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Received date: 16-12-2022 | Accepted date: 20-12-2022 | Published date: 23-03-2023

Production of drug carriers loaded with bioactive molecules through the use of a supercritical assisted foaming process

Drug carriers are characterized by double function: transportation and protection of entrapped drugs. Therefore, they are designed to avoid drug degradation, which is responsible of poor bioavailability. The use of carries preserves drug properties during administration while reducing toxic side effects. Conventional methods for drug carrier production suffer of several drawbacks such as high solvent residue, large particle size distributions, low encapsulation efficiency and high environmental impact.

Novel techniques were developed to achieve higher stability of drug over time and to improve drug entrapment efficiency. In order to provide essential oils for encapsulation in drug carriers, a novel extraction process was employed with low environmental impact (Naviglio Extractor). This technique consists in a low-pressure liquid extraction on a solid matrix, working on the principle of a pressure gradient created among the core of the matrix and the outer bulk. The main advantages consist in complete elimination of organic solvents, saturation of the matrix, preservation of active principles and low extraction times.

In this work, essentials oils separated using Naviglio Extractor from karkadè plant are obtained as a colored mixture of bioactives, having beneficial effects in terms of antioxidant activity. Therefore, polycaprolactone and a defined amount of karkadè oil were dissolved in organic solvent at mild temperature, before reaching gel phase. Once cooled at room temperature, a polymeric cylinder was obtained. The effect of different drug to lipid ratio on mass basis was investigated. Then, a supercritical assisted process was used to expand the cylinder with carbon dioxide as blowing agent.

Pressure (75 to 150 bar) and temperature (30 to 45 °C) were varied to optimize the process. The produced foams were then characterized in terms of cell size and morphology, encapsulation efficiency and release kinetic profiles. A sustainability analysis was performed on both processes to demonstrate their low environmental impact.

Recent Publications:

1. Trucillo, P (2021) Drug carriers: Classification, administration, release profiles, and industrial approach. *Processes*, 9: 470.
2. Naviglio, D (2003) Naviglio's principle and presentation of an innovative solid-liquid extraction technology: extractor Naviglio®. *Analytical letters*, 36: 1647-1659.
3. Naviglio, D, Scarano, P, Ciaravolo, M, Gallo, M (2019) Rapid Solid-Liquid Dynamic Extraction (RSLDE): A powerful and greener alternative to the latest solid-liquid extraction techniques. *Foods*, 8: 245.

Biography

Paolo Trucillo is a researcher in material science and technology and assistant professor in chemical plant design, at the Department of Chemical, Materials and Industrial Production Engineering, University of Naples Federico II, Italy. He has a PhD in industrial engineering and has expertise as a process engineer in many fields of application, such as nutraceutical, pharmaceutical and cosmetic. He has an expertise in the production of liposomes, niosomes and nanostructured lipid particles using processes assisted by conventional, sub-critical and supercritical fluids. He is also an expert in high-pressure foaming processes for the production of polymeric drug carriers loaded with active principles. He has worked on conventional and supercritical assisted processes for the extraction of essential oils from natural matter, for their encapsulation in drug carriers.

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