Ultrasound Technology in Gluten-Free Foods: A Novel Approach to Functional and Sustainable Breadmaking

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Abstract

Producing high-quality gluten-free bread remains a challenge due to the absence of gluten, which compromises texture, volume, and sensory appeal. Ultrasound technology has emerged as a promising method to enhance the functionality of gluten-free flours by inducing structural and functional modifications at the molecular level (1).

This study investigates the impact of ultrasound-treated gluten-free composite flour, comprising starches, flours, hydrocolloids, and enzymes, on key bread quality attributes. The flour was sonicated at 15% hydration for 10 minutes at room temperature. Two bread variants were prepared: one using sonicated flour and the other with non-sonicated flour as a control. Both were made using a standardized formulation (56% composite flour, 38% water, 4% vegetable oil, and 2% fresh yeast) and baked at 220°C after proofing. Analytical evaluations included bake loss, loaf volume, water activity, pH, texture profile analysis (hardness, chewiness, cohesiveness, springiness, and resilience), color, and sensory assessment by a trained panel.

The results revealed that sonicated flour significantly increased bread volume, which can be attributed to improved gas retention (2). While bake loss and water activity remained consistent between the two samples, the pH of the sonicated bread was slightly higher, potentially indicating changes in enzymatic activity. Texture analysis showed a softer crumb and crust, with reductions in hardness and chewiness (3, 4) (Figure1). Colour analysis confirmed no perceptible colour changes (ΔE* = 0.88). Sensory panellists preferred the texture of sonicated bread for its softness and chewability.

These findings demonstrate the potential of ultrasound as an effective and sustainable tool for improving the quality of gluten-free bread. By enhancing the structural and functional properties of gluten-free composite flour, ultrasound addresses key challenges in gluten-free product development, offering innovative solutions to meet consumer expectations for better texture and sensory appeal.

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Figure

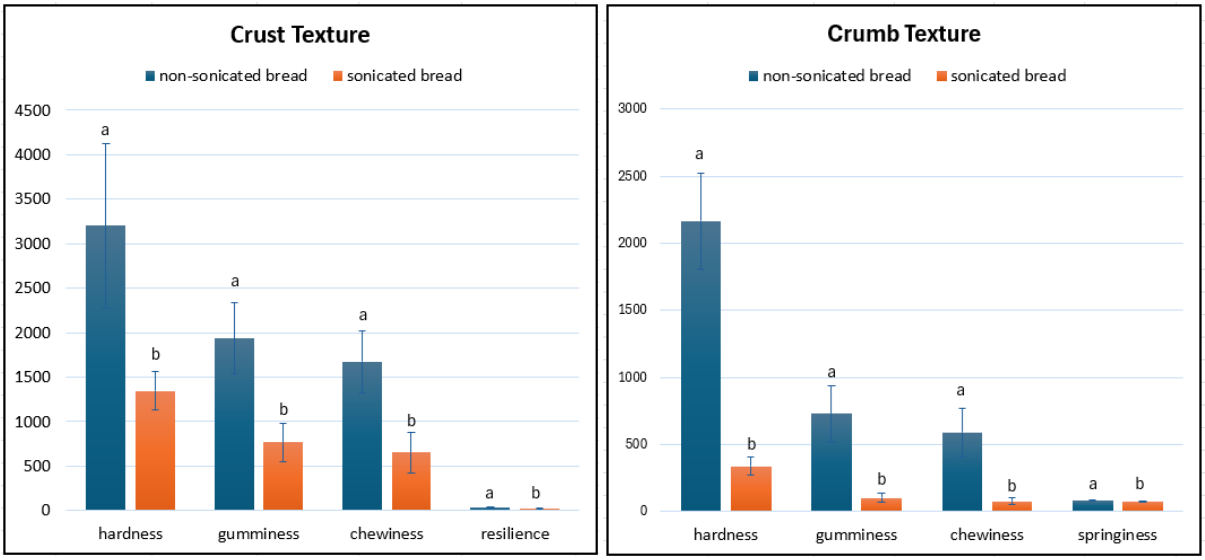

Figure 1 - Results of crumb and crust texture analysis in non-sonicated and sonicated (15% hydration) gluten-free bread.

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