AEROBIC GRANULAR SLUDGE FOR WASTEWATER TREATMENT AND RESOURCE RECOVERY

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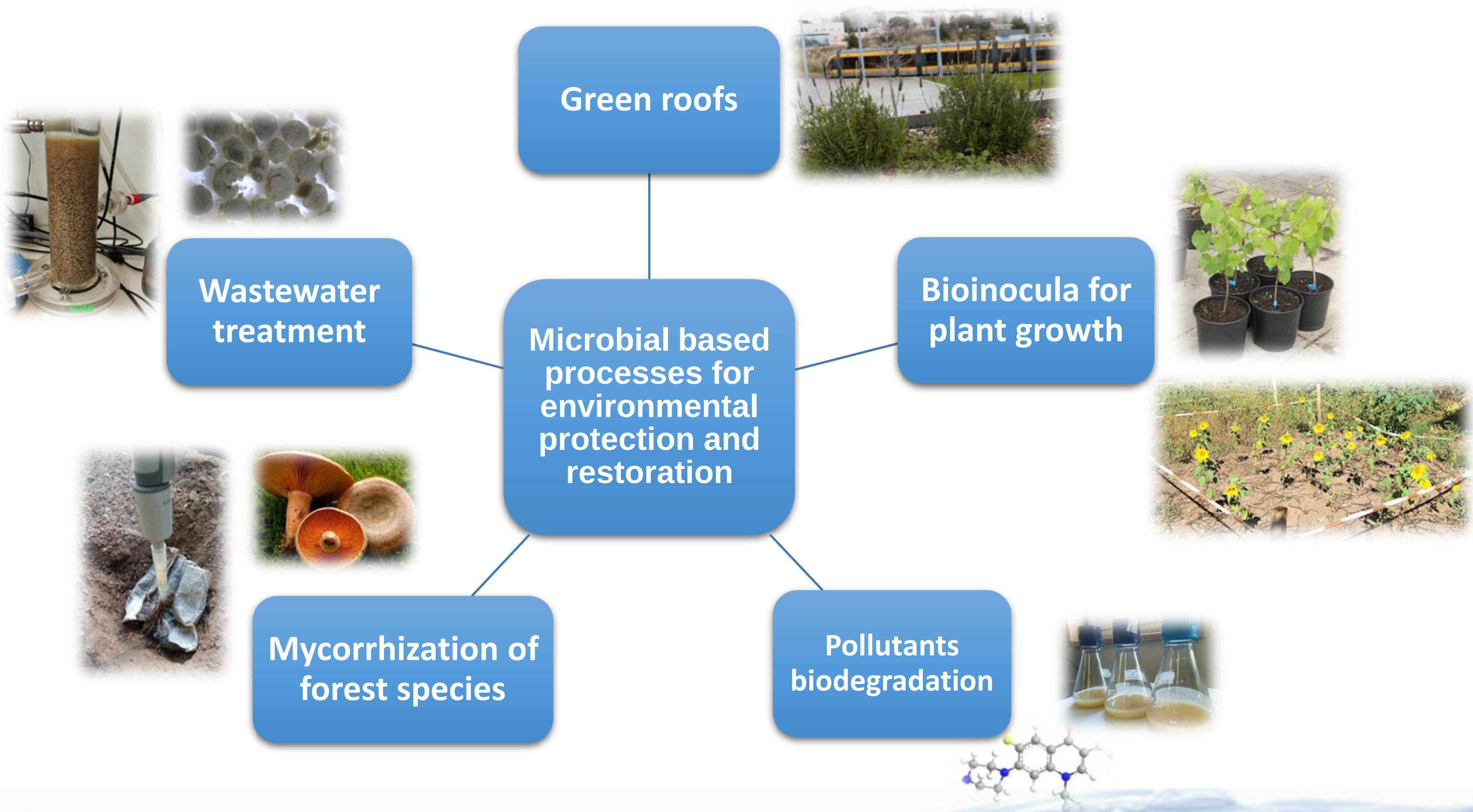

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AQUAVAL
Valorisation of water use in aquaculture using multi trophic systems

AquaVal
Valorization of water use in aquaculture using multi trophic systems

Funding Agency
ERA-NET Cofunf WaterWorks2015

UCP role: Coordinator

MULTIBIOREFINERY

MULTIBIOREFINERY
Multi-purpose strategies for broadband agro-forest and fisheries by-products valorisation: a step forward for a truly integrated biorefinery

