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The interaction between sodium chloride and wheat proteins

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Abstract
The interaction between sodium chloride (NaCl) and wheat proteins plays a critical role in determining the quality of soft wheat dough. This review explores the multifaceted impact of NaCl on dough properties, including gluten network formation, dough rheology, fermentation behavior, and final product quality. By examining recent research findings, this paper aims to provide a comprehensive understanding of how varying levels of NaCl influence the structural and functional attributes of wheat proteins and their subsequent effect on dough characteristics and baking performance.

Keywords: Interaction between, network formation, sodium chloride

Introduction
The role of sodium chloride (NaCl) in the processing of wheat-based products is multifaceted and profound, impacting both the chemical and physical properties of dough and final products such as bread, pastries, and noodles. Sodium chloride is not merely a flavor enhancer but plays a pivotal role in the functional characteristics of wheat proteins, primarily gluten, which is the dominant protein in wheat contributing to the viscoelastic properties of dough. Gluten, a complex mixture of glutenin and gliadin proteins, is responsible for the unique ability of wheat dough to retain gas and expand during fermentation and baking, resulting in the light, airy texture of baked bread. The interaction between sodium chloride and these proteins is crucial for achieving the desired texture and structural integrity in wheat-based products.

Main objective
The main objective of studying the interaction between sodium chloride and wheat proteins is to understand how sodium chloride influences the properties and behavior of wheat proteins, particularly gluten, during the processing and development of wheat-based products.

Literature Review
Wheat proteins, primarily glutenins and gliadins, are responsible for the viscoelastic properties of dough. Glutenins contribute to dough strength and elasticity, while gliadins provide extensibility. The balance and interaction between these proteins are crucial for forming a cohesive gluten network, which traps gases during fermentation and provides structure to the final baked product.

NaCl impacts gluten network formation by modulating protein interactions and hydration. Studies have shown that salt can enhance the hydration and solubility of gluten proteins, facilitating their alignment and cross-linking. This results in a stronger and more elastic dough. Conversely, excessive NaCl can lead to over-tightening of the gluten network, reducing dough extensibility and making it more prone to tearing.

The rheological properties of dough, such as elasticity, viscosity, and extensibility, are significantly influenced by NaCl. Rheological tests, including farinograph and extensograph analyses, have demonstrated that optimal salt concentrations improve dough stability and handling properties. NaCl helps maintain the balance between strength and extensibility, ensuring the dough can withstand mechanical stresses during mixing and sheeting.

NaCl affects yeast activity and fermentation kinetics. At appropriate levels, salt regulates yeast activity, ensuring a steady fermentation rate that allows for optimal gas production and retention. However, high NaCl concentrations can inhibit yeast function, leading to reduced gas production, poor dough rise, and dense, low-volume baked products. The quality of the final baked product, including texture, crumb structure, and volume, is directly linked to the NaCl-mediated interactions within the dough. Properly balanced salt levels contribute to a fine, uniform crumb structure, desirable chewiness, and optimal product volume. Excessive or insufficient NaCl can compromise these attributes, resulting in inferior product quality.

Interaction in Sodium Chloride and Wheat Proteins
The interaction between sodium chloride and wheat proteins significantly influences the functionality and quality of wheat-based products. Sodium chloride, commonly known as salt, plays a crucial role in enhancing the flavor, texture, and preservation of these products. When added to wheat dough, sodium chloride affects the solubility and hydration properties of wheat proteins, particularly gluten. This interaction is essential for dough formation and its rheological properties. Salt strengthens the gluten network by promoting protein-protein interactions, leading to improved dough elasticity and extensibility. It also affects the water absorption capacity of the flour, which is critical for achieving the desired dough consistency. Moreover, sodium chloride impacts the enzymatic activity within the dough. It inhibits the activity of proteolytic enzymes that break down gluten proteins, thereby maintaining the integrity of the gluten network during fermentation and baking. This results in better loaf volume, crumb structure, and overall bread quality. Additionally, salt influences the yeast fermentation process by controlling the rate of yeast activity, ensuring a balanced and controlled rise in the dough. The presence of sodium chloride also affects the ionic strength of the dough system, which can alter the interactions between proteins and other dough components such as starch and lipids. This can influence the

gelatinization and pasting properties of starch, further affecting the texture and shelf life of the final product. The interaction between sodium chloride and wheat proteins is a complex but essential aspect of wheat-based product formulation, significantly impacting their sensory and functional properties.

