Quercetin Recovery with Ceramic Membranes

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Abstract

Polyphenols are functional foods as they have a variety of health benefits beyond essential conventional nutrition. Using polyphenols is becoming a growing market. Using polyphenols in different industries makes it attractive to recover polyphenols from wastewater. Polyphenol recovery by ceramic membranes was investigated in this work. Filtration tests indicated that quercetin could be retained on the surface or in the pores of the ceramic membranes. Recovery tests showed that the polyphenol retained on the surface of the ceramic membranes can be recovered by ethanol. Because polyphenols have economic value, ceramic membrane nanofiltration can be an alternative for polyphenol recovery.

Keywords: Ceramic Membranes; Nanofiltration; Polyphenol, Quercetin; Recovery

1. Introduction

Phenolic compounds are bioactive phytochemicals naturally found in plants. Polyphenols have been shown to have benefits in the prevention of cardiovascular diseases, cancer, diabetes, neurodegenerative conditions, aging, and skin-related problems. It also has a significant prebiotic effect. They increase the rate of beneficial bacteria in the gut, which is important for overall health, weight management, and disease prevention. Polyphenols are functional foods as they have a variety of health benefits beyond essential conventional nutrition. Therefore, its use is expected to increase primarily in the functional food market. (Grand View Research, 2019). Polyphenols are also used in polishes, drugs, pesticides, and cosmetics (Mudimu et al., 2012).

Membranes are divided into two main groups: inorganic and organic. Inorganic membranes are divided into ceramic membranes and metallic membranes. The inorganic membrane material is a mixture of oxides and sintered metals. Oxides such as alumina, silica, titania, or mixtures of these components are some of the widely used commercial ceramic membranes (Goh and Ismail, 2018). Ceramic membranes are the most suitable alternative in water treatment with complex conditions, such as industrial wastewater treatment and oil/water separation processes. In this work, the quercetin recovery performance of the ceramic membranes was investigated.

2. Material and Methods

Dead end membrane test unit was used to determine the quercetin recovery performances of the one kDa TAMI ceramic membranes. Polyphenol recovery tests were conducted by filtering 50 mg/L quercetin solution for 4 hours at room temperature. Then, polyphenol recovery from the surface of the membrane was investigated by back-washing with distilled water and ethanol.

3. Results and Discussion

To meet the industrial demand for polyphenols, there are various studies conducted aiming at the recovery of polyphenols from wastewater (e.g., olive growing, winemaking, artichoke, and corn processing industries) or solid wastes (e.g., orange liquor, wine waste, fruit seeds, fermented grape press, grape starter). In this work, polyphenol recovery by ceramic membranes was investigated. Filtration tests indicated that quercetin could be retained on the surface or in the pores of the ceramic membranes. Recovery tests showed that the polyphenol retained on the surface of the ceramic membranes can be recovered by ethanol.

4. Conclusions

In this work, quercetin recovery by ceramic membranes was investigated. The results demonstrated that even though the molecular weight of quercetin is 302 g/mol, it can be retained by ceramic nanofiltration membranes, and recovered by ethanol back-washing. Because polyphenols have economic value, ceramic membrane nanofiltration can be an alternative for polyphenol recovery.

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