Effect of coffee cherry pulp on rheological properties and quality parameters of dough and batters

Gustavo A. Rosas-Sánchez[1,2], Zorba J. Hernández-Estrada[1], Mirna L. Suarez-Quiroz[1], Oscar Gonzalez-Rios[1], and Patricia Rayas-Duarte[2]. [1]Tecnológico Nacional de México / IT de Veracruz, México [2]Robert M. Kerr Food and Ag. Products Center, Department of Biochemistry and Molecular Biology, Oklahoma State University, Stillwater, OK.

Introduction: Coffee is a beverage widely consumed around the world. According to the International Coffee Organization, in 2018 about 10.5 million tons of fresh coffee was produced in the world; this implies the generation of 5.25 million tons of coffee cherry pulp (CCP) as a by-product. If CCP is not used in sustainable processes, it becomes a severe environmental problem. CCP contains fiber, minerals, amino acids, and polyphenolic compounds potentially beneficial for human nutrition. CCP could be used to fortify bread and muffins products deficient in dietary fiber and other nutrients.

Purpose: The purpose of this study was to determine the effect of CCP on rheological and baking properties of muffins batter and bread dough.

Methods: Wheat flour was substituted by CCP at 0, 1.25, 2.5, and 5% (flour basis) on bread and 0, 10, 20, and 40% on muffins. A creep-recovery test was conducted on bread dough and gluten, and data was analyzed with the Burgers model. Frequency sweep tests were conducted on dough, gluten, and batters, and the data was fitted to a power law model. Breadmaking quality was evaluated with the optimized straight-dough breadmaking approved method 10-10.03 of AACCI and crumb firmness by compression method 74-09.01 using a TA-XT2i Texture Analyzer with a slight adaptation for muffins.

Results: Volume of bread and muffins decreased significantly ($p<0.05$, Tukey's) up to 36 and 9.5%, respectively (with maximum substitution level), and firmness of crumb bread and muffin increased (up to 146 and 47%, respectively). Dough compliance J_0, J_1, and J_2 was positively correlated (r=0.90) with bread volume and dough zero shear viscosity η_0 was negatively correlated (r=-0.92). Gluten and batter elastic and viscous moduli $G'\omega_1$ and $G''\omega_2$ were negatively correlated with bread volume (r=-0.89). Elastic character of batter decreased significantly up to 44% and was positively correlated with muffin's volume and negatively correlated with muffin's firmness (r=0.78 and r=-0.80, respectively). In base formulations without additives, CCP can be substituted up to 40% in muffins and 1.25% in bread, suggesting that muffins offer more versatility to enrichment with CCP. Batters, dough, and gluten increased their solid-like behavior as the concentration of CCP increases.

Significance: CCP is a suitable ingredient for enhancing the nutritional value of baked products and clearly needs further research using additives to improve volume and softness. Utilization of CCP byproduct would reduce its environmental impact. Burgers and power law model parameters are good predictors of bread and muffin quality, respectively.

Keywords: Coffee cherry pulp, creep recovery, compression recovery, coffee byproducts utilization.