OPTIMIZATION OF THE EXTRACTION CONDITIONS FOR ANTIOXIDANT PHENOLIC COMPOUNDS RECOVERY BY AUTOHYDROLYSIS OF SPENT COFFEE GROUNDS

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Agro-industrial residues often contain high added-value substances that can be extracted by designing a proper bioprocess to exploit them in the food, chemical and pharmaceutical industries. Particularly, phenolic compounds are of great interest due to their enormous benefits for human health. Previous researches have shown that the potential of phenolic compounds is related to their antioxidant activity, protecting against chronic-degenerative diseases as cancer and diabetes. Nonetheless, their properties are not limited the antioxidant activity, but they can also present anti-inflammatory, antiallergenic and/or antimicrobial effects.

Recently, spent coffee grounds (SCG), which is the main waste of the coffee industry obtained during the processing of roasted coffee powder with hot water to prepare instant coffee, have been studied as a natural source of phenolic compounds [1, 2]. These findings showed the ability of a conventional solid-liquid extraction method to recover phenolic compounds from SCG using organic solvents such as ethanol [1] and methanol [2]. However, there is a necessity of evaluating and identifying more eco-friendly methodologies, which may enhance the extracts compatibility for the food industry and enable their use as added-value constituent for several applications such as natural preservatives against food degradation, raw material in the development of functional food and as especial components into edible food packaging, among others.

Therefore, the aim of the present study was to extract antioxidant phenolic compounds from SCG using an eco-friendly technique, namely autohydrolysis. Additionally, the conditions able to produce a phenolic rich extract with high antioxidant activity were optimized. Experimental assays were performed under different conditions of temperature (160 to 200 °C), water/solid ratio (5 to 15 ml/g SCG) and extraction time (10 to 50 min), which were combined according to a 2^3 central composite design. Total phenolic compounds concentration in the extracts was quantified by the Folin-Ciocalteu method and the antioxidant potential of the extracts was determined by FRAP, DPPH, ABTS and total antioxidant activity (TAA) procedures. The extraction yield expressed as grams of extract recovered per 100 grams of SCG, was calculated for each experimental condition. Statistical analysis of the results was performed to identify the influence of the variables on the responses, and the conditions able to maximize the extraction of antioxidant phenolic compounds were established.

According to the results, the three operational variables exerted great influence on the extraction of antioxidant phenolic compounds from SCG. For instance, the extracted phenolic compounds content varied between 6.09 ± 0.07 and 39.29 ± 0.83 mg GAE/g SCG. The antioxidant activity values increased from 0.03 ± 0.001 to 0.25 ± 0.008 mmol Fe(II)/g SCG by the FRAP assay and from 18.28 ± 0.09 to 119.01 ± 1.19 µmol TE/g SCG by the DPPH assay. Whereas that antioxidant activity by ABTS and TAA assays raised from 21.53 ± 1.83 to 124.39 ± 3.21 µmol TE/g SCG and from 8.14 ± 0.23 to 64.79 ± 0.98 mg α-TOC/g SCG, respectively. However, the water/solid ratio resulted to be the process variable with more influence on all the responses. On the other hand, the worst values for all responses were achieved when the lowest limit was used for each variable and the best results were obtained for the highest limits, except for DPPH assay. Similarly, the best yield of the extraction process (26.06 % (w/w)) was achieved with the highest extraction time, temperature and liquid/solid ratio.

Considering these results and after adopting the criteria to find the optimal extraction condition, the model predicted a phenolic compounds extraction of 35.07 mg GAE/g SCG; and antioxidant activity values for FRAP, DPPH, ABTS and TAA of 0.25 mmol Fe(II)/g SCG, 121.75 µmol TE/g SCG, 130.01 µmol TE/g SCG and 64.17 mg α-TOC/g SCG, respectively. These values were achieved when maximizing the process variables (temperature = 200 °C, ratio = 15 ml/g and time = 50 min).

Thus, this study revealed two-times higher phenolic compound extraction by autohydrolysis when compared to solid/liquid extractions using organic solvents such ethanol [3] or methanol [4]. Moreover, SCG resulted a raw material of great interest for using on biotechnological processes due to their low cost and availability, and mainly due to their antioxidant capacity and presence of phenolic compounds.

References:

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