Funding Agency
SAICT and PAC

UCP role: Member

GReAT

GReAT
Granular microalgae-bacterial sludge for aquaculture wastewater treatment

Funding Agency
FCT and European Regional Development Fund

UCP role: Coordinator

AGeNT

AGeNT
Aerobic Granular Sludge technology combined with microbial agents to degrade toxic pollutants

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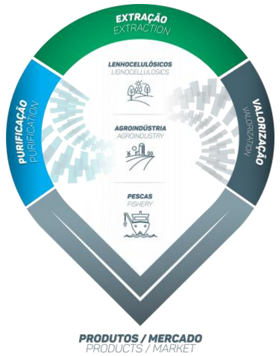
Multi-purpose strategies for broadband agro-forest and fisheries by-products valorization: a step forward for a truly integrated biorefinery

A multidisciplinary scientific research and technological development project presented by a consortium of six research units with complementary skills to create synergies that will seek to capitalize and optimize means and resources and to create critical mass to accelerate the production of knowledge and solutions to societal challenges, mainly in the agro-food sector, ensuring environmentally friendly practices.



universidade de aveiro

Universidade do Minho

iBET Instituto de Biologia Experimental e Tecnológica

U C Universidade de Coimbra

NOVA SCHOOL OF SCIENCE & TECHNOLOGY

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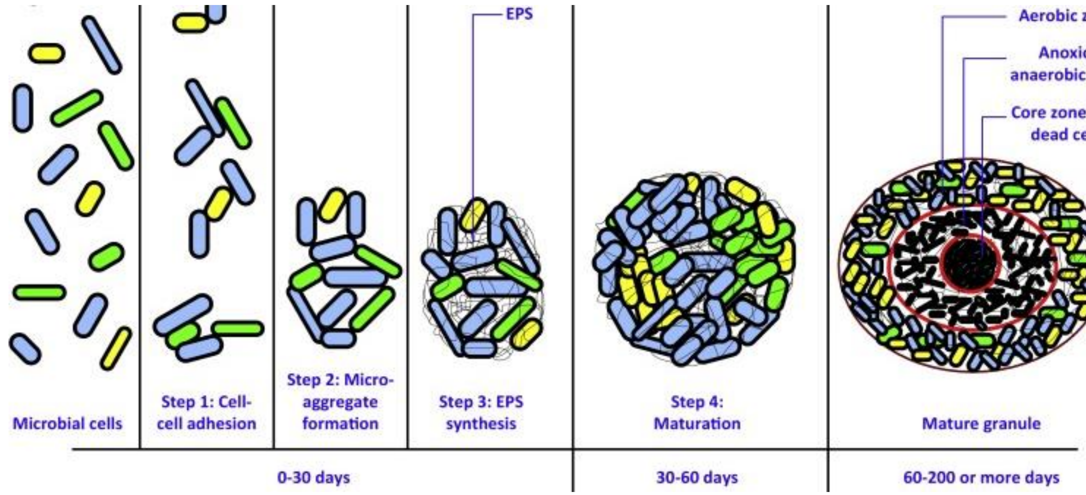
AEROBIC GRANULAR SLUDGE PROCESS

- **Biofilm technology** for wastewater treatment;
- Special case of biofilm composed of **self-immobilized microorganisms** forming spherical sludge aggregates



