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The Influence of Bed Geometry in Obtaining Volatile and Non-Volatile Compounds From Rosemary by SFE

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The aim of this study was to evaluate the use of the supercritical CO_2 extraction in obtaining target compounds from rosemary using a laboratory system containing 2 one-liter extractors with different height (H_B) to bed diameter (D_B) ratios. The objective was to compare the kinetic parameters of the extraction curves obtained for both two geometries (E-1: H_B/D_B=7.1; E-2: H_B/D_B=2.7) maintaining the S/F (solvent mass to feed mass) ratio equal between the beds. The other process variables were also maintained constant, as the bed porosity (ϵ =0.47), apparent and true densities of the raw material (ρ_a =0.48g/cm^3 and ρ_r =1.36g/cm^3, respectively), particle average size (d_p =0.66mm), temperature (40°C), pressure (30MPa), CO_2 flow rate (Q=17.3g/min) and time of extraction (360min). It was observed that the bed E-2 presented global yields slightly superior whether compared to E-1. The mass transfer rates in the CER (constant extraction rate) period were 0.24 ± 0.01 g of extract/min for E-1 and 0.32 ± 0.01 g of extract/min for E-2. Likewise, the yields in the CER period were 41 ± 5 g of extract/100 g of extractable for E-1 and 51 ± 1 g of extract/100 g of extractable for E-2. The kinetic content of oxygenated monoterpenes (i.e., 1,8-cineole, camphor, α -terpineol and borneol), sesquiterpenes (i.e., trans-caryophyllene) and phenolic diterpenes (i.e., carnosic acid) in the extracts was also different between both bed geometries. These differences are associated to the characteristics of the raw material/extracts (i) and to the strong compaction of the vegetal matrix in the bed (ii). In the first case (i), where the solute is attached to the cellular structure, the mass diffusion phenomena cannot be neglected and it has been responsible for taking a long extraction time. Thus, the bed geometry presented a pronounced influence in the mass transport properties and it has been more evident for rosemary than for clove [1], because the clove oil is easily extracted at the beginning of the process (≈ 60min) and its diffusion period can be neglected. In the second case (ii), we concluded that the lowest yield in E-1 was also influenced by strong compaction and CO_2 channeling, resulting in large axial dispersion of the solvent-solute. These phenomena were most likely small in E-2.