Adding value to tomato pomace via enzyme-assisted aqueous extraction

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The food industry is increasingly concerned with operational sustainability and food waste reduction. In the United States, the massive tomato industry was worth $1 billion in 2020. Tomato processors have striven to valorize pomace by-products, which contain seeds with valuable compounds such as 30% oil. Tomato seeds are rich in bioactive compounds. Meanwhile, global edible oil production is forecasted to reach 632 million tons in 2022, and there is increasing interest to produce specialty oils. Organic solvent extractions are commonly used to extract oils from various commodities, but this method comes with some environmental concerns. Enzyme-assisted aqueous extractions (EAEP) have been proposed as a green alternative to oilseed solvent extractions. The objectives of this research were 1) to determine the impact of various extraction factors on oil yields from EAEP of tomato seeds; 2) to evaluate the effect of aqueous extractions on oil quality, and 3) to establish whether these processing steps are economically feasible for industrial commercialization.
The highest oil yield (41%) was obtained during 2 h extractions at pH 9, which were 68% higher than from 2 h extractions performed at pH 3. Enzyme addition was only beneficial during 8 h extractions of tomato seeds (4% cellulase, pH 3), which led to 53% higher oil yield compared to the control. Increasing incubation time from 2 to 8 h improved oil yields to 63% and 69% for cellulase extractions and protease extractions, respectively.
The pH of the aqueous extractions did not have a significant effect on the quality parameters of the extracted tomato oils, except for polyphenol content, DPPH production, peroxide, and TBARS values. Overall, tomato oil had peroxide and free fatty acid values comparable to other specialty oils, such as sunflower and sesame oils.
From a techno-economic point of view, tomato oil production at a flow rate of 1,752,000 kg pomace/yr garnered $13 million in profit after a payback time of 1.6 years, which was more profitable than the industry's current pomace disposal practice. Sustainable strategies of how tomato by-products could be repurposed to reduce waste and make value-added food products were demonstrated.