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Green approach for the valorization of microalgae *Tetradesmus obliquus*

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ABSTRACT

The main goal of this study was to develop an efficient, green approach for the valorization of *Tetradesmus obliquus* biomass, with zero waste. This microalga was selected because it is widespread, resistant, easy for cultivation, and fast-growing. In the first step, supercritical carbon dioxide ($ScCO_2$) extraction followed by rapid gas decompression was used for the extraction of biomass. The following step was to apply ultrasound-assisted (UA), microwave-assisted (MA), and subcritical water (SW) extraction on the $ScCO_2$-treated biomass to determine the most efficient processing technology. SW demonstrated to be a superior technique over MW and UA with regard to extraction yield and antioxidant content. Moreover, the chemical and microbiological profiles of SW extracts were determined to evaluate their potential and safety. In addition, to create a procedure with zero waste, the solid waste after SW extraction (residue) was analyzed. The organic profile of extracts and residues contained compounds that belong to groups of aliphatic saturated hydrocarbons, aliphatic unsaturated hydrocarbons, alkylated hydrocarbons, ketones, phenols, and esters. Furthermore, these compounds can be applied in different industries including the pharmaceutical and cosmetic industries. Additionally, the content of metals in residues indicated that this material can be used as *animal feed and in agriculture. Finally*, a complete reduction of microorganisms present in the initial biomass was obtained for the extracts and residues, indicating their safety.

1. Introduction

Tetradesmus (previously known as *Scenedesmus*) *obliquus* is a microalga widespread in freshwater lakes and rivers (Miranda et al., 2012). It represents a significant source of different types of components with the potential to be applied in food, pharmaceutical, and cosmetic industries (Gilbert-López et al., 2017; Guedes et al., 2013). Moreover, Afify et al. (2018) confirmed antioxidant and potential antiviral activities of *S. obliquus* protein hydrolysates against Coxsackie B_3 virus, whereas Marrez et al. (2019) demonstrated that its

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