Reduction of Indoor Exposures through the Development of Environment Friendly Sample Preparation Methods

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ABSTRACT

Isolation of active ingredients and pharmacologically active components from natural products is accomplished using organic solvents. During this process, volatile organic solvents are released to the atmosphere as airborne particles or vapor, deteriorating the air quality at the workplace. Unavoidable settling of some of those hazardous residues with the final product is considered a drawback. Hence, the usage of conventional organic solvents as extraction media needs to be replaced with environmental benign and cost effective methods that on the other hand have the ability to improve product quality.

This research has attempted to use supercritical carbon dioxide [CO_2] to extract and determine compounds that present the fragrance of Jasmine (Jasminum spp.), as a case example while demonstrating specificity and selectivity of the method. The rationale is that, extraction of volatile compounds such as aromatics yields almost negligible amounts in conventional methods as opposed to Supercritical Fluid Extraction, where percentage yield is considerably higher.

Liquid carbon dioxide [CO_2] was used in the instrument where it was made to behave in gaseous and supercritical forms interchanging. Conditions adjusted were such that gaseous CO_2 fed was converted into supercritical form in the actual extracting phase. This achieved a combination of near extraction solvent power of a liquid and higher diffusion co-efficient of a gas which attributes to the desired extraction under supercritical condition.

Selectivity of The SC CO_2 was high and remained adjustable at both extraction and releasing stages of the process. The end result was a higher yield, a definite advantage in trace analysis. The returning of CO_2 to gaseous phase released extracted material and the only effluent to the environment was gaseous CO_2.

The extraction conditions were optimized to yield the extraction of 0.05 g of the analyte (mainly an amine) into 5 cm^3 of solvent (used to trap because the analyte itself is highly volatile) from 31.00 g of solid sample. Same amount of analyte would need enormous amounts of both sample and solvent in conventional solvent extraction. Tedious solvent extraction processes expose people in the vicinity to the solvent for more than 3 hrs compared no chemical exposure with SC CO_2. The extracts if not volatile can directly be collected solvent free. Most SC CO_2 extraction cycles produce high yields in pre-programmed, 45 minute fully automated cycles in the instrument used in this project. A combination of a pressure and a temperature specific to the given compound could be defined for SCF Extraction. This was a major selectivity advantage over other methods of separation. Applicability of this combination of parameters was understood to be varying with the sources where analyte may be embedded amongst different ranges of chemicals.

Supercritical Fluid Extraction is being used and developed further even in countries that have less unexplored natural resources to extract from. Therefore in countries such as Sri Lanka, laboratories should start using SCFE to utilize its indigenous resource base while ensuring safe standards of indoor air.