Evaluating Step-feed for Enhanced Biological Phosphorus Removal (EBPR) in Tropical climate

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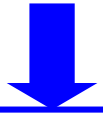
Introduction

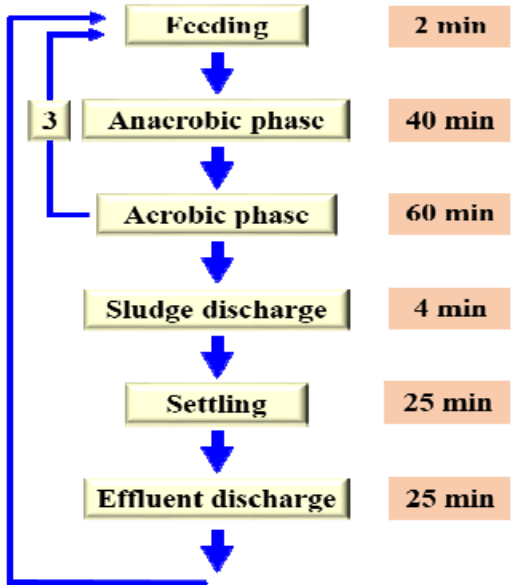
- GAOs are the major competitor of PAOs that causes EBPR failure, especially under tropical climate
- Many studies indicate that the employment of EBPR in tropical climate is challenging
- It is known that deterioration of EBPR occurs when temperature is higher (25~30^{o}C)



However, a few successful EBPR processes operated at high temperature shed some light on the feasibilities of high temperature EBPR

Feeding strategy and carbon source effect on EBPR in tropical climate

Reactor setup



Time (min)	Stage 1	Stage 2	Stage 3
Days	0-86	87-263	264-345
A	40	35	40
O	60	65	60

