

SELECTION AND CHARACTERIZATION OF NATURAL MICROBIOMES FOR POLYHYDROXYALKANOATES PRODUCTION

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Introduction

In nature, microorganisms thrive within complex ecosystems called microbiomes, where their collective capabilities surpass those of individual populations. Through bacterial communication, involving metabolite exchanges and molecular signalling, microbial consortia achieve a division of labour, enhancing productivity and resilience against environmental fluctuations. Over time, this communal living fosters stability within consortia, making them robust in diverse environmental conditions. Leveraging these attributes, natural microbiomes from various ecosystems can be tailored to produce commercially valuable metabolites, such as biopolymers. Polyhydroxyalkanoates (PHAs), biocompatible and biodegradable polyesters synthesized by select microbial species, offer sustainable alternatives to conventional plastics.

This proposal studied the evolutionary trajectories of natural microbiomes collected from distinct habitats towards PHAs-enriched consortia subjected to specific selective pressure conditions.

Results

Collection of sediments in different sites of Portugal



Quantification of PHA by different microbiomes (Gas chromatography)

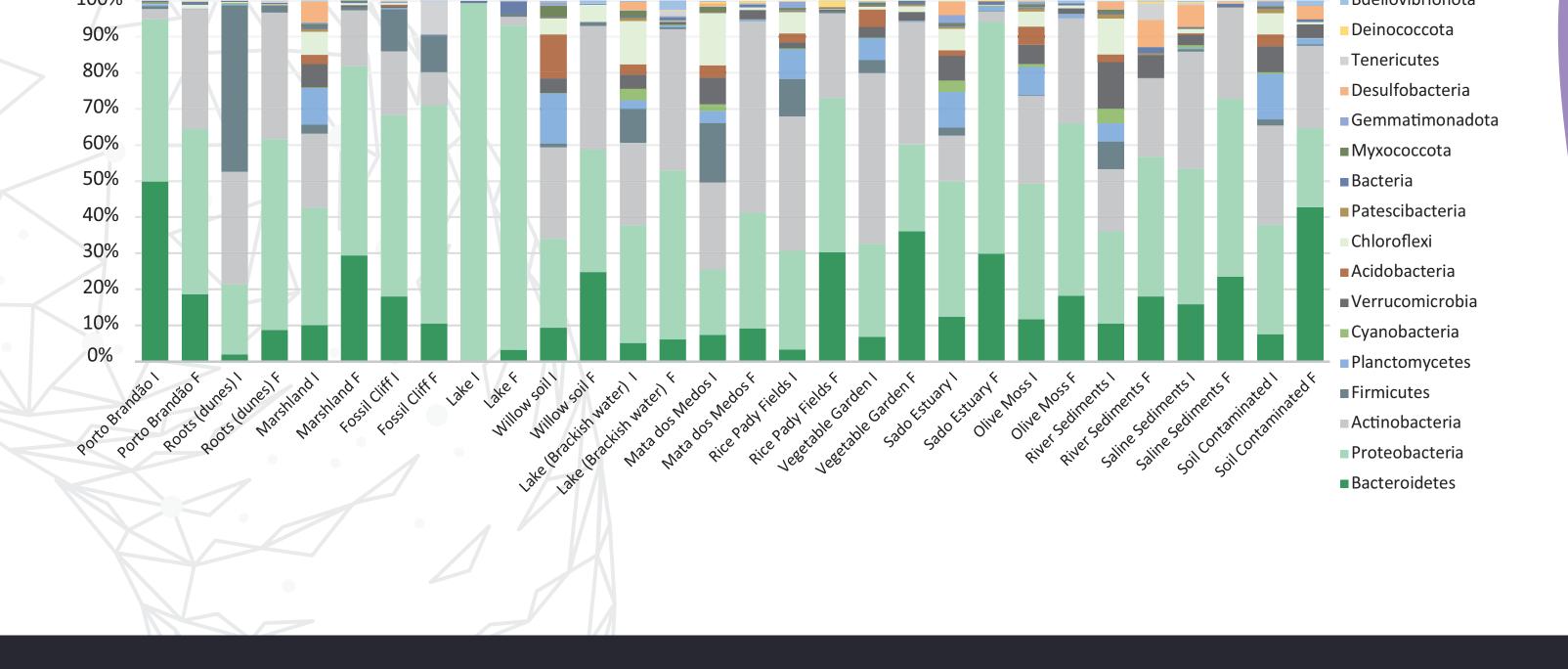
MICROBIOME	VSS (g/L)	mgPHA/gVSS
Porto Brandão	6.60 ± 0.00	23.13 ± 0.00
Dunes Plant Roots	$6.20 \pm 0,00$	125.88 ± 0.00

Porto Brandão (Costa da Caparica)	Fossil Cliff Soil (Costa da Caparica)	Dunes Plant Roots (Costa da Caparica)	Corroios Marshland (Seixal)	FEAST AND SAMINE STRATEGY2 hydraulic retention times20°СрН7	Corroios Marshland	4.50 ± 0.00	116.47 ± 3.46
					Fossil Cliff Soil	10.40 ± 0.60	5.07 ± 0.45
					Lake Water	9.60 ± 0.20	45.79 ± 0.52
					Willow Tree Soil	12.60 ± 0.00	2.18 ± 0.10
Lake Water (Costa da Caparica)	Willow Tree Culture (Lagoa Albufeira)	Lake (Brackish water - Lagoa Albufeira)			Lake (brackish water)	12.75 ± 0,15	16.57 ± 0.49
					Mata dos Metos	11.00 ± 0.00	43.35 ± 0.00
					Rice Paddy Fields	11.35 ± 0.55	3.50 ± 0.35
				Vegetable Garden	11.65 ± 1.45	77.43 ± 3.87	
Rice Paddy Fields (Coruche)	Vegetable Garden (Coruche)	Sado Estuary (Setúbal)	Olive Moss (Aveiro)		Sado Estuary	13.10 ± 0.00	30.56 ± 3.81
					Olive Moss	10.15 ± 0.35	95.44 ± 0.00
					River Sediments	8.10 ± 0.70	19.17 ± 0.00
					Saline Sediments	11.75 ± 0.25	0.00 ± 0.00
River Sedime	ents (Coruche) Saline Sedime		ated With Metals e Candeeiros)		Soil Contaminated	9.00 ± 0.60	4.06 ± 0.04

Genetic characterization of microbiomes

Conclusions

Microbiomes with diverse physical, chemical and genetic characteristics



were collected and subject to the same selective pressure.

The microbiomes yielding higher amount of PHA were found in Dunes Plant Roots, Marshland, Vegetable Garden and Olive Moss.

All of the 15 microbiomes evolve into PHA-accumulating organisms -Proteobacteria and Actinobacteria.

Oceanimonas, Halomonas, Corynebacterium, Alcaligenes, Acinetobacter, Paracoccus and Pararhodobacter are the most abundant genera after 2 HRT of cultivation.



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