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

Kamal, A. Gelicus and K. Allaf

Abstract:
The present work is directed towards the impacts of Détente InstantanéeContrôléeDIC (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 $\delta W_s$ 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 $10^{-10}$ m²s⁻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.