Biotreatment of Fludioxonil Wastewater in a Fixed-bed Reactor under Various Hydraulic Retention Times

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The fruit processing industry is among the agro-industrial sectors rapidly expanded worldwide. This industrial sector is challenged by severe fruit losses, often exceeding 50%, due to fungal infections during postharvest storage (Brandhorst and Klein, 2019). These are incited by certain gray, green and blue molds, belonging to the species *Botrytis cinerea*, *Penicillium digitatum* and *P. italicum*/*P. expansum* (El-Otmani et al., 2011). To control fungal infestations during storage, chemical treatment with fungicides has contributed significantly to the extension of the fruits shelf life during storage (Nguyen Van Long et al., 2016).

A variety of fungicides has been used at postharvest level, including ortho-phenylphenol, thiabendazole, imazalil and fludioxonil (D'Aquino et al., 2013). Fungicides application is a common practice in postharvest fruit processing, but at the same time it results in the generation of large volumes of wastewaters containing high concentrations of these antimicrobial agents. Disposal of fungicide-contaminated wastewaters without processing in water ecosystems is prohibited since they are very toxic to aquatic organisms (Commission Directive 2007/76/EC). Hence, fungicide-contaminated effluents require treatment prior to their disposal in water receivers. Conventional wastewater treatment systems are not appropriate in the depuration of fungicide-containing effluents generated by the fruit processing industries (Masiá et al., 2013). Physicochemical treatment methods are proposed for treatment, such as sorption in activated carbon and (photo)catalytic oxidation (Morin-Crini at al., 2018; Fenoll et al., 2011). However, biological treatment methods are restricted due to persistent nature of post-harvest fungicides and only a few attempts have been performed, focusing mainly to biobed systems.

In this work, a fixed-bed bioreactor was setup and operated to treat fludioxonil-containing wastewater derived from the application of this fungicide in the post-harvest treatment of fruits. Bioreactor operation resulted in high COD removal efficiencies (above 70%) under various hydraulic retention times, whereas removal of fludioxonil was greater than 90%. Indeed, the prevention of biomass wash out and the consequent biomass retention resulted in the prevalence of slow, but specialized, microbial constituents, which enhanced bioreactor efficiency.

Keywords: post-harvest fungicides; fixed-bed reactor; biodegradation; biological treatment.

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