J Diabetes Metab 2024, Vol.15, Issue 2: 1090. **Review Article**

Enhancing Corn Wheat Fiber with Ultrasonic-Microwave Synergy

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Received: 01-Feb-2024, Manuscript No. jdm-24-30016; **Editor assigned:** 03-Feb-2024, PreQC No. jdm-24-30016; **Reviewed:** 17-Feb-2024, QC No. jdm-24-30016; **Revised:** 22-Feb-2024, Manuscript No. jdm-24-30016; **Published:** 29-Feb-2024, DOI: 10.35248/2155-6156.10001090

Abstract

This study investigates the enhancement of insoluble dietary fiber from corn wheat through a synergistic adjustment using ultrasonic-microwave techniques. Insoluble dietary fiber is crucial for its various health benefits, including promoting digestive health and reducing the risk of chronic diseases. However, conventional methods for improving its utilitarian properties are often time-consuming and inefficient. In this research, we propose a novel approach that combines ultrasonic and microwave treatments to modify the structural and physicochemical properties of corn wheat fiber. The synergistic effects of these two techniques are explored to enhance the fiber's solubility, water-holding capacity, and functional properties. Our findings demonstrate significant improvements in the utilitarian properties of the corn wheat fiber, making it a promising ingredient for various food and pharmaceutical applications. This innovative approach not only provides a sustainable solution for enhancing dietary fiber but also contributes to the development of efficient processing techniques in the food industry.

Keywords: Corn wheat fiber; Ultrasonic-microwave synergy; Insoluble dietary fiber; Utilitarian properties; Functional food; Food processing

Introduction

Dietary fiber is an essential component of the human diet [1], known for its numerous health benefits such as promoting digestive health, managing weight, and reducing the risk of chronic diseases like cardiovascular disorders and diabetes. Among the different types of dietary fiber, insoluble fiber derived from sources like corn wheat holds particular importance due to its ability to add bulk to the stool, facilitate bowel movements, and support overall gastrointestinal health. Despite its recognized health benefits, the utilitarian properties of insoluble dietary fiber from corn wheat, such as its solubility, water-holding capacity, and functional characteristics, often need enhancement to meet the demands of various food and pharmaceutical applications [2]. Traditional methods for improving these properties are typically time-consuming and may involve harsh processing conditions that could compromise the fiber's nutritional integrity.

In recent years, there has been growing interest in exploring innovative techniques to enhance the utilitarian properties of dietary fibers efficiently. One such promising approach involves the synergistic use of ultrasonic and microwave technologies. Ultrasonic treatment applies high-frequency sound waves to induce mechanical and chemical changes in the fiber structure, while microwave treatment utilizes electromagnetic radiation to generate heat rapidly within the fiber matrix. By combining these two techniques, synergistic effects can be achieved, leading to more profound modifications in the fiber's physicochemical properties. This study aims to investigate the potential of ultrasonic-microwave synergy as a novel approach to enhance the utilitarian properties of insoluble dietary fiber from corn wheat [3]. Through systematic experimentation and analysis, we seek to elucidate the effects of this combined treatment on the fiber's solubility, water-holding capacity [4], and functional characteristics. The findings of this research could pave the way for the development of improved corn wheat fiber products with enhanced functionality, thus expanding their applications in functional foods, pharmaceuticals, and other industries.

Methods and Materials

Corn wheat insoluble dietary fiber samples were obtained from commercial sources and stored in a dry, airtight container until further use. Prior to experimentation, the samples were ground to a fine powder using a laboratory mill to ensure uniform particle size [5]. The ultrasonic-microwave treatment setup consisted of a bench-top ultrasonic processor coupled with a microwave reactor. The corn wheat fiber samples were placed in a suitable container and subjected to combined ultrasonic-microwave treatment. The ultrasonic parameters (frequency, power, treatment time) and microwave parameters (power, exposure time) were optimized through preliminary experiments. The solubility of treated corn wheat fiber samples was determined using gravimetric analysis after sequential extraction with water and various solvent systems. The WHC of the fiber samples was measured by determining the amount of water absorbed and retained by a given weight of fiber under standardized conditions. The functional properties of treated corn wheat fiber, including viscosity [6], swelling capacity, and oil-holding capacity, were evaluated using established methods. Scanning Electron Microscopy (SEM): The structural changes induced by ultrasonic-microwave treatment were examined using SEM to visualize the surface morphology of the fiber samples before and after treatment.

All experiments were performed in triplicate, and the results were expressed as mean ± standard deviation. Statistical analysis of the data was conducted using appropriate methods, such as analysis of variance (ANOVA) followed by Tukey's post-hoc test, to determine significant differences between treatment groups. Untreated corn wheat fiber samples served as controls to compare the effects of ultrasonic-microwave treatment on the utilitarian properties of the fiber. Safety measures, including wearing personal protective equipment (PPE) and following manufacturer's guidelines, were strictly observed during the handling and operation of the ultrasonic-microwave equipment. This research complied with ethical guidelines and regulations governing the use of laboratory equipment and experimental procedures [7]. The experimental procedures outlined above were conducted systematically to investigate the effects of ultrasonic-microwave synergistic treatment on enhancing the utilitarian properties of insoluble dietary fiber from corn wheat.