Temperature was maintained at 30-32°C

+

Step-feeding strategy ← Acetate, Propionate

+

HRT of 12 h

+

SRT of 7.5 days

+

pH of 7.2-8.0

+

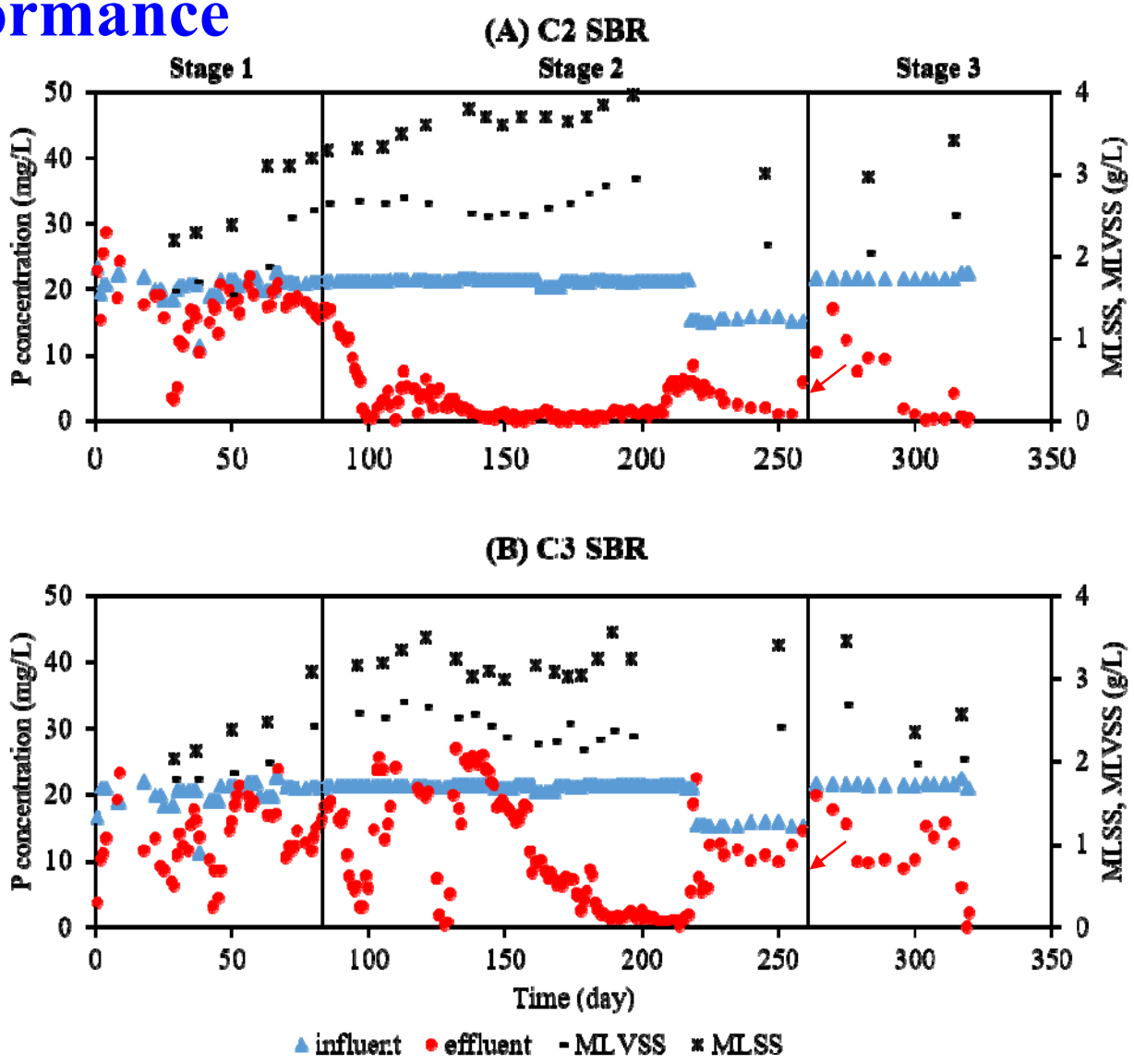
DO of 2-3 mg/L

+

COD/P of 20 ← 400 COD, 20 P; 300 COD, 15 P.

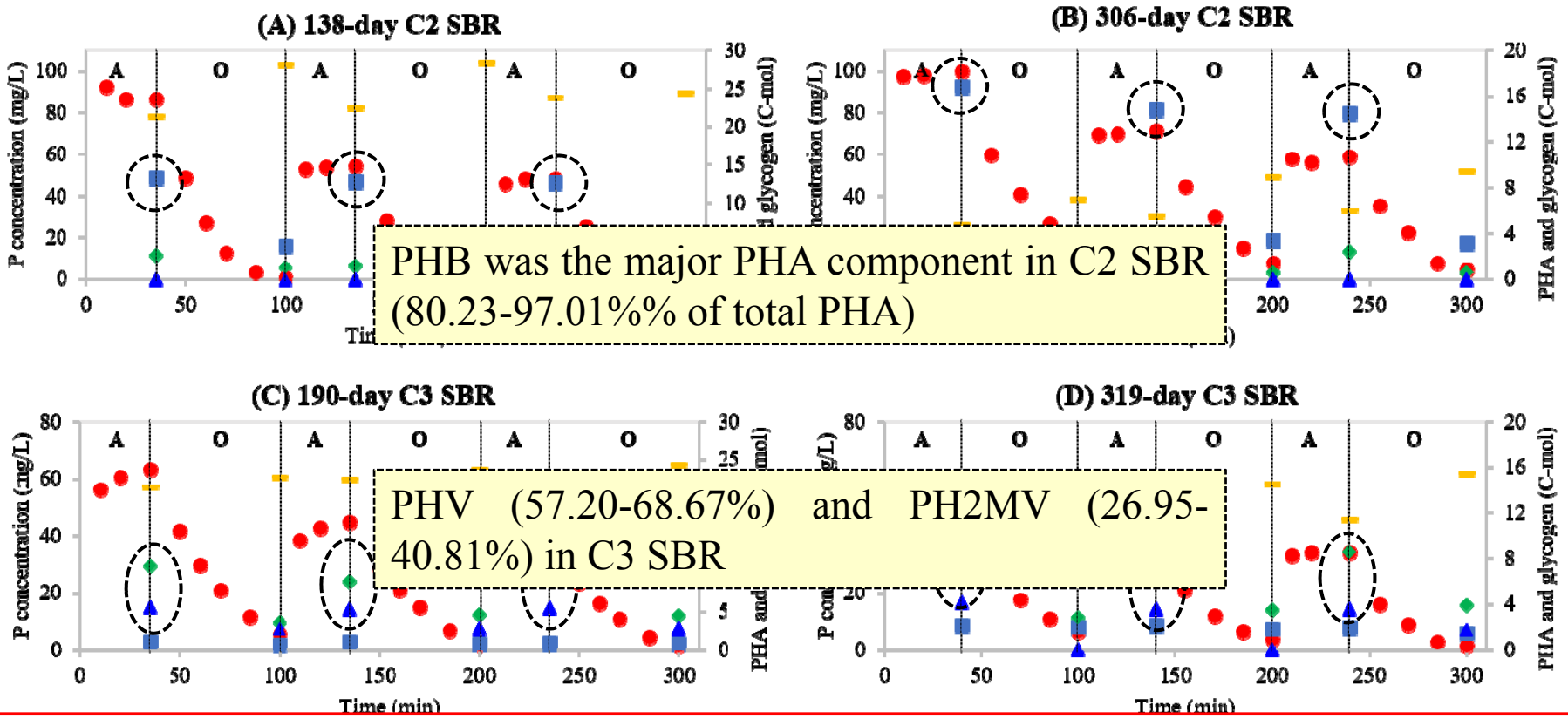
Results

SBRs performance



Results

Cyclic study during stage 2 and 3



PHB was the major PHA component in C2 SBR (80.23-97.01%% of total PHA)

PHV (57.20-68.67%) and PH2MV (26.95-40.81%) in C3 SBR

- Carbon uptake and P release rates were higher at high temperature
- PHA composition: similar with the results reported under lower temperature
- The fractions of PHA and glycogen in biomass were lower at high temperature

