

Hansen Solubility Parameters, Quality by Design Tool for Developing Green Nanoemulsion to Eliminate Sulfamethoxazole from Contaminated Water

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Abstract : Exhaustive application of sulfamethoxazole (SUX) became as a global threat for human health due to water contamination through diverse sources. The addressed combined application of Hansen solubility (HSPiP software) parameters and Quality by Design tool for developing various green nanoemulsions. HSPiP program assisted to screen suitable excipients based on Hansen solubility parameters and experimental solubility data. Various green nanoemulsions were prepared and characterized for globular size, size distribution, zeta potential, and removal efficiency. Design Expert (DoE) software further helped to identify critical factors responsible to have direct impact on percent removal efficiency, size, and viscosity. Morphological investigation was visualized under transmission electron microscopy (TEM). Finally, the treated was studied to negate the presence of the tested drug employing ICP-OES (inductively coupled plasma optical emission microscopy) technique and HPLC (high performance liquid chromatography). Results showed that HSPiP predicted biocompatible lipid, safe surfactant (lecithin), and propylene glycol (PG). Experimental solubility of the drug in the predicted excipients were quite convincing and vindicated. Various green nanoemulsions were fabricated, and these were evaluated for in vitro findings. Globular size (100-300 nm), PDI (0.1-0.5), zeta potential (~ 25 mV), and removal efficiency (%RE = 70-98%) were found to be in acceptable range for deciding input factors with level in DoE. Experimental design tool assisted to identify the most critical variables controlling %RE and optimized content of nanoemulsion under set constraints. Dispersion time was varied from 5-30 min. Finally, ICP-OES and HPLC techniques corroborated the absence of SUX in the treated water. Thus, the strategy is simple, economic, selective, and efficient.

Keywords : quality by design, sulfamethoxazole, green nanoemulsion, water treatment, icp-oes, hansen program (hspip software)

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