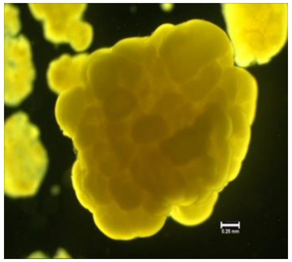


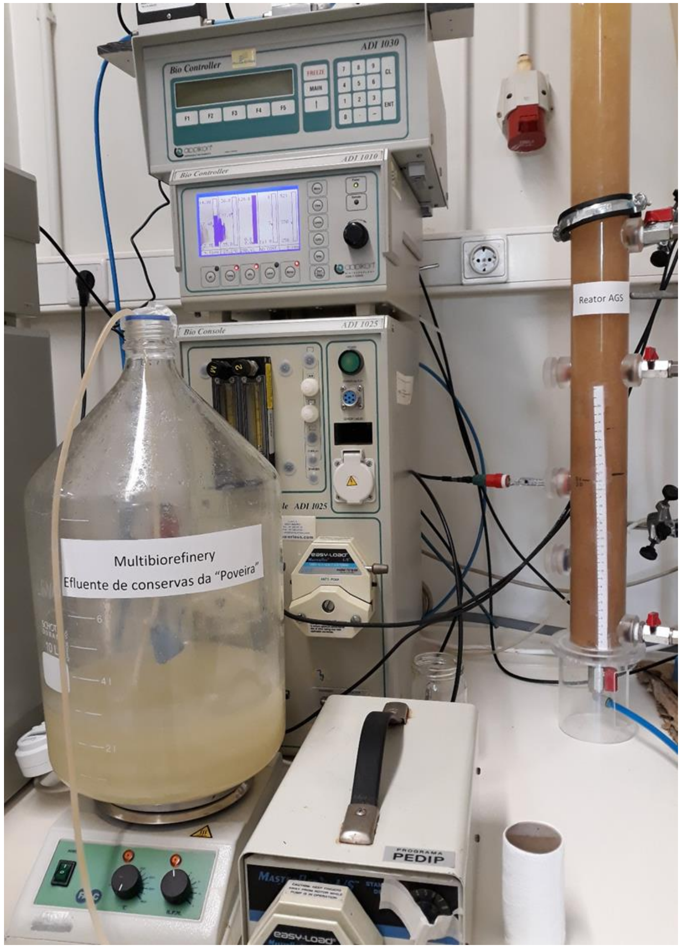
Figure from *Sarma et al. 2017*

EPS: Extracellular polymeric substances

AEROBIC GRANULAR SLUDGE PROCESS

- 75% less land area
- 30-50% less energy-costs
- Less construction materials

AEROBIC GRANULAR SLUDGE PROCESS TREATS REAL FISH CANNING WASTEWATER



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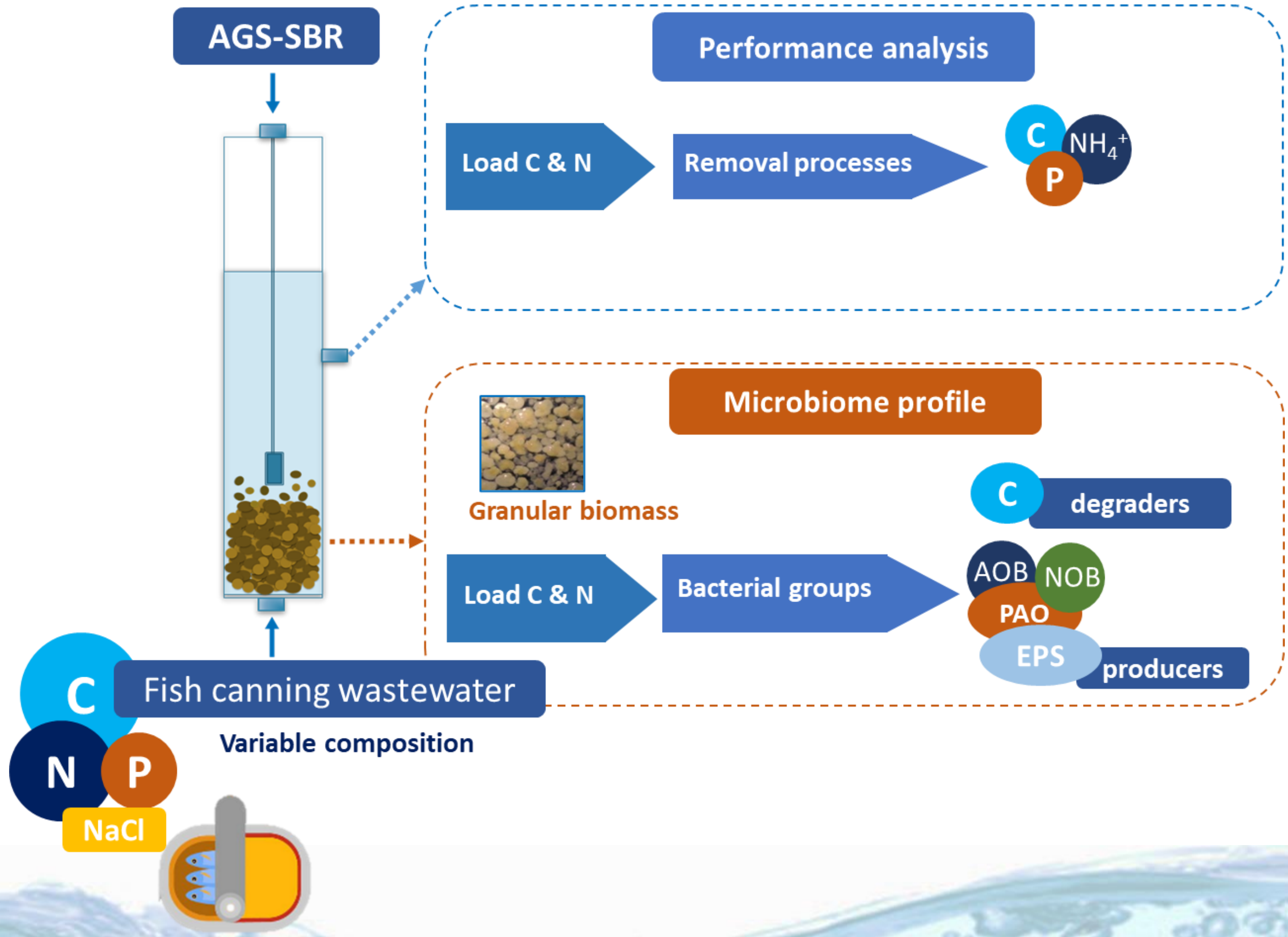

