

## Synergistic effect of probe sonication and ionic liquid for extraction of phenolic acids from oak galls

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### ABSTRACT

Phenolic acids of oak gall were extracted using ultrasonic-probe assisted extraction (UPAE) method in the presence of ionic liquid. It was compared with classical ultrasonic-bath assisted extraction (CUBAE) and conventional aqueous extraction (CAE) method, with and without the presence of ionic liquid. Remarkably, the UPAE method yielded two-fold higher extraction yield with the presence of ionic liquid, resulting 481.04 mg/g for gallic acids (GA) and 2287.90 mg/g for tannic acids (TA), while a decreased value of 130.36 mg/g for GA and 1556.26 mg/g for TA were resulted with the absence of ionic liquid. Intensification process resulted the highest yield of 497.34 mg/g and 2430.48 mg/g for GA and TA, respectively, extracted at temperature 50 °C with sonication intensity of 8.66 W/cm<sup>2</sup> and 10% duty cycle, diluted in ionic liquid, 1-Butyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide, [Bmim][Tf<sub>2</sub>N] at concentration of 0.10 M with sample-to-solvent ratio 1:10 for 8 h. Peleg's model successfully predicted the UPAE process confirming that extraction capacity is the controlling factor in extracting phenolic acids. Hence, it can be concluded that UPAE method and ionic liquid have synergistic effect as it effectively enhanced the extraction efficiency to increase the bioactive constituents yield.

### KEYWORDS

Oak galls; Ionic liquids; Ultrasonic-probe assisted extraction

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