Impact of Low-Sodium and Table Salt on Creep–Recovery and Oscillatory Rheological Properties of Wheat Flour Dough, a Colloidal System

*Georgiana Gabriela Codin ă [1, *], Olga Boestean [2], Sorina Ropciuc [1], Corina Caracaci [2], Aliona Ghendov-Mosanu [2]*

[1] Ştefan cel Mare University, Suceava, Romania
[2] Technical University of Moldova, Chisinau, Moldova

codina@fia.usv.ro

Wheat dough is a complex colloidal system of gluten network embedded with starch granules and other dispersed particles which exhibits nonlinear viscoelastic behavior under stress. Sodium chloride is one of the raw materials used in dough making with a major impact on its rheological properties and, therefore on its processability, being closely correlated with the final products quality. Since bakery products are one of the main contributors to daily sodium intake, reducing their sodium content is important for public health. However, a significant reduction of sodium chloride in bakery products formulation, without affecting dough processability and bakery products quality remains a major challenge for the bakery industry. This study evaluates the impact of conventional table salt (NaCl) and a low-sodium sea salt (a mix of 82.5-87.5% KCl, 12.5-17.5% NaCl, 1% SiO_2) with a less than 85% sodium content (SS) than table salt on rheological properties of wheat-flour dough, a colloidal system. The effects of the SS were compared with those obtained by NaCl for an addition levels in wheat flour up to 1.6%. For this purpose, a HAAKE MARS 40 rheometer had been used were creep-recovery and oscillatory test were performed. For oscillatory frequency sweeps tests storage (G′) and loss (G″) moduli were fitted using a power-law model. The power law exponents (n′, n″) were slightly lower for SS, indicating reduced frequency dependence of viscoelastic behavior. For NaCl dough, G′ and G″ initially decreased at 0.4% compared to the control sample, then increased at 0.8–1.2%, before decreasing again at 1.6%, showing the concentration-dependent reinforcement of the viscoelastic dough network. SS addition presented higher values for G′, G″ compared to dough samples with NaCl indicating a stronger and more uniform dough network with more stable colloidal interactions. Loss tangent was lower than 1 for all the dough samples which indicates their solid-like behavior. On creep and recover tests, SS and NaCl had similar effects, but dough with NaCl was slightly weaker with a J_{max} values higher than those for SS and a recovery ratio lower than dough samples with SS. These results indicates that NaCl substitution with SS lead to dough samples with good viscoelasticity, offering a promising approach for obatining bakery products with a less sodium content without affecting dough technological behaviour.

Keywords:
wheat flour dough, rheological behaviour, low sodium salt, creep–recovery tests, oscillatory measurements

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