Impacts of Improved Maize Production Technology: A Case Study of the Ghana Grains Development Project Economics Program", No 99-01, Mexico, D.F., 1999.

[29] Moss, R., Gore, P.J. and Murray, I.C., "The influence of ingredients and processing variables on the quality and microstructure on Hokkien, Cantonese and instant noodles" Food Microstructure. Vol. 6, 63-74, 1987.

[30] Neuhausen, S.L., Steele, L., Ryan, S., Mousavi, M., Pinto, M., Osann, K.E., Flodman, P. and Zone, J.J. (2008). Co-occurrence of celiac disease and other autoimmune diseases in celiacs and their first-degree relatives.Journal of Autoimmunity, 31: 160–165.

[31] O. Remi (2023). Nutritional composition of processed and unprocessed samples of unripe plantain (Musa × paradisiaca) Journal of Advanced Education and Sciences, 2023; ISSN NO: 2583-2360, 3(1):75-81.

[32] Reddy, B.S., Hirose, Y., Cohen, L.A., Simi, B., Cooma, I. and Rao, C.V. (2000). Preventive potential of wheat bran fractions against experimental colon carcinogenesis: *implications for human colon cancer prevention. Cancer Research*, 60: 4792–4797.

[33] Shewry, P.R. (2007). Improving the protein content and composition of cereal grain. *Journal of Cereal Science,* 46: 239–250.

[34] Shewry, P.R. (2009). The HEALTHGRAIN programme opens new opportunities for improving wheat for nutrition and health. *Nutrition Bulletin*, 34(2): 225–231.

[35] Shewry, P.R. and Jones, H.D. (2005). Transgenic wheat: where do we stand after the first 12 years? *Annals of Applied Biology*, 147: 1–14.

[36] Shewry, P.R., Powers, S., Field, J.M., Fido, R.J., Jones, H.D., Arnold, G.M., West, J., Lazzeri, P.A., Barcelo, P., Barro, F., Tatham, A.S., Bekes, F., Butow, B. and Darlington, H. (2006). Comparative field performance over three years and two sites of transgenic wheat lines expressing HMW subunit transgenes.*Theoretical and Applied Genetics,* 113: 128–136.

[37] Simmonds, D.H. (2005). Inherent Quality Factors in Wheat. Wheat and Wheat Quality in Australia. Australia Wheat Board, Melbourne, pp. 31–61.

[38] Singh, A., Hung, Y., Corredig, M., Phillips, R. D., Chinnan, M. S. and McWatters, K. H., "Effect of milling method on selected physical and functional properties of cowpea (Vigna unguiculata) paste", International Journal of Food Science and Technology, Vol. 40, pp. 525-536, 2005.

[39] Sui, Z., Lucas, P.W. and Corke, H., "Optimal cooking time of noodles related to their notch sensitivity", Journal of Texture Studies. Vol. 37, pp. 428–441, 2006.

[40] Topping, D.(2007).Cereal complex carbohydrates and their contribution to human health.*Journal of Cereal Science,* 46: 220–229.

[41] Wagner H, Pharmazeutische Biologic", 5 th Edition, AUFI.15 BN 3-437-20 498-X, 1993.