

## Hot trub from breweries as a source of phenolic compounds

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Beer is the alcoholic beverage most consumed in the world. With the high production volume, a high volume of solid waste that must be properly treated by the breweries is also generated, resulting in high production costs. On the other hand, several compounds such as proteins, phenolic, and fibers can be recovered from the solid residues. In this study, we investigated the extraction of phenolic compounds from the hot trub fraction, which is a residue from the boiling step that contains hops but was never assessed in the literature. The hot trub, from a West Coast IPA beer brewing, was collected in a local brewery. Then, the sample was centrifuged to separate the solid fraction from the liquid, and the solids' composition was analyzed.

Ultrasound-assisted extraction (20 kHz, 6 minutes) with ethanol/water mixture was used as a green method, and a Box-Behnken design of experiment was used to identify the effects of the solid:liquid ratio (1:20, 2:20, and 3:20 m/v), ethanol:water ratio (10:90, 50:50, and 90:10) and temperature (30, 45, and 60 °C) on the total phenolic content (TFC) extracted. The total phenolic compounds concentration obtained in the ultrasound-assisted extraction varied from 0.015 to 2.488 mg GAE mL<sup>-1</sup>. The three independent parameters of the design of experiment were considered statistically significant (linear effect) for the extraction, and their increase leads to the increase of the TFC extracted. The optimum condition for the extraction was assessed from the predicted model to be solid:liquid ratio 3:30, ethanol:water ratio 90:10, and 60 °C, resulting in a predicted TFC of 2.85 mg GAE mL<sup>-1</sup>. Three runs were conducted in the optimized conditions, obtaining a TFC of 3.14 mg GAE mL<sup>-1</sup>, which is within 10% error and indicates that the model represents well the behavior of the dependent variable. The ultrasound-assisted extraction was convenient to extract phenolic compounds from the hot trub obtained from breweries, but further analysis must be performed to identify the phenolic compounds obtained and future applications.