CYPRYS UNIVERSITY OF TECHNOLOGY
FACULTY OF GEOTECHNICAL SCIENCES AND
ENVIRONMENTAL MANAGEMENT

Graduate thesis

CHARACTERIZATION OF MICROBIAL COMMUNITY OF *POSIDONIA OCEANICA* WITH POTENTIAL BIOTECHNOLOGICAL APPLICATIONS

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Limassol, 2015

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APPROVAL FORM

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Characterization of microbial community of *P.oceanica* with potential biotechnological applications

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ABSTRACT

The marine environment is characterized by significant microbial diversity and considered as significant habitat for many microorganisms. Among these microorganisms, are bacteria and fungi, which may have significant unexplored biotechnological potential. In the framework of this study, a first approach was made in order to determine the microbial diversity of the seagrass *Posidonia oceanica,* a seriously threatened Mediterranean species, in Cyprus. Furthermore, the ability of marine fungi to produce laccases able to decolorize Remazol Brilliant Blue was also investigated. These microorganisms should be exploited in biotechnology and investigate for use in wastewater treatment processes in order to ensure the quality of wastewater. It was therefore necessary to thoroughly access the quality of wastewater at different stages so as to unravel possible toxic point sources that would require the application of microorganism for the further actions. Toxicity tests using biological indicators provide an integrated holistic approach and complement chemical analysis.

In the framework of this study, the toxicity of a wastewater treatment plant (WWTP1), which receives both domestic and industrial wastewater, was evaluated using *Vibrio fischeri.* Test based on *V. fischeri* bioluminescence inhibition is a rapid, easy handling and cost effective method for the toxicity assessment of wastewater samples. The ultimate goal was to correlate physicochemical and toxicity data was made in order to search for possible connection and guarantee the safety of aquatic organisms.

The findings of this study revealed that the bacteria genera found in *P. oceanica* were: *Vibrio*, *Pseudovibrio*, *Pseudoalteromonas* and *Labrenzia*. *Vibrio* was found to be the predominant genus of bacteria in the three sampling locations. Furthermore, our findings demonstrated that the predominant genus of fungi was *Cladosporium* followed by *Aspergillus*, *Penicillium*, *Stamphylium* and *Davidiella*. Eleven species of fungi were identified: *Stemphylium vesicarium, Cladosporium cladosporioides, Cladosporium herbarum, Penicillium chrysogenum, Aspergillus tubingensis, Cladosporium sphaerospermum, Penicillium brevicompactum, Aspergillus niger, Davidiella tassiana, Cladosporium macrocarpum* and *Stemphylium vesicarium.* 55 fungal isolates were found to have degradation percentage greater than 80% at 0.0% and 3.0% NaCl compared to 80.64% degradation percentage of *Phanerochaete chrysosporium* and were considered as laccases producers. The enzymatic screening highlights the capability of marine fungi to produce laccases useful to biodegrade lignocelluloses compounds even in the existence of high salt concentrations. These findings

suggest the exploitation of these fungi in different biotechnological areas, such as decolorization of colored effluents and treatment of toxic wastewater effluents.

Toxicity results revealed that all influent samples are very toxic to the tested organism with two samples showing extremely high toxicity. Secondary and final effluent wastewater samples, in the majority have no negative effect on the tested organism. No correlation between influent samples toxicity units and COD (0.15) and a positive correlation between SS and COD (0.79) were observed. The removal efficiency of COD and SS during tertiary treatment was achieved in high levels. Regarding point sources, PUMP_C and PUMP_E are the two pump stations with the highest toxicity load and the two pharmaceutical industries have the highest toxicity among the tested industrial wastewater samples. However, the toxicity observed could not be accurately correlated to the physicochemical parameters evaluated, pointing the complicated synthesis of real matrices.

Colcluding the presented results are a fisrt approach to the understanding of the ecological role of bacteria and fungi in marine environments and in particular in *P. oceanica* meadows, in Mediterranean basin. Furthermore, the ability of these fungi producing laccases leads to the exploitation of them in biotechnology and particularly in quality of sewage network since the points that contributed to the increase of toxicity in the sewage network have been revealed.