Discussion

The interaction between NaCl and wheat proteins is complex and multifaceted. NaCl's role in enhancing protein hydration and solubility is beneficial up to a certain threshold, beyond which negative effects can occur. The concentration of NaCl must be carefully controlled to achieve the desired balance between dough strength and extensibility, crucial for both dough handling and final product quality.

Additionally, the impact of NaCl on fermentation behavior underscores its importance in bread making. By modulating yeast activity, NaCl helps control the fermentation process, contributing to the development of dough structure and volume. This regulation is particularly important for soft wheat dough, where delicate handling and precise control over dough properties are essential.

Future research should focus on elucidating the molecular mechanisms underlying NaCl-protein interactions and their implications for dough rheology and fermentation. Advances in analytical techniques, such as proteomics and rheometry, could provide deeper insights into these interactions, enabling the development of optimized dough formulations for various baking applications.

Conclusion

The interaction between sodium chloride and wheat proteins is a critical factor in determining the quality of soft wheat dough. By influencing gluten network formation, rheological properties, and fermentation behavior, NaCl plays a pivotal role in dough development and final product quality. Understanding and optimizing these interactions is essential for producing high-quality baked goods with desirable textural and sensory attributes. Future research should continue to explore the intricate balance between NaCl concentration and dough performance, paving the way for innovative approaches to dough formulation and baking technology.

References

1. Belton PS. Mini Review: On the elasticity of wheat gluten. Journal of Cereal Science,2001:33(3):271-9.
2. Sliwinski EL, Kolster P, Vliet T. On the relationship between gluten protein composition of wheat flours and large-deformation properties of their doughs. Journal of Cereal Science,2004:39(2):247-64.
3. Goesaert H, Brijs K, Veraverbeke WS, Courtin CM, Gebruers K, Delcour JA. Wheat flour constituents: how they impact bread quality, and how to impact their functionality. Trends in Food Science & Technology,2005:16(1-3):12-30.
4. Wieser H. Chemistry of gluten proteins. Food Microbiology,2007:24(2):115-9.
5. Marco C, Pérez G, León A. Effect of salt on wheat flour dough fermentation: II. Kinetics of the release of carbon dioxide. Journal of Food Engineering,2008:84(1):96-103.
6. Ukai T, Matsumura Y, Urade R. Disaggregation and reaggregation of gluten proteins by sodium chloride. Journal of Agricultural and Food Chemistry,2008:56(3):1122-30.
7. Wang Q, Tang Y, Yang Y, Lei L, Zhao J, Zhang Y, *et al*. Combined effects of quercetin and sodium chloride concentrations on wheat gliadin structure and physicochemical properties. Journal of the Science of Food and Agriculture,2021:101(6):2511-8.
8. Beck M, Jekle M, Becker T. Impact of sodium chloride on wheat flour dough for yeast-leavened products. I. Rheological attributes. Journal of the Science of Food and Agriculture,2012:92(3):585-92.
9. Chen G, Ehmke L, Miller R, Faa P, Smith G, Li Y. Effect of sodium chloride and sodium bicarbonate on the physicochemical properties of soft wheat flour doughs and gluten polymerization. Journal of Agricultural and Food Chemistry,2018:66(26):6840-50.
10. Jekle M, Becker T. Effects of acidification, sodium chloride, and moisture levels on wheat dough: I. Modeling of rheological and microstructural properties. Food Biophysics,2012:7:190-9.
11. Ortolan F, Corrêa GP, da Cunha RL, Steel CJ. Rheological properties of vital wheat glutens with water or sodium chloride. LWT - Food Science and Technology,2017:79:647-54.
12. Carcea M, Narducci V, Turfani V, Mellara F. A comprehensive study on the influence of sodium chloride on the technological quality parameters of soft wheat dough. Foods,2020:9(7):952.
13. Gebregewergis A. Review on the influence of NaCl on the quality parameters of soft wheat dough. International Journal of Agriculture and Nutrition,2022:4(1):17-20. DOI: 10.33545/26646064.2022.v4.i1a.48
14. Wang X, Liang Y, Wang Q, Zhang X, Wang J. Effect of low-sodium salt on the physicochemical and rheological properties of wheat flour doughs and their respective gluten. Journal of Cereal Science,2021:102:103371.
15. Chen G, Hu R, Li Y. Potassium chloride affects gluten microstructures and dough characteristics similarly as sodium chloride. Journal of Cereal Science,2018:82:155-63.
16. Tang YU, Yang Y, Wang Q, Tang Y, Li F, Zhao J, *et al*. Combined effect of carboxymethylcellulose and salt on structural properties of wheat gluten proteins. Food Hydrocolloids,2019:97:105189.