Integration of bioactive compounds rich pomegranate wastes into biorefinery

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Introduction

The fruit processing industry exposes a significant amount of waste. The food residuals rich in bioactive components, can be evaluated as fertilizer or animal feed. Especially the peel of the pomegranate fruit, which composes about 30-40%, is an important waste concomitantly a valuable substrate rich in phenolic compounds. Punicalagin and ellagic acid, obtained from pomegranate are important bioactive compounds and also known as natural antimicrobial, antibiofilm, antioxidant and anticancer agents.

Recovery of bioactive compounds is accomplished by various extraction methods. Although different types of solvents such as water, ethanol, methanol, and acetone are used for the extraction, the recovery of these compounds can be lower when water is used as a solvent. In addition, methanol generally gives higher yields in extractions, but ethanol is mostly preferred since it is suitable for food applications and also generates high yields of bioactive compounds (punicalagin 11-14% and ellagic acid 11-17%; Balaban *et al*., 2022).

During extractions, the extracts rich in bioactive components as well as the solid fruit part containing less bioactive components will come out (Figure 1). While the obtained extract can be used in applications such as food and pharmacology, the solid part can also be evaluated as animal feed, biofertilizer and a substrate for fermentation to produce metabolites. The recovery of ethanol used as a solvent in the evaporation unit and reuse in the extraction unit will also provide an economic contribution for the relevant facility.

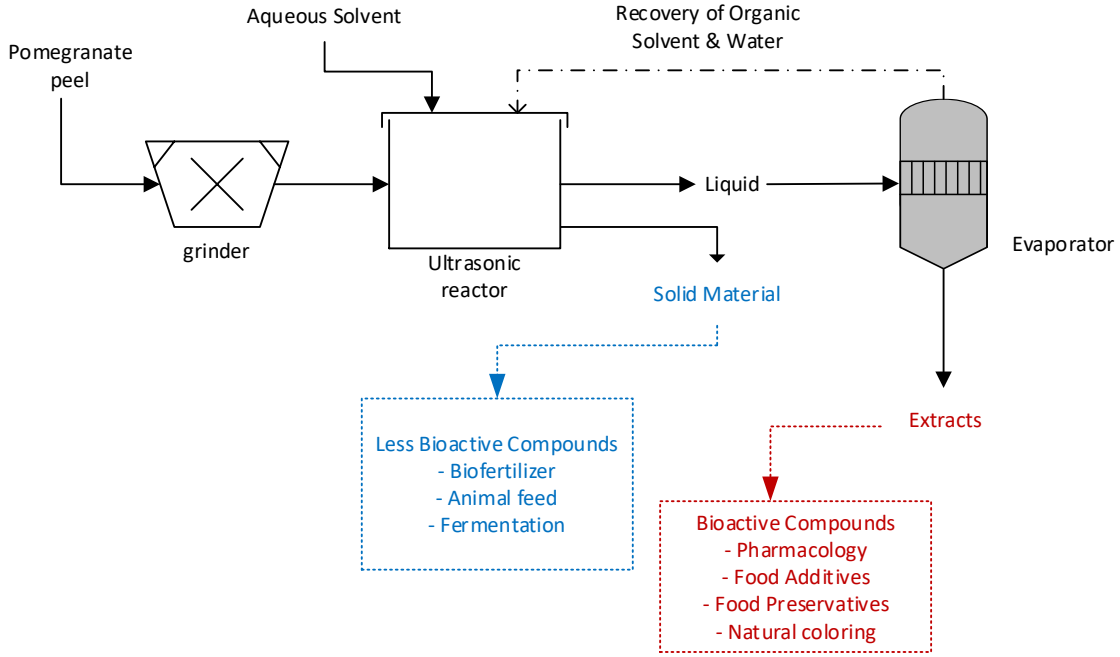

Figure 1. Schematic diagram of extraction process of pomegranate peel and its potential applications in industries.

Ellagic acid and punicalagin can be used as potential disinfectants in the food industry due to their antimicrobial and antibiofilm activities against various microorganisms (Balaban *et al*., 2021; Balaban *et al*., 2022). PPEs can also be considered as food additives since they contain various phenolic compounds with natural antioxidant properties (Rakshit *et al*. 2020). On the other hand, Bulkan *et al*. (2022) reported that *Aspergillus oryzae* is not affected by ellagic acid, therefore, fungal biomass can be obtained from pomegranate-derived phenolic compounds.

It has been shown that pomegranate seeds and extracts have antioxidant, anti-cardiovascular, anti-osteoporosis, antidiabetic, anti-inflammatory and anticancer activities both *in vitro* and *in vivo* studies (Fourati *et al*., 2020). Thus, it has potential use in pharmacology.

The natural red color of pomegranate can be an attractive material for various industries. For this purpose, Rehman et al. (2018) have developed textiles with natural color and antibacterial activity using pomegranate extracts. Thus, it shows that PPEs have the potential to be used both in textile and in biomedical sectors, apart from food and pharmacology applications.

Conclusion

The recovery of bioactive compounds by the extraction method of wastes from the fruit juice industry such as pomegranate will contribute to both waste management and bioeconomy with their potential applications in various industries such as food, pharmacology, textile and biomedicine.

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