Functional Diversity of Microbial Communities Associated with the Mucus of Scleractinians around Moorea (French Polynesia)

MS #8

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Purpose

Mucus production by scleractinians appears as an antifouling mechanism which prevents settlement of other organisms and accumulation of sediments on their surface. This Surface Muccopolysaccharide Layer (SML) harbours dense populations of bacteria which play a paramount role in scleractinians nutrition, metabolism and good health maintenance. However, environmental disturbances can alter these microbiocenoses. Characterization of bacterial communities was carried out using a set of simple techniques that enable us to describe the state and functions of whole microbial communities associated with different hard coral species. Multi-comparisons have been performed on bacterial communities from open water, interstitial water, sedimentary interface and macro algae as well as between healthy and bleached colonies, and patches associated or not with Pomacentridae fishes.

Methods

The functional study included measurements of bacterial biomass, respiration, oxydative and hydrolytic metabolisms.

-ATP biomass for bacterial densities

-SEM counts for biomass and mean cell volume

-Frequency of dividing divided cells (FDDC) for bacterial production

-Apizym plates for hydrolytic activities

-Biolog plates for metabolic potential

This set of data was used to calculate a « functional diversity index » based on Shannon's one.

Results

On the one hand, open water and macroalgal associated microbiocenoses are very similar for all measurements. On the other hand, sedimentary interface and non-fungiidae corals ones are also very similar except for the **hydrolytic activity, higher in corals**. Moreover, interstitial water is particular due to the mix of aerobic and anaerobic media and show an **average hydrolytic activity** (but this activity is lower in function of bacterial number because anaerobic bacteria seem to have a lower metabolic activity).

And finally, Fungiidae corals are very specialized in relation to their way of life : **lots of bacteria, very diversified, with high activities**.

	Units	Open water	Macro-algae	Interstitial water	Sedim. interface	Non Fungiid corals	Fungiidae
Bacterial numbers	10^5 ml^{-1}	**12.1**	**10.7**	**24.3**	30.9	30.3	**173.6**
Bacterial Biomass	ng C ml^{-1}	**16.1**	**13.0**	31.9	43.8	41.7	**252.5**
Proportions Rods/Cocci/Vibrios	%	**31 / 66 / 3**	**33 / 65 / 2**	**44 / 47 / 9**	50 / 43 / 7	51 / 47 / 2	**64 / 35 / 1**
Mean cellular Volume	µm^3	**0.044**	**0.041**	0.062	0.051	0.064	**0.070**
Estimated turn over time	hours	22	26	30	15	22	21
Metabolic Activity	µg form. l^{-1} d^{-1} 10^{-5} bact	12.7	13.3	**2.6**	10.2	11.9	13.1
Global hydrolytic activity	Nmol h^{-1} ml^{-1}	**33.0**	**31.5**	**88.3**	**59.4**	**214.4**	711.9
Specific hydrolytic activity	Nmol h^{-1} ml^{-1} 10^{-5} bact	2.7	2.9	3.6	**1.9**	**7.1**	4.1
% potential substates used	%	51	52	57	62	69	**85**
Shannon functional diversity index	bits	3.04	3.07	3.60	3.59	3.50	**4.33**

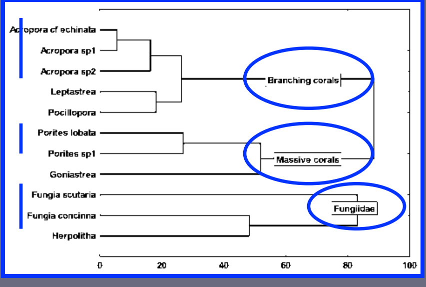
Bleached corals show **more abundant bacteria**, with **higher respiration** rate and **higher hydrolytic activity** than healthy ones. Moreover, they display a **higher division percentage**, a **higher growth rate** and a **lower turn-over time.**

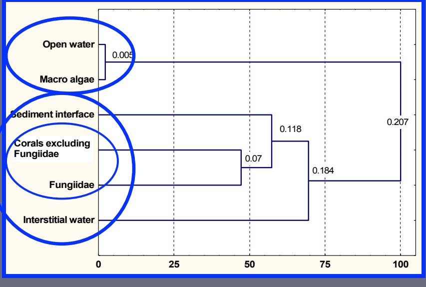
	Units	Mean Scleractinaria unbleached	*Pocillopora sp.* unbleached	*Porites sp.* unbleached	*Pocillopora sp.* bleached	*Porites sp.* bleached
Bacterial numbers	10^5 ml^{-1}	30.3	36.5	23.0 – 36.4	**64.9**	**55.8 – 77.1**
Bacterial Biomass	ng C ml^{-1}	41.7	63.2	37.0	**99.9**	**94.6**
Proportions Rods/Cocci/Vibrios	%	51 / 47 / 2	56 / 43 / 1	55 / 42 / 3	**73 / 22 / 5**	
Mean cellular volume	µm^3	0.064	0.062	0.061	**0.073**	**0.073**
Estimated turn over time	hours	22	21	25	**12**	**13**
Metabolic Activity	µg form. l^{-1} d^{-1} 10^{-5} bact	11.9	12.5	11.6 – 13.0	**19.8**	**21.8**
Global hydrolytic activity	nmol h^{-1} ml^{-1}	214.4	-	150.1 – 216.4	**321.5 – 374.6**	**334.6 – 361.5**
Specific hydrolytic activity	nmol h^{-1} ml^{-1} 10^{-5} bact	7.1	-	4.9 – 9.4	**3.9 – 4.4**	**3.8 – 4.2**
% potential substates used	%	69	-	64 –75	72	70 – 76
Shannon funct. diversity index	bits	3.50	-	3.56	3.62	3.60

Coral patches associated with Pomacentridae fishes show **more abundant** and **metabolically active bacteria** (higher respiration and higher hydrolytic activity) than corals without territorial fishes.

	Units	Mean Scleractinaria Without fishes	Mean Scleractinaria With fishes
Bacterial numbers	10^5 ml^{-1}	25.7	37.3
Metabolic Activity	µg form. l^{-1} d^{-1} 10^{-5} bact	13.9	22.9
Global hydrolytic activity	nmol h^{-1} ml^{-1}	132.6	165.6

Distances trees confirm similarities between microbiocenoses of some compartments of the reef and show clear systematic characteristics according to bacterial communities. **Corals** are grouped according to the genus and the morphological type of the colony. Moreover, **corals group** is associated **with sedimentary interface** and moreafter with **interstitial water**, separated from **open water and macro-algae**.





Conclusion

We confirmed that bleaching events or the presence of sedentary fishes modify the bacterial communities structure and affect relationships between coral, endosymbiotic algae, SML-associated microbial community and associated organisms. Such results highlight that SML-bacterial communities are modified by bleaching and raise the question of a potential protection of fishes against pathogens.

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