Removal of Phenolic Compounds from Olive Mill Wastewater by Adsorbent Resins

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INTRODUCTION

The extraction of olive oil is achieved through discontinuous (pressing) or continuous (centrifuging) processes in traditional mills or in modern units, respectively. Centrifugation, despite its high water consumption (around 0.6 m³/tones of olives processed), is still the most widely employed method for production of virgin olive oil, especially in countries that produce large amounts of olives [1]. Usually, two by-products are obtained with either process: a solid residue and a brownish black colored effluent from the olive plus the wash water, i.e., the olive oil mill wastewater (OMW) [2]. Since OMW has a high polluting organic load including sugars, tannins, phenolic compounds, polyalcohols, pectins and lipids [3], it is certainly responsible for the largest environmental problem in the oil producing areas. The major factor of the environmental problem is because of the high polyphenol content of OMW streams, that is to say it may contain up to 10 g/L of polyphenols [4]. This effluent having high polyphenol content is apparently toxic for soil microflora, seeds and aquatic organisms. On the other hand, the waste could provide a cheap source of phenolic compounds with strong antioxidant properties. Hydroxytyrosol and tyrosol are naturally occurring phytochemicals found in olives as major phenolics.

Recovery of phenolic compounds from OMW by means of appropriate technologies will not only avoid waste disposal problem, but also will allow obtaining added-value phenolic compounds as by-products. These phenolic compounds may be used as natural ingredients in variety of food products to enhance their quality. In this study, for removal of phenolic compounds, adsorption process was performed via adsorbent resins. Moreover kinetics and mechanisms of the adsorption process was investigated.

MATERIALS & METHODS

Several styrene-DVB based resins were tested to determine adsorption effectiveness. Adsorption experiments were performed by mixing 100 ml of OMW with different amounts of resin (1.0, 5.0, 10.0 g) at different temperatures (20, 30, 40, and 50°C). OMW and resin were stirred in tubes continuously for 3 h. Regeneration of resins and desorption of phenolic compounds were carried out with 1 N NaOH: ethanol (0.2: 0.8) solution. Total phenolic content was determined by Folin-Ciocalteu method.

RESULTS & DISCUSSION

Styrene-DVB based resin with functional group of tertiary amine was found to be an effective adsorbent. 90% of removal was achieved with 150 g resin/L in the single step batch system in one hour (Figure 1).
The data was well fitted to Langmuir isotherm model at these temperatures. Equilibrium adsorption data was monitored at 20 °C with 150 g resin/L and the adsorption process was found to be followed pseudo second order kinetics, and pore diffusion was found to be the effective adsorption mechanism. The adsorption efficiency did not significantly change even after five sorption cycle. Desorption rate of almost 100% were acquired in two steps to gain phenolic compounds.

CONCLUSION
Adsorption was revealed to be an efficient process for removal of phenolic compounds in OMW. Thus, the environmental problem seen in olive oil producing areas can be best avoided by adsorption process using suitable resin. Moreover, effective recovery of phenolic compounds may provide value-added natural ingredients in food.

REFERENCES