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Hospital wastewater treatment using actinomycetes to eliminate multi-resistant bacteria

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PURPOSE OF THE ABSTRACT

Hospital wastewater represent a potential source of microbiological pollution besides chemical micro-pollutants such as contrast agents, hormone-disrupting substances or drugs [1]. Amongst these microbial agents, multidrug-resistant microbial strains are of special concern [2]. Moreover, wastewater treatment plants which have not been designed to specifically eliminate multidrug-resistant bacteria (MDRB) can generate dangerous sewage sludge for environment and human health. Indeed, the main sustainable valorization pathway for these solid wastes being land farming, the presence of MDRB which can contribute to the spread of antibiotic resistance is an important issue.

Given this worrying situation, it is necessary to find a management and treatment solution to eliminate MDRB from hospital effluents. Actinomycetes from marine habitats currently constitute the main source of natural antibiotics [3]. Antibiotics can be produced by actinomycetes either from antagonistic interaction through competition for a common resource or via predation.

In this context, the aim of this study was to compare the ability of actinomycetes using the two antibiotic production strategies to be used as a new means of biological control against MRB. For this purpose effluents from the Marrakesh (Morocco) hospital treated by different actinomycetes were monitored using chemical (Fig. 1) and microbiological (Fig. 2) analysis. Thermochemolysis coupled with gas chromatography and mass spectrometry (THM-GCMS) was used to investigate the cellular fatty acids composition of 6 Strains of Gram + and Gram - MRB and 4 strains of actinomycetes. The distributions of these microbial molecular biomarkers, observed as methyl esters, were used both for chemotaxonomy and to monitor the biological interactions in controlled media and in effluents.

THM-GCMS allowed to discriminate between Gram+ and Gram - bacteria moreover different fatty acid methyl esters distributions were obtained from MRB and actinobacteria. Specific Biomarkers of MRSA such as anteiso pentadecanoic acid and eicosanoic acid decreased during the predation process, while branched tetradecanoic, linear pentadecanoic and hexadecanoic acids which are specific of predatory actinobacteria increased. Fatty acids characteristic of bacteria such as dodecanoic and oleic, decreased during the treatment, while those characteristic of actinomycetes such as branched iso pentadecanoic and heptadecanoic increased.

This study demonstrated the capacity of actinomycetes to be used for hospital wastewater treatment and the potentiality of THM-GCMS for chemotaxonomy study of bacteria and for monitoring microbiological processes such as antagonistic interaction or predation.

FIGURES

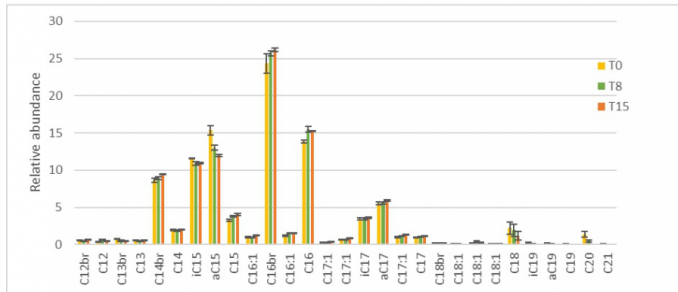


FIGURE 1

Figure 1

FaMes distribution during the predation process

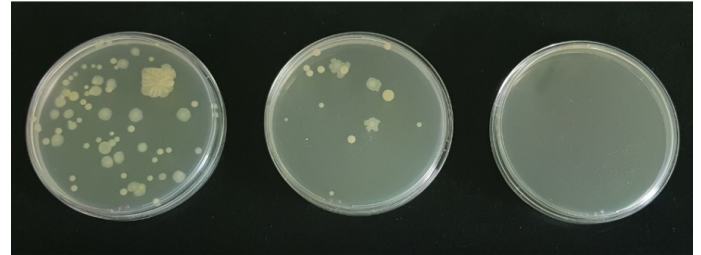


FIGURE 2

Figure 2

Assessment of MDRB by CFU enumeration during the treatment via antagonist actinomycetes

KEYWORDS

Hospital wastewater | multi resistant bacteria | actinomycetes | thermochemolysis

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