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Commentary

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Impact of Germination on Maize Starch Structure, Flour Attributes and Gastric Digestion Characteristics

Sanibel Yahoos*

Department of Food Science and Engineering, Jilin Agricultural University, China

Abstract

Germination is known to induce significant changes in the biochemical composition and structural properties of grains. This study investigates the impact of germination on maize starch structure, flour attributes, and gastric digestion characteristics. Maize seeds were subjected to controlled germination conditions, followed by analysis using various techniques including scanning electron microscopy (SEM), X-ray diffraction (XRD), and in vitro gastric digestion assays. Results revealed substantial alterations in maize starch structure post-germination, characterized by increased amylose content and altered granule morphology as observed through SEM imaging. XRD analysis indicated modifications in the crystalline structure, potentially affecting the digestibility properties of maize flour. Furthermore, germinated maize flour exhibited distinct rheological properties, with implications for its applicability in food processing and product development.

In vitro gastric digestion assays demonstrated enhanced digestibility of germinated maize flour, attributed to the breakdown of starch granules and altered physicochemical properties. These findings suggest that germination-induced changes in maize starch structure and flour attributes could influence its nutritional profile and gastrointestinal response upon consumption. Overall, this study provides valuable insights into the effects of germination on maize grain quality and highlights its potential to enhance the functional properties and digestibility of maize-based food products. This abstract encapsulates the key findings and implications of the study on the impact of germination on maize starch and flour characteristics, as well as its relevance for digestive processes.

Keywords: Germination; Maize; Starch structure; Flour attributes; Gastric digestion; In vitro

Introduction

Maize (Zea mays L.) is one of the most important cereal crops worldwide [1], serving as a staple food for millions of people and a vital component of animal feed and industrial products. Its nutritional value and functional properties largely depend on the composition and structural organization of its major constituent, starch. Starch, primarily composed of amylose and amylopectin, undergoes structural modifications during grain development and post-harvest processing, influencing its physicochemical properties and digestibility. Germination [2], a natural biological process initiated by seed hydration and enzymatic activation, has been recognized as a potential strategy to enhance the nutritional quality and functional attributes of grains. During germination, various metabolic pathways are activated, leading to biochemical changes in the grain composition, including alterations in starch structure and enzyme activity. These changes may impact the processing and nutritional properties of germinated grains and their derived products [3]. Previous studies have reported significant alterations in starch properties, flour characteristics, and digestibility profiles following grain germination in various cereal crops. However, limited research has been conducted to comprehensively investigate the effects of germination on maize starch structure, flour handling qualities, and gastric digestion characteristics. Understanding these effects is essential for optimizing the utilization of germinated maize in food and feed applications and enhancing its nutritional value and digestibility. Therefore, this study aims to elucidate the impact of germination on maize starch structure, flour attributes, and in vitro gastric digestion characteristics [4,5]. By employing a combination of analytical techniques and digestion assays, we seek to uncover the underlying mechanisms governing the observed changes and their implications for maize-based food products and human health.

Materials and Methods

Commercially available maize seeds were selected for the study. Seeds were cleaned and sorted to remove debris and damaged grains [6]. Maize seeds were subjected to controlled germination conditions in a germination chamber. Germination parameters including temperature, humidity, and duration were optimized based on preliminary experiments and literature review. Germinated seeds were harvested at predetermined time points to capture different stages of germination. Germinated maize seeds were dried to a standardized moisture content to minimize variability. Dried seeds were milled into fine flour using a laboratory-scale mill. Scanning Electron Microscopy (SEM) was employed to visualize the morphology of starch granules. X-ray Diffraction (XRD) analysis was conducted to determine the crystalline structure of maize starch. Proximate analysis was performed to determine moisture content, protein content, lipid content, ash content, and carbohydrate content of maize flour. Particle size distribution of flour particles was measured using laser diffraction.

The rheological properties of maize flour suspensions were evaluated using a remoter [7]. Parameters such as viscosity, shear stress, and shear rate were measured under controlled conditions. Simulated gastric digestion assays were conducted to assess the digestibility of maize flour. Enzymatic digestion was simulated using pepsin under controlled pH and temperature conditions. Digestion kinetics was monitored by measuring the release of reducing sugars over time using

***Corresponding author:** Sanibel Yahoos, Department of Food Science and Engineering, Jilin Agricultural University, China, E-mail: sanil.yah@hoos.com

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spectrophotometric methods. Data obtained from experiments were subjected to statistical analysis using appropriate software. Analysis of variance (ANOVA) and Tukey's post-hoc test were performed to determine significant differences between samples. Experiments were conducted in triplicate to ensure reproducibility of results. Quality control measures were implemented throughout the experimental procedures to minimize variability [8]. This section outlines the materials, experimental procedures, and analytical techniques used in the study to investigate the impact of germination on maize starch structure, flour attributes, and gastric digestion characteristics.

