MULTIVARIATE ANALYSIS OF DOUGH RHEOLOGYAND BREAD QUALITY WITH RYE SOURDOUGH ADDITION

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Introduction. Rye sourdough incorporation significantly changes dough rheology and bread physical characteristics due to its biological acidification and non-starch polysaccharide interactions. The solubilization of rye arabinoxylans (pentosans) compensates for acid-induced gluten depolymerization, enhancing water absorption and gas retention capacity during proofing.

Materials and Methods. Two rye sourdough types from Puratos, Sapore Othello (SO) and Sapore Traviata (ST), were incorporated into wheat flour type 650 at substitution levels of 0–4%. The effects of sourdough addition on dough pH, rheological properties and bread quality were evaluated. Dough properties were assessed using a Rheofermentometer and Alveograph according to ICC Standard Method No. 121, while bread quality was characterized in terms of crumb and crust color (L*, a*, b*), texture (hardness, springiness, cohesiveness, and chewiness), physical characteristics (porosity, elasticity, and loaf volume), sodium concentration, and sensory values. Dough pH was measured using a Hach HQ30d portable digital multimeter. Bread color was determined using a CR-400 colorimeter based on the CIELAB system, and texture was measured with a TA.HD plus texture analyzer. Physical characteristics were determined according to SR 91:2007, sodium concentration by Flame Atomic Absorption Spectrometry, and sensory attributes using a 9-point hedonic scale. Principal Component Analysis (PCA) was applied to the standardized dataset to identify relationships among dough and bread quality parameters and to discriminate the samples according to sourdough type and substitution level. Principal Component Analysis explained 74.00% of total variance across the first two dimensions (PC1: 44.97%, PC2: 29.03%).

Results and Discussion. The control sample (CS) separated distinctly in the upper-left quadrant, characterized by baseline dough strength, high extensibility and high initial pH value. Increasing rye sourdough substitution levels shifted samples progressively rightward along PC1 axe. High SO additions moved to the positive PC1 domain, strongly correlated with increased crumb redness, higher Alveograph configuration ratio value and increased crumb hardness and chewiness. In contrast, ST formulations remained primarily in the negative PC1 domain, exhibiting higher crust, crumb lightness and higher coefficient of retention values relative to SO. Along PC2 axes, both sourdough types loaded negatively due to strong positive correlations with Rheofermentometer total gas production, gas retention values, maximum fermentation height and sensory acceptability.

Conclusions. Multivariate analysis indicates distinct behavior for the samples with the two rye sourdough ingredients. ST preserves crumb lightness while enhancing fermentation volume and gas retention, whereas SO drives pronounced crumb color darkening and textural firmness at higher addition levels (3–4%). Optimal overall acceptability was achieved at lower-to-moderate substitution levels (1–2% SO and 1–4% ST).

Keywords: *principal component analysis, Alveograph, dough fermentation, bread quality*

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