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Science of the Total Environment 756 (2021) 144007

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Long-term stability of a non-adapted aerobic granular sludge process treating fish canning wastewater associated to EPS producers in the core microbiome

Ana M.S. Paulo [a,*], Catarina L. Amorim [a], Joana Costa [b], Daniela P. Mesquita [b], Eugénio C. Ferreira [b], Paula M.L. Castro [a]

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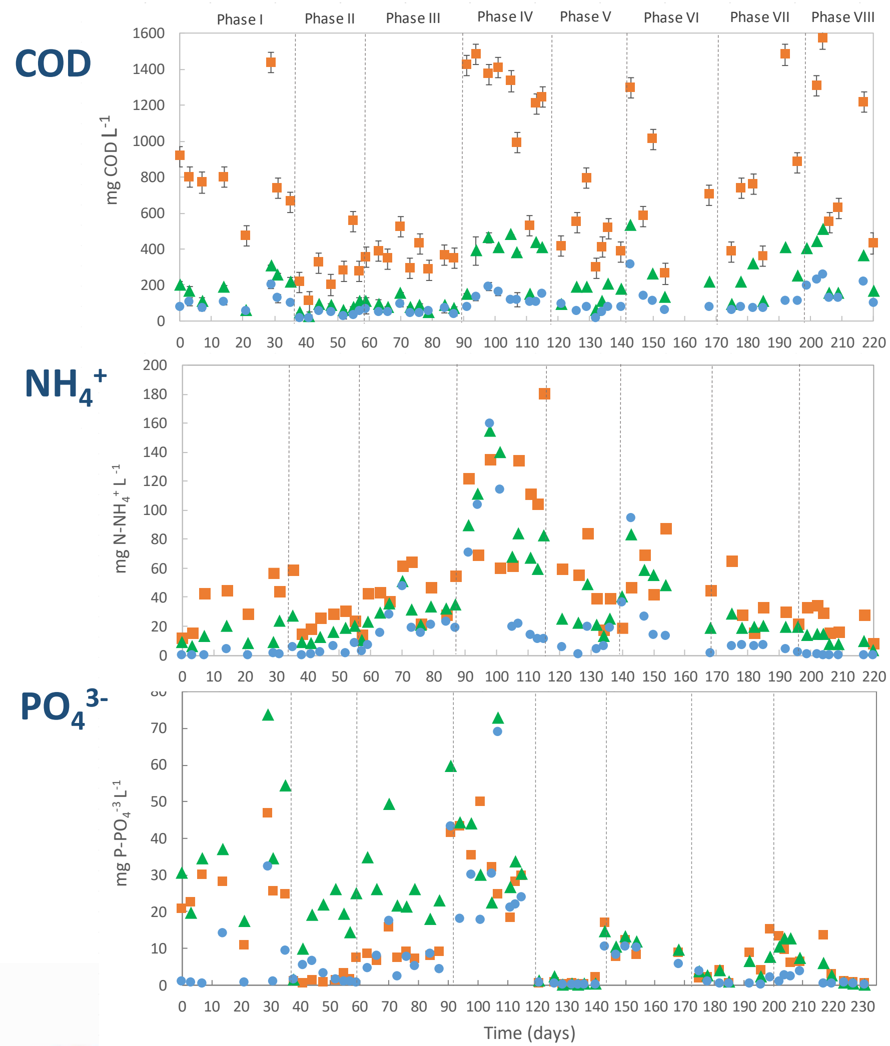
[b] Centre of Biological Engineering, Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal

Performance analysis

- AGS presented good performance for all removal processes, being temporarily disturbed by a period of higher OLR
- Carbon removal was mostly affected by higher OLR (above 2 kg m^{-3} day^{-1}), while higher carbon and nitrogen loads promoted a sequential effect on nutrients removal processes.



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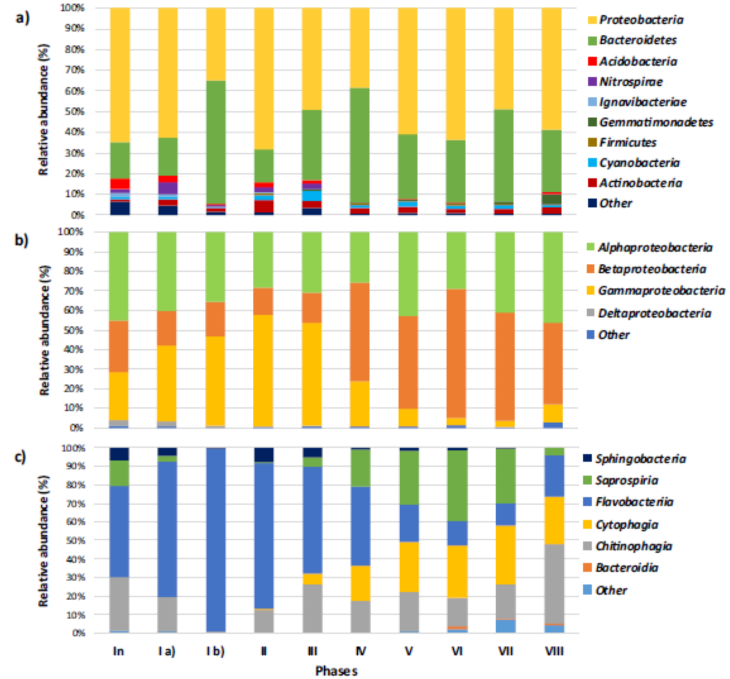
Microbiome analysis

- Main microbial community changes occurred during higher organic load period
- Bacterial groups associated to EPS production, carbon and nutrients removal were resilient.



Best classification										
Methylocaldum	7.39	13.09	6.94	14.53	3.46	0.00	0.00	0.00	0.00	0.42
Rhodobacteraceae	7.22	4.40	1.20	3.31	1.31	0.20	0.15	0.50	0.68	0.81
Plasticicumulans	5.54	9.46	5.77	14.05	10.17	0.22	0.00	0.00	0.00	0.00
Novosphingobium	5.15	2.99	0.85	0.55	0.54	0.00	0.24	0.17	0.00	0.29
Phenylobacterium	[illegible]	5.83	3.06	3.73	2.50	1.01	3.05	2.60	4.23	5.03
Chryseobacterium	4.70	9.25	57.61	11.62	15.24	19.33	3.63	1.16	3.40	2.57
Nitrospira	1.53	[illegible]	0.82	2.48	2.77	0.00	0.00	0.00	0.00	0.00
Pseudoxanthomonas	0.00	0.00	1.72	4.74	7.70	8.27	5.20	1.30	0.62	0.97
Comamonadaceae	0.00	0.00	[illegible]	4.59	4.19	3.29	2.53	0.00	0.00	0.53
Ferruginibacter	2.84	2.15	0.39	1.22	4.90	2.04	2.26	1.03	1.65	3.09
Flavobacterium	3.67	1.77	0.36	[illegible]	3.72	1.98	1.24	0.79	0.13	0.55
Haliscomenobacter	1.87	0.57	0.00	0.11	1.53	11.14	8.56	9.84	10.39	0.58
Leadbetterella	0.00	0.00	0.00	0.00	[illegible]	8.75	5.00	2.37	6.12	4.87
Thauera	0.00	0.00	0.00	0.00	[illegible]	8.55	12.43	25.60	15.49	2.54
Taibaiella	0.00	0.00	0.00	0.00	0.12	[illegible]	1.12	0.58	0.00	6.04
Paracoccus	0.69	0.54	0.46	1.91	1.66	[illegible]	9.29	8.30	11.07	1.21
Micavibrio	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	1.99	0.00	0.00
Nitrosomonas	1.60	1.13	0.00	0.30	0.00	0.00	[illegible]	5.42	0.81	0.00
Ohtaekwangia	0.00	0.00	0.00	0.13	0.52	1.26	2.03	[illegible]	6.18	0.90
Sphingomonadaceae	1.59	1.40	1.22	1.26	1.90	0.88	0.62	[illegible]	0.74	5.04
Gemmatimonas	0.00	0.00	0.00	0.00	0.33	0.46	0.73	0.38	1.28	4.89

