

Application of Response Surface Methodology for the optimization of natural compounds' extraction from pomegranate seed oil using acoustic cavitation technology

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Natural compounds play a significant role in the organoleptic and nutritional features of fruits with polyphenols, fatty acids, carotenoids and vitamins being mostly abundant, not only in the edible, but also in the non-edible parts. Especially pomegranate and its by-products – including its seed oil (PSO), albedo and peels - have gained a lot of attention because of their health promoting role, linked to these compounds^{1,2}. To recover them from fruit products, different extraction techniques, mostly conventional such as Soxhlet, maceration, percolation etc., have been implemented. However recently, “green” technologies, that consider environmental and economic protection have been proposed, with acoustic cavitation being one of them. In our study, we evaluated the effect of different extraction parameters, such as the extraction solvent (EtOH-H₂O ratio), extraction time and solvent-to-solid ratio, to the responses of PSO' yield and total phenolic content by using response surface methodology (RSM), by utilizing an ultrasonic bath. The optimum variables were later used to extract PSO which was characterized for its phenolic, flavonoid, and tannin content, as well as for its antioxidant activity. Additionally, LC-QTOF-MS and GC-FID were used to detect and quantify phenolic compounds and fatty acids. Response surface methodology identified that a 1/57 solvent-to-solid ratio, a 49/51 EtOH-H₂O concentration and an extraction time of 94 minutes, were the optimum variables for achieving highest yield (21.14%) and TPC (7.41mg GAE/g oil) simultaneously. Additional experiments confirmed the effectiveness of the experimental design achieving a yield of 21.13 ± 0.96% and a TPC of 9.0 ± 0.59mg GAE/g oil. Results have shown that PSO exhibited high antiradical activity of 91.64%, flavonoid content of 1.18 ± 0.32 mg CE/g oil and tannin content of 6.51 ± 1.07 mg TT/g oil. Finally, several polyphenols and fatty acids were detected through chromatographic analysis.

References:

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