Results

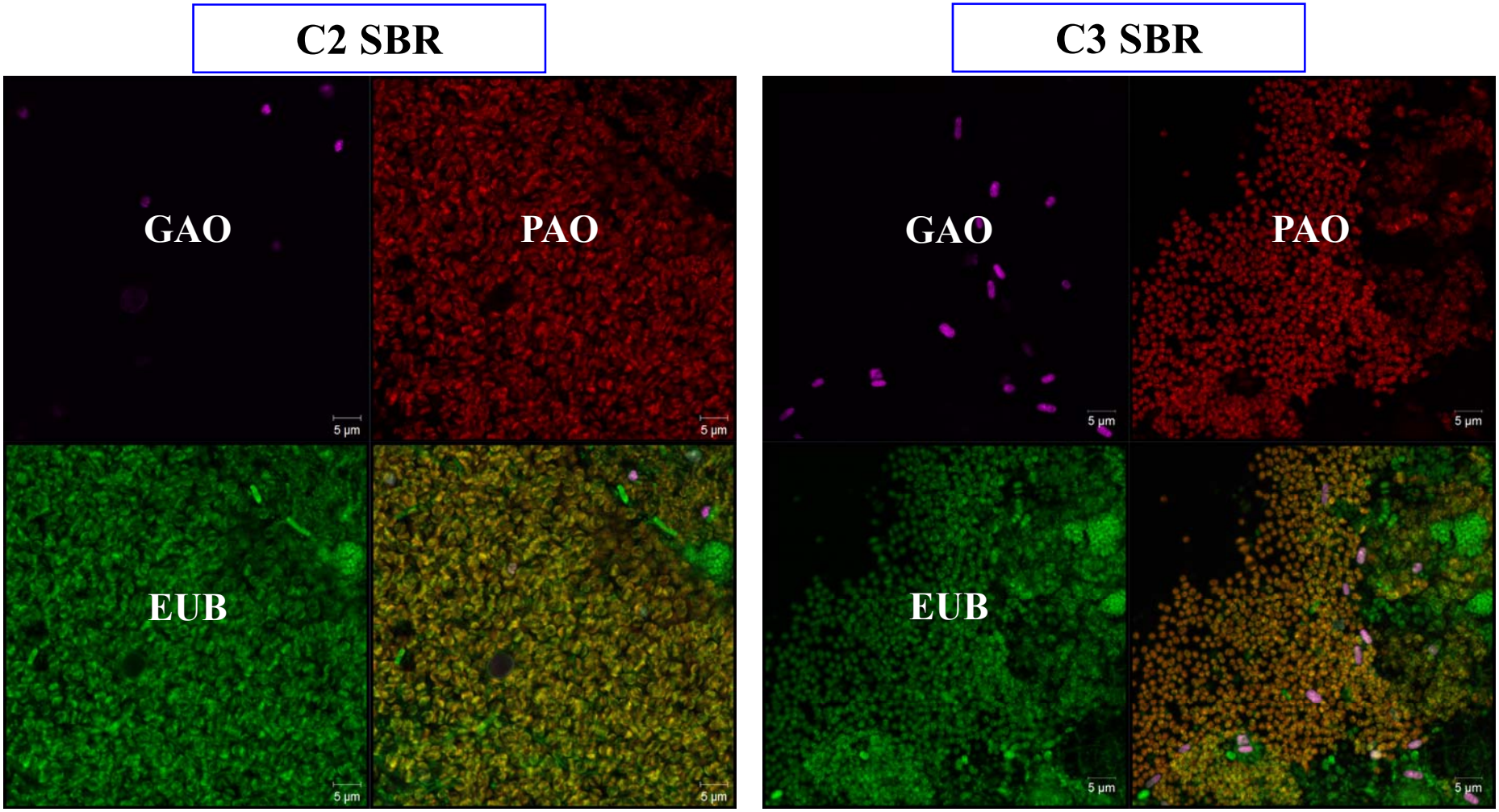
Stoichiometric ratios of P and C transformation

	C2-SBR							C3-SBR						
	Anaerobic phase			Aerobic phase				Anaerobic phase				Aerobic phase		
Sub-cycle 3	0.692-0.762	0.833-0.989	0.040-0.151	0.234-0.423	0.606-0.701	0.804-0.957	0.264-0.354	0.404-0.634	0.020-0.063	0.457-0.689	0.268-0.352	0.163-0.248	0.457-0.504	0.905-0.906	0.281-0.401
* Normalized value	0.723-0.819	0.821-0.964	0.069-0.189	0.244-0.407	0.639-0.709	0.751-0.979	0.214-0.277	0.454-0.652	0.025-0.050	0.491-0.706	0.268-0.429	0.162-0.303	0.474-0.514	0.737-0.844	0.189-0.262
Model	0.50	1.33		0.50				0.42	1.22			0.33			

- The ratio of P/C was higher at high temperature, maintenance energy
- Most PHA/C ratios were lower than the model under lower temperature
- Most Gly/C ratios were lower than the model under lower temperature, PAM dominated
- P/PHA ratios under high temperature were higher than lower temperature

Results

