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CASCADE VALORIZATION OF COFFEE GROUNDS

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PURPOSE OF THE ABSTRACT

The valorization of by-products linked to the production of foodstuffs has become a real preoccupation in recent decades [1]. For example, nearly 7 million tons of coffee grounds are generated each year related to coffee consumption. The overall objective of the project is to propose a local and sustainable value chain for coffee grounds, from collection to end-users, by integrating the stakes of eco-design and industrial ecology. That is includes several steps allowing the production of high added value products (biomolecules, active ingredients, enzymes) before the energy recovery stages (energy production, pellets, char logs). Up to now, the work was focused on eco-extraction of biomolecules of interest (antioxidant polyphenols) [2], then solid state fermentation for enzymes production [3].

The spent coffee grounds came from a local waste collection company, Gecco (Avelin, France). For ultrasonic assisted extractions, a 0.9 L stainless steel pipe with a 20 kHz frequency generator (SINAPTEC, Ultrasonic Lab750) was used. Three microplate assays were carried out to analyse the polyphenols extracts. Total polyphenols content and antioxidant capacity were determined with the Folin-Ciocalteu assay and with DPPH and ABTS assays respectively. Experimental design tool was used to identify the most influencing factors. For solid state fermentation, 0.5 g of dry coffee ground were used as substrate in deep well plates (24-well) and 106 spore/g of dry matter were inoculated. This fermentation was performed over 7 days at 25 °C and 200 % of humidity. Enzyme recovery were performed with physiological water at 50 °C during 3 hours on a mixing block. Xylanase activity was measured with DNS assay on xylan birchwood.

The first valorization step studied was ultrasound-assisted extraction (UAE). The main factor for the antioxidant extraction is the ethanol quantity in aqueous solvent, followed by the ultrasonic power and the solid-liquid ratio. 65 % of the total polyphenols present in the coffee grounds could be extracted with a power of 400W. In comparison, for the same extraction time with a conventional extraction at 70 °C, less antioxidants polyphenols were extracted, and electric consumption was more than 3.5 times higher. The second valorization studied was the fungi growth on coffee grounds for the production of xylanases. An isolation of fungi from this by-product was performed for this purpose and more than forty species of fungi were identified. A screening in solid fermentation allowed to determine, among these fungi, those with performant xylanase production like Penicillium and Fusarium solani, respectively 21 and 25 mU. Study on extraction and fermentation conditions is underway to optimize the value chain.

Eco-extraction with green solvents like ethanol and innovative processes such as ultrasound-assisted extraction, has a promising future in the waste recovery because of its efficiency and ecological approach. Solid state fermentation is still not used enough and deserves to be better known to by-product valorization. This process uses only the substrate as a resource, which makes it a perfect way to valorise waste. The cascade processes are an excellent way to transform what can be considered as a waste into an exhaustible ?raw? material.

FIGURES

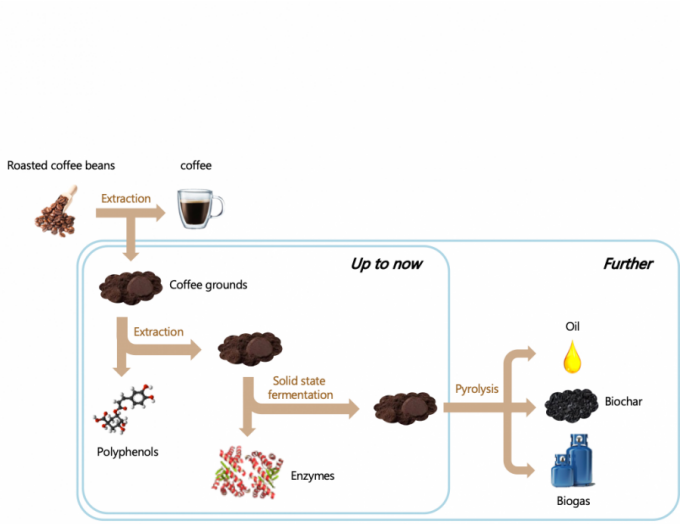

FIGURE 1

Cascade valorization of coffee grounds

Scheme of the cascade with the different recovery stages. The first step: eco-extraction, second step: solid fermentation and last step: pyrolysis

FIGURE 2

KEYWORDS

Coffee grounds | Valorization cascade | Ultrasound-assisted extraction | Solid state fermentation

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