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High Carbon Load in Food Processing Industrial Wastewater is a Driver for Metabolic Competition in Aerobic Granular Sludge

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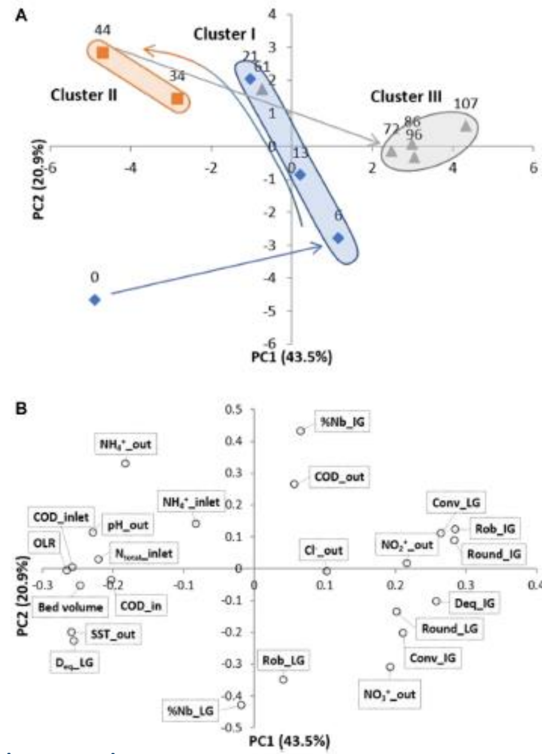
Performance analysis and QIA



EPS composition analysis

TABLE 2 | Biochemical characterization of the EPS extracted from the AGS biomass (average value ±standard deviation).

Sampling day	Carbohydrates (mg g^{-1} VSS ±SD)	Proteins (mg g^{-1} VSS ±SD)	PN/PS	Humic acids (mg g^{-1} VSS ±SD)	Total EPS (mg g^{-1} VSS ±SD)
Day 0	56.7 ± 3.7^{a}	221.5 ± 18.9^{a}	±3.9^{a}	163.2 ± 20.3^{a}	441.4 ± 35.3^{a}
Day 55	101.0 ± 7.6^{b}	201.9 ± 18.4^{b}	±2.0^{b}	68.4 ± 8.0^{b}	371.3 ± 26.2^{b}
Day 107	76.9 ± 8.7^{c}	224.5 ± 18.1^{a}	±2.9^{c}	92.4 ± 17.8^{b}	393.7 ± 40.7^{a,b}

PN, protein content in the EPS; PS, polysaccharide content in the EPS. Means with different letters (a, b or c) in the same column differed significantly according to Tukey's post-hoc test ($p < 0.05$).

- EPS is mainly composed of proteins, carbohydrates and humic acids, that changed over time
- We found correlation between performance and granules morphological and structural changes

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Main conclusions

- AGS can treat fish canning wastewater
- Carbon and nitrogen loads were identified the main disturbance factors
- Microbiome diversity and adaptation supported AGS stability and fast recovery

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