Bacterial community structure of the marine diatom Haslea ostrearia

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Introduction

The marine diatom Haslea ostrearia produces a water-soluble blue-green pigment known as marenine. However, the lack of knowledge of the ecological conditions under which this microalga develops in its natural ecosystem (oyster ponds), as well as the interactions between this diatom and other bacteria, inhibits optimization of its culture in well-controlled conditions.

The present work was intended to: i) characterize the structure of the bacterial community of H. ostrearia from oyster ponds in different localities of the French Atlantic coast; ii) describe the temporal dynamics of the bacterial community structure at the time scale of one culture cycle under laboratory conditions and after several subculturing steps.

A metabolic fingerprinting (untargeted approach) was aimed at assessing the global metabolic profile of H. ostrearia cultures, whether or not associated with the bacterial phyllosphere.

Materials and methods

Water and sediment samples were collected in 4 oyster farming localities (Fig. 1) more especially in oyster ponds (Fig. 2), which were immersed for a 2-week period before and after isolation of H. ostrearia cells (sediment vs. biofilm). A second comparison was made with the biofilm bacteria of the microalgal phytoplankton, i.e., embedded in exopoly saccharides or epiphytic and the suspended (suspended sediment water) community after separation of the two compartments by centrifugation and filtration. A third comparison was undertaken for a same metabolic profile at various growth stages (Fig. 3) and for several subcultures (0, 3, 6, 9 months) sampled during the exponential growth stage.

Small soluble extracellular target compounds produced by the bacteria and H. ostrearia recovered from the water sample in non-aerobic and non-aerobic H. ostrearia cultures were detected by high-resolution mass spectrometry (HRMS).

Results

The structure of the bacterial community from the sediment compared to that of the biofilm after H. ostrearia isolation differed considerably only 10% similarity between sediment and biofilm (Fig. 3). This result demonstrates that the bacteria associated with H. ostrearia were specific to the microalgae.

A comparison of community structure of the bacteria recovered from the biofilm with those of the water column (WLC), i.e., suspended bacteria (Fig. 4), revealed similarities that did not exceed 10%.

With respect to the biofilm, the observed similarities in bacterial community structures exceeded 50% regardless of the geographic origin of the H. ostrearia isolates.

Conclusion

For the first time, this study has analyzed the bacterial ecosystem surrounding the marine diatom H. ostrearia and showed that this bacterial structure is specific to the geographic origin of the microalgal isolate. Under laboratory conditions, once H. ostrearia has been isolated from oyster ponds, the bacterial community structure was shown to be resilient over a 9-month subculturing despite structural changes at the culture time scale according to the growth stage. Similarly, the differences in bacterial structures of two H. ostrearia isolates (HO and HD-BM) grew to specific metabolomic profiles. These profiles were more distinct with non-aerobic microalgae, i.e. with inclusion of their associated bacteria, than with aerogenic microalgae, thus suggesting reciprocal relationships between bacteria and H. ostrearia cells.

Moreover, in parallel with this first study, 36 bacterial strains have been isolated from the raw samples and cultured under appropriate conditions (Marine Agar 2216, 16C). Afterwards, all isolated strains were tested in co-culture with Haslea ostrearia under controlled conditions. Different responses have been observed on algal biomass production, in comparison with a control (Haslea mono-culture). Maximal biomass, lag-time and μmax have been modeled in order to select and identify bacteria species enhancing algal biomass. Publication of this second part of COSELMAR action 2.3 will be done in 2016-17.

Results presented here were published in Algal Research in April 2016


Acknowledgements

This study was funded under the COSTMB801 project supported by the French CNRS and University of Nantes, and the COSTMB801 project supported by the University of Nantes and CNRS. The authors thank the IRM of Nantes for their hospitality. The study was funded by the French “agence mondiale pour le renforcement de la recherche académique” (Agence mondiale pour le renforcement de la recherche académique) to support the research activities of the “Labex BS3”. The authors also would like to thank all the members of the BS3 Labex for their assistance and collaboration. Special thanks to Thierry Defferre for his technical advice and Maxime Albuixache for his support in the laboratory. This work was done under the COSTMB801 project supported by the French CNRS and University of Nantes, and the COSTMB801 project supported by the University of Nantes and CNRS. The authors thank the IRM of Nantes for their hospitality. This study was funded by the French “agence mondiale pour le renforcement de la recherche académique” (Agence mondiale pour le renforcement de la recherche académique) to support the research activities of the “Labex BS3”. The authors also would like to thank all the members of the BS3 Labex for their assistance and collaboration. Special thanks to Thierry Defferre for his technical advice and Maxime Albuixache for his support in the laboratory.