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New Opportunities in the Supercritical CO2 Extraction of Polyphenols from Agri-Food Residues

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PURPOSE OF THE ABSTRACT

The potential of agri-food residues as sources of functional ingredients and their recovery has been markedly intensified in the last years as a strategy to valorize and exploit their byproducts in the biomedical or cosmeceutical fields. The extraction of bioactive material from the original matrices has always been one of the critical points to effectively develop on industrial scale the study of agri-food residues and to make the process environmentally and economically sustainable. Common extraction methods, like Soxhlet or maceration, are the most used for the majority of the organic natural compounds, from apolar to polar, from fats to saponins and polyphenols, although the massive use of organic solvents can in some cases prevent the eco-sustainability of the overall process. In fact, the industrial approach is often to use water as an extraction solvent, but this also represents a problem in terms of environmental sustainability, as water is a precious good.

Supercritical fluid extraction (SFE) with carbon dioxide has recently become an interesting green technique to extract compounds soluble in CO2, thus perfectly applicable to lipophilic compounds like fats [1].

The peculiarity properties of SFE ensure safe and not expensive extractions with low environmental impact [2]. Moreover, CO2 is easily removed from the solid at ambient conditions and/or, on industrial scale, can be recovered through specific apparatus for its freshly reuse. A further advantage is the limited use of organic solvent for extraction of more polar species (i.e. phenolic acids, anthocyanins, flavonoids, etc [3,4]) employing in most case ethanol as co-solvent, which is well tolerated by various industrial sectors. Additionally, the relatively low critical temperature of CO2 allows the extraction of thermolabile substances avoiding their degradation. In spite of these advantages, very few applications to extract polar compounds have so far been reported.

Our ongoing projects focus on the valorization of wastes from different natural solid matrices with a special emphasis on polyphenols. Several secondary metabolites of plants and animals display a polyphenolic structure. These molecules are generally involved in defense against ultraviolet radiation or aggression by pathogens. The reason for the widespread interest in polyphenols is the recognition of their antioxidant properties, their great abundance in our diet, and their alleged role in the prevention of various diseases associated with oxidative stress [5].

Here we report the application of supercritical fluid extractions using carbon dioxide added with an organic modifier (ethanol or methanol) from different agri-food wastes. The experimentation successfully resulted in the extraction of polyhydroxylated naphtoquinones from sea urchins wastes, ellagic acid from pomegranate fermentation [6] and chlorogenic acids from byproducts of coffee roasting.

The effects of the main operating conditions of extraction, namely, temperature, pressure and modifier percentage, on the extraction yield and the corresponding analytical profile were assessed.

The results show a substantial advantage with respect to a Soxhlet extraction in terms of easy recovery, selectivity, compounds stability, time, and an overall total energy saving.

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FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

Supercritical Fluid Extraction | Agri-Food Residues | Polyphenols

BIBLIOGRAPHY

[1] Martínez J., Aguiar A., Curr Anal Chem 2013, 10, 67–77.
[2] da Silva R.P.F.F., Rocha-Santos T.A.P, Duarte A.C., Trends Anal Chem 2016, 76, 40–51.
[3] Ameer K., Shahbaz H.M., Kwon J-H., Compr Rev Food Sci Food Saf 2017, 16, 295–315.
[4] Ferrentino G., Morozova K., Mosibo O.K., Ramezani M., Scampicchio M., J Clean Prod 2018, 186, 253–61.
[5] Fraga C.G., Croft K.D., Kennedy D.O., Tomás-Barberán F.A., Food Funct 2019, 10, 514–28.
[6] Verotta L., Panzella L., Antenucci S., Calvenzani V., Tomay F., Petroni K., et al., Food Chem 2018, 246, 129–36.