Kinetika Proses Kristalisasi dan Analisa Eksergi Pada Pembuatan Kopi Jahe Instan

(Kinetics of the Crystallization Process and Exergy Analysis in the Production of Instant Ginger Coffee)

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ABSTRACT

Coffee and ginger are functional foods rich in bioactive compounds and have the potential to be developed into instant powdered beverages. The production process includes extraction, heating, stirring, crystallization, and packaging. The crystallization stage plays a crucial role because it affects the texture, solubility, and stability of the product during storage. This study aims to analyze the crystallization kinetics in the production of instant ginger coffee and determine the most appropriate mathematical model based on changes in total dissolved solids (°Brix), as well as to evaluate its thermodynamic efficiency through exergy analysis. Experiments were conducted at three solution concentration levels: 1.170 M, 1.462 M, and 1.754 M, using an electric stove. Observations were made every two minutes by measuring °Brix, moisture content, solids content, temperature, pH, and specific gravity. Kinetic analysis was performed using the Avrami, Gompertz, and Hill models, while the crystal fraction was calculated from changes in the °Brix value during the process. Model fit was evaluated using R^2, RMSE, MBE, SSE, AIC, and SIC. The results showed that an increase in solution concentration prolongs the crystallization time due to an increase in viscosity. The maximum crystallization time was reached at 58, 62, and 66 minutes for concentrations of 1.170 M, 1.462 M, and 1.754 M, respectively. The Gompertz model provided the best results with R^2 values of 0.995, 0.987, and 0.993, respectively. Meanwhile, exergy analysis showed the highest efficiency at a concentration of 1.170 M at 12,35%, followed by 1.462 M at 8,02% and 1.754 M at 7,33%. The results of this study can serve as a basis for developing a more efficient and controlled production process for instant ginger coffee.

Keywords*: instant ginger coffee, crystallization, kinetics, Gompertz model, exergy.*