

Impact of Instant Controlled Pressure Drop (DIC) Treatment on Drying Kinetics and Caffeine Extraction from Green Coffee Beans

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Abstract:

The present work is directed towards the impacts of Détente Instantanée Contrôlée DIC (French, for instant controlled pressure-drop) in terms of decaffeination and drying of Ethiopian green coffee beans (GCBs). DIC consisted in subjecting the product to a high-pressure saturated steam during some seconds and ended with an abrupt pressure drop towards a vacuum. A conventional aqueous extraction and a hot air-drying took place after DIC treatment. In this study, Response Surface Method (RSM) was used with DIC saturated steam pressure P , thermal treatment time t , and initial moisture content W as the independent variables. Both direct DIC extract recovered from the vacuum tank and the aqueous extracts were analyzed and quantified using the reversed phase-HPLC. With decaffeination ratios as dependent variables, P and W were the most significant operating parameters; while t was much weaker. Total decaffeination ratio could reach 99.5% after DIC treatment at specific conditions of $W=11.00\%$ db, $P=0.1$ MPa, and $t=35$ s while it was only 58% when achieved with untreated raw material. The effective diffusivity D_{eff} and the starting accessibility δW_s were calculated from the diffusion/surface interaction kinetic model of hot air drying after DIC treatment. They dramatically increased with P and t while W had a weak impact. Thus, at the optimized DIC conditions, and increased from 0.33 to 12.60 $10^{-10} \text{m}^2 \text{s}^{-1}$ and from 0.75 to 11.53 g/100 g db, respectively. Drying time needed to reach 5% db became 60 min instead of 528 min for untreated raw material.