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# Supercritical Carbon Dioxide combined with Water or Deep Eutectic Solvents for Caffeine Extraction from Spent Coffee Grounds

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## PURPOSE OF THE ABSTRACT

Supercritical CO2 (SC-CO2) extraction is a technology using CO2 at temperature and pressure above its critical point at 31°C and 74 bars. Under those conditions, CO2 is an economical and non-toxic apolar solvent providing hybrid properties such as a gas viscosity and a liquid's solvation capacity. The SC-CO2 is particularly suitable for lipids extraction and also for medium polar molecules such as caffeine that is largely present in coffee by-products.[1]

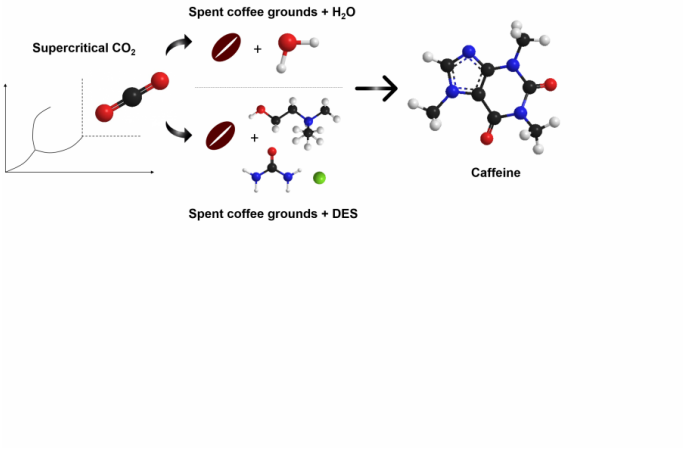
Spent coffee grounds (SCG) is the most significant coffee by-product, with 6 Mt of waste generated each year worldwide. Its composition is well-known and it contains a wide variety of high value molecules family such as lipids, polyphenols and methylxanthines.[2]

Supercritical CO2 is a commonly used solvent for selective removal of caffeine from wet green coffee beans. However, caffeine is not extractible from dry green coffee beans by supercritical CO2. Several hypotheses have been emitted in the literature to explain the roles of water i) that leads to the hydrolytic rupture of hydrogen bonds between adsorbed caffeine to the natural matrix, before being dragged by supercritical CO2, ii) that contributes to the swelling of cell membrane favoring solute diffusion and iii) that modifies polarity of SC-CO2. [3]

The results of the present study highlighted the predominant role of water in breaking the chlorogenic acid-caffeine complex interactions that occur inside the SCG matrix, thus releasing caffeine for its extraction with SC-CO2. Polar fraction is composed exclusively of caffeine. Then, the high selectivity for the extraction of caffeine by SC-CO2 comes from the lack of miscibility of H2O in SC-CO2, which is around 0.3 wt%. Thereby, the polarity of SC-CO2 is not significantly modified, which leads to the absence of polyphenols in the extracts, contrary to the use of EtOH co-solvent. Thereby, green solvents, immiscible with SC-CO2 and able to solubilize caffeine from SCG, were also studied, which are Deep Eutectic Solvents (DES).

These results establish experimentally the use of triphasic system SC-CO2/DES/Biomass for the extraction of CO2 soluble molecules like caffeine, retains by their matrix. This novel system might be applied to for the selective extraction of other CO2 soluble molecules from other biomasses.

## FIGURES




### FIGURE 1

Scheme of Supercritical Carbon Dioxide combined with Water or Deep Eutectic Solvents for Caffeine Extraction from Spent Coffee Grounds

Graphical Abstract

### FIGURE 2


## KEYWORDS

Supercritical CO2 | Deep Eutectic Solvents | Spent Coffee Grounds | Caffeine


## BIBLIOGRAPHY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