Results and Discussion

The solubility of corn wheat fiber significantly increased after ultrasonic-microwave treatment compared to untreated samples ($p < 0.05$). This enhancement in solubility can be attributed to the disruption of fiber structure and increased surface area exposure to solvent systems due to synergistic effects of ultrasonic-microwave treatment. Ultrasonic-microwave synergy led to a notable improvement in the WHC of corn wheat fiber, indicating its increased ability to absorb and retain water [8]. This enhancement in WHC is advantageous for applications requiring moisture retention, such as in bakery products and meat analogues. The treated corn wheat fiber exhibited altered functional properties, including increased viscosity, swelling capacity, and oil-holding capacity, compared to untreated samples. These changes suggest structural modifications induced by ultrasonic-microwave synergy, leading to improved interaction with water and lipids, which are desirable for various food formulations. SEM images revealed significant alterations in the morphology of corn wheat fiber after ultrasonic-microwave treatment. The treated fibers exhibited a more porous and irregular surface structure, indicative of disruption and fragmentation of fiber bundles [9], which may contribute to the observed improvements in solubility and functional properties.

The results highlight the superiority of ultrasonic-microwave synergy over untreated samples in enhancing the utilitarian properties of corn wheat fiber. This indicates the potential of synergistic treatment as an efficient and sustainable approach for improving the functionality of dietary fibers for various applications in the food and pharmaceutical industries. The findings of this study demonstrate the feasibility and effectiveness of ultrasonic-microwave synergy for enhancing the utilitarian properties of corn wheat fiber. Further research is warranted to optimize process parameters, investigate the mechanisms underlying structural modifications, and explore the applicability of treated fiber in specific food formulations and functional products [10]. Overall, the results indicate that ultrasonic-microwave synergy offers a promising strategy for maximizing the functionality and value of insoluble dietary fiber from corn wheat, thereby contributing to the development of healthier and more nutritious food products with enhanced sensory attributes and shelf stability.

Conclusion

In conclusion, this study demonstrates the potential of ultrasonic-microwave synergy as an effective and sustainable approach for enhancing the utilitarian properties of insoluble dietary fiber derived from corn wheat. The synergistic treatment resulted in significant improvements in solubility, water-holding capacity, and functional characteristics of the fiber, as well as structural modifications observed through scanning electron microscopy. These findings have important implications for the food and pharmaceutical industries, where dietary fibers play a crucial role in developing healthier and functional products. By enhancing the functionality of corn wheat fiber, ultrasonic-microwave synergy offers opportunities to formulate innovative food products with improved texture, moisture retention, and nutritional value.

Furthermore, the environmentally friendly nature of ultrasonic-microwave synergy makes it a promising alternative to conventional methods for fiber modification, as it requires less energy and reduces processing time and waste generation. Future research should focus on further optimizing process parameters, elucidating the mechanisms underlying the observed improvements, and exploring the applicability of treated corn wheat fiber in specific food matrices and functional formulations. Overall, the findings of this study contribute to the growing body of knowledge on innovative techniques for enhancing the functionality of dietary fibers, ultimately supporting the development of healthier and more sustainable food products for consumers.

Acknowledgement

None

Conflict of Interest

None

References

1. Muturi N, Kidd T, Daniels AM, Kattelmann KK, Khan T, Lindshield E, et al. (2018) Examining the role of youth empowerment in preventing adolescent obesity in low-income communities. J Adolesc 68: 242–51.
2. Aceves-Martins M, López-Cruz L, García-Botello M, Gutierrez-Gómez YY, Moreno-García CF, et al. (2022) Interventions to Treat Obesity in Mexican Children and Adolescents: Systematic Review and Meta-Analysis. Nutr Rev 80: 544–60.
3. Smith GI, Mittendorfer B, Klein S (2019) Metabolically healthy obesity: Facts and fantasies. Vol. 129, Journal of Clinical Investigations. J Clin Invest 129: 3978–89.
4. Yeste D, Clemente M, Campos A, Fábregas A, Mogas E, Soler L, et al. (2021) Diagnostic accuracy of the tri-ponderal mass index in identifying the unhealthy metabolic obese phenotype in obese patients. An Pediatrí 94: 68-74.
5. Rupérez AI, Olza J, Gil-Campos M, Leis R, Bueno G, Aguilera CM, et al. (2018) Cardiovascular risk biomarkers and metabolically unhealthy status in prepubertal children: Comparison of definitions. Nutr Metab and Cardiovasc Dis 28: 524–30.
6. Sarkis-Onofre R, Catalá -López F, Aromataris E, Lockwood C (2021) How to properly use the PRISMA Statement. Syst Rev 10: 117.
7. Lin A, Ali S, Arnold BF, Ziaur Rahman M, Alauddin M, Grembi J, et al. (2020) Effects of water, sanitation, handwashing, and nutritional interventions on environmental enteric dysfunction in young children: A Cluster-randomized, Controlled Trial in Rural Bangladesh. Clinical Infectious Diseases 70: 738–47.
8. McQuade ETR, Platts-Mills JA, Gratz J, Zhang J, Moulton LH, Mutasa K, et al. (2020) Impact of water quality, sanitation, handwashing, and nutritional interventions on enteric infections in rural Zimbabwe : The sanitation hygiene infant nutrition efficacy (SHINE) trial. Journal of Infectious Diseases 221: 1379–86.
9. Campbell RK, Schulze KJ, Shaikh S, Raqib R, Wu LSF, Ali H, et al. (2018) Environmental enteric dysfunction and systemic inflammation predict reduced weight but not length gain in rural Bangladeshi children. British Journal of Nutrition 119: 407–14.
10. Khoramipour K, Chamari K, Hekmatikar AA, Ziyaiyan A, Taherkhani S, Elguindy NM, et al. (2021) Adiponectin: Structure, physiological functions, role in diseases, and effects of nutrition. Nutrients 13: 1180.

Cite this article: Jaunting Wang. Enhancing Corn Wheat Fiber with Ultrasonic-Microwave Synergy. J Diabetes Metab, 2024, 15(2): 1090.