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# **SUPERCRITICAL FLUIDS IN SEPARATION, SAMPLE PREPARATION AND HYPHENATED TECHNIQUES: THE GOOD, THE BAD AND THE UGLY**

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The power of supercritical fluids, especially carbon dioxide (CO<sub>2</sub>), for chromatography (SFE) and extraction (SFC) has fascinated scientists for more than fifty years. SFC and SFE use fluids with low viscosities, high diffusivities and liquid-like solvent strengths. Chromatographic and extraction selectivity can be tuned as the solvating power can be adjusted by pressure, temperature and modifier selection. High diffusivity means faster kinetics than in LC and efficiency per unit time is higher whilst analysis times are shorter. The same apply for SFE, better penetration in the sample and faster extraction compared to solvent extraction. Concerning hyphenation, pre-column and post-column hyphenation with mass spectrometry are facilitated by the volatilization of CO<sub>2</sub> at atmospheric pressure.

Notwithstanding all these features, the application of supercritical fluids in separation science is limited to some nice applications such as enantioselective separations by SFC and natural product extraction by SFE. SFC has definitely suffered by the enormous progress in recent years made in LC through the introduction of ultra high pressure LC (UHPLC) and elevated temperature LC (ETLC) while interest and progress in SFE has been counteracted by developments like accelerated solvent extraction (ASE), microwave assisted solvent extraction (MASE), etc.

If all good things of supercritical fluids still remain valid, why have the use of SFC and SFE no recognized momentum? Are there bad or even ugly points that we should know and have underestimated in the past? In this contribution, the good's, bad's and ugly's will be reviewed. Solutions to overcome the shortcomings of supercritical fluids will be presented and illustrated with challenging real life applications.