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Assessment of temporal and spatial evolution of bacterial communities in a biological sand filter mesocosm treating winery wastewater

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Abstract

Aims: To assess the impact of winery wastewater (WW) on biological sand filter (BSF) bacterial community structures, and to evaluate whether BSFs can constitute alternative and valuable treatment-processes to remediate WW. **Methods and Results**: During 112 days, WW was used to contaminate a BSF mesocosm (length 173 cm/width 106 cm/depth 30 cm). The effect of WW on bacterial communities of four BSF microenvironments (surface/deep, inlet/ outlet) was investigated using terminal-restriction fragment length polymorphism (T-RFLP). BSF achieved high Na (95·1%), complete Cl and almost complete chemical oxygen demand (COD) (98·0%) and phenolic (99·2%) removals. T-RFLP analysis combined with ANOSIM revealed that WW significantly modified the surface and deep BSF bacterial communities. **Conclusions**: BSF provided high COD, phenolic and salt removals throughout the experiment. WW-selected bacterial communities were thus able to tolerate and/or degrade WW, suggesting that community composition does not alter BSF performances. However, biomass increased significantly in the WW- impacted surface sediments, which could later lead to system clogging and should thus be monitored. **Significance and Impact of the Study:** BSFs constitute alternatives to constructed wetlands to treat agri effluents such as WW. To our knowledge, this study is the first unravelling the responses of BSF bacterial communities to contamination and suggests that WW-selected BSF communities maintained high removal performances.

Introduction

In South Africa, up to one billion litres of wastewater per annum is produced by the wine industry (SAWIS 2010). Winery wastewater (WW) can originate from the washing processes during vinification and bottling as well as from various other cleaning operations (such as the rinsing of wine barrels and fermentation tanks). Differences in grape varietals and the seasonality of many of the operational procedures result in significant variability in the chemical composition of cellar effluent (Malandra et al. 2003; Sheridan et al. 2011). Generally, WW has a high organic content and chemical oxygen demand (COD), with values typically reaching 5000 mg l^{-1}, but values as high as 25 000 mg l^{-1} have been reported (Malandra et al. 2003). Because WW can have toxic effects on crop

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Supporting Information

Additional Supporting Information may be found in the online version of this article: Table S1 Sediment characterization of the biological sand filters.