Results and Discussion

SEM imaging revealed notable changes in the morphology of maize starch granules following germination. Germinated maize starch exhibited altered granule size, shape, and surface structure compared to non-germinated starch [9]. These structural modifications may be attributed to enzymatic activities during germination, leading to starch degradation and rearrangement. Proximate analysis demonstrated variations in the composition of germinated maize flour compared to non-germinated flour. Germination resulted in changes in moisture content, protein content, lipid content, and carbohydrate composition of maize flour. Particle size distribution analysis indicated differences in the size distribution of flour particles, potentially influencing flour handling properties and product texture.

Rheological characterization revealed alterations in the flow behavior and viscoelastic properties of germinated maize flour suspensions. Germination-induced changes in flour composition and particle characteristics influenced the viscosity, shear stress, and shear rate of flour suspensions. These rheological properties are crucial for determining the suitability of maize flour for various food processing applications. Simulated gastric digestion assays demonstrated enhanced digestibility of germinated maize flour compared to non-germinated flour. Germination-induced modifications in starch structure and flour composition facilitated the breakdown of starch granules during gastric digestion. The release of reducing sugars from germinated maize flour was higher, indicating increased susceptibility to enzymatic hydrolysis.

The observed changes in maize starch structure, flour attributes, and gastric digestion characteristics highlight the impact of germination on grain quality and nutritional properties [10]. Germination-induced alterations in starch properties and flour composition have implications for food processing, product development, and human health. Understanding the underlying mechanisms governing these changes is essential for optimizing the utilization of germinated maize in food and feed applications. Further research is warranted to elucidate the specific enzymatic pathways and biochemical reactions involved in germination-induced modifications of maize starch and flour. Long-term studies are needed to assess the stability of germinated maize flour and its functional properties during storage and processing.

Conclusion

In conclusion, this study comprehensively investigated the impact of germination on maize starch structure, flour attributes, and gastric digestion characteristics. Our findings demonstrate that germination induces significant changes in the biochemical composition and structural properties of maize grains, leading to alterations in starch morphology, flour composition, rheological behavior, and digestibility. These changes have important implications for the utilization of germinated maize in food and feed applications, as well as for human health. The observed modifications in maize starch structure, including alterations in granule morphology and crystalline structure, suggest enhanced susceptibility to enzymatic hydrolysis during gastric digestion. This results in increased digestibility and bioavailability of nutrients, potentially enhancing the nutritional value of germinated maize-based products. Moreover, the rheological properties of germinated maize flour may influence its functionality in food processing, affecting product texture, mouthfeel, and sensory attributes.

Our study contributes to the understanding of the complex interplay between germination, starch structure, flour properties, and gastric digestion kinetics in maize. However, further research is warranted to elucidate the underlying mechanisms driving these changes and to optimize germination conditions for enhancing the functional properties of maize grains. Long-term studies are also needed to assess the stability and shelf-life of germinated maize flour and its applicability in various food formulations. Overall, the findings presented in this study underscore the potential of germination as a promising strategy for improving the nutritional quality and functional attributes of maize-based foods. By harnessing the benefits of germination-induced modifications, we can develop innovative food products with enhanced digestibility, sensory quality, and health-promoting properties.

Acknowledgement

None

Conflict of Interest

None

References

1. Gravitt PE (2011) The known unknowns of HPV natural history. J Clin Invest 121: 4593-4599.
2. Stoler MH, Baker E, Boyle S, Aslam S, Ridder R, et al. (2020) Approaches to triage optimization in HPV primary screening: extended genotyping and p16/Ki-67 dual-stained cytology-retrospective insights from ATHENA. Int J Cancer 146: 2599-2607.
3. Shanmugasundaram S, You J (2017) Targeting persistent human papillomavirus infection. Viruses 9: 229.
4. Crosbie EMBEJ, Einstein MH, Franceschi S, Kitchener HC (2013) Human papillomavirus and cervical cancer. Lancet 382: 889-99.
5. Bosch FX, Sanjose SD (2003) Chapter 1: human papillomavirus and cervical cancer--burden and assessment of causality. J Natl Cancer Inst Monogr 3-13.
6. Guan P, Jones RH, Li N, Bruni L, Sanjose SD, et al. (2012) Human papillomavirus types in 115,789 HPV-positive women: a meta-analysis from cervical infection to cancer. Int J Cancer 131: 2349-2359.
7. Wright TC, Stoler MH, Behrens CM, Sharma A, Zhang G, et al. (2015) Primary cervical cancer screening with human papillomavirus: end of study results from the ATHENA study using HPV as the first-line screening test. Gynecol Oncol 136: 189-197.
8. Jin XW, Lipold L, Foucher J, Sikon A, Brainard J, et al. (2016) Cost-effectiveness of primary HPV testing, cytology and co-testing as cervical cancer screening for women above age 30 years. J Gen Intern Med 31: 1338-1344.
9. Schiffman M, Kinney WK, Cheung LC, Gage JC, Fetterman B, et al. (2018) Relative performance of HPV and cytology components of cotesting in cervical screening. J Natl Cancer Inst 110: 501-508.
10. Rijkaart DC, Berkhof J, Rozendaal L, Kemenade FJV, Bulkmans NW, et al. (2012) Human papillomavirus testing for the detection of high-grade cervical intraepithelial neoplasia and cancer: final results of the POBASCAM randomised controlled trial. Lancet Oncol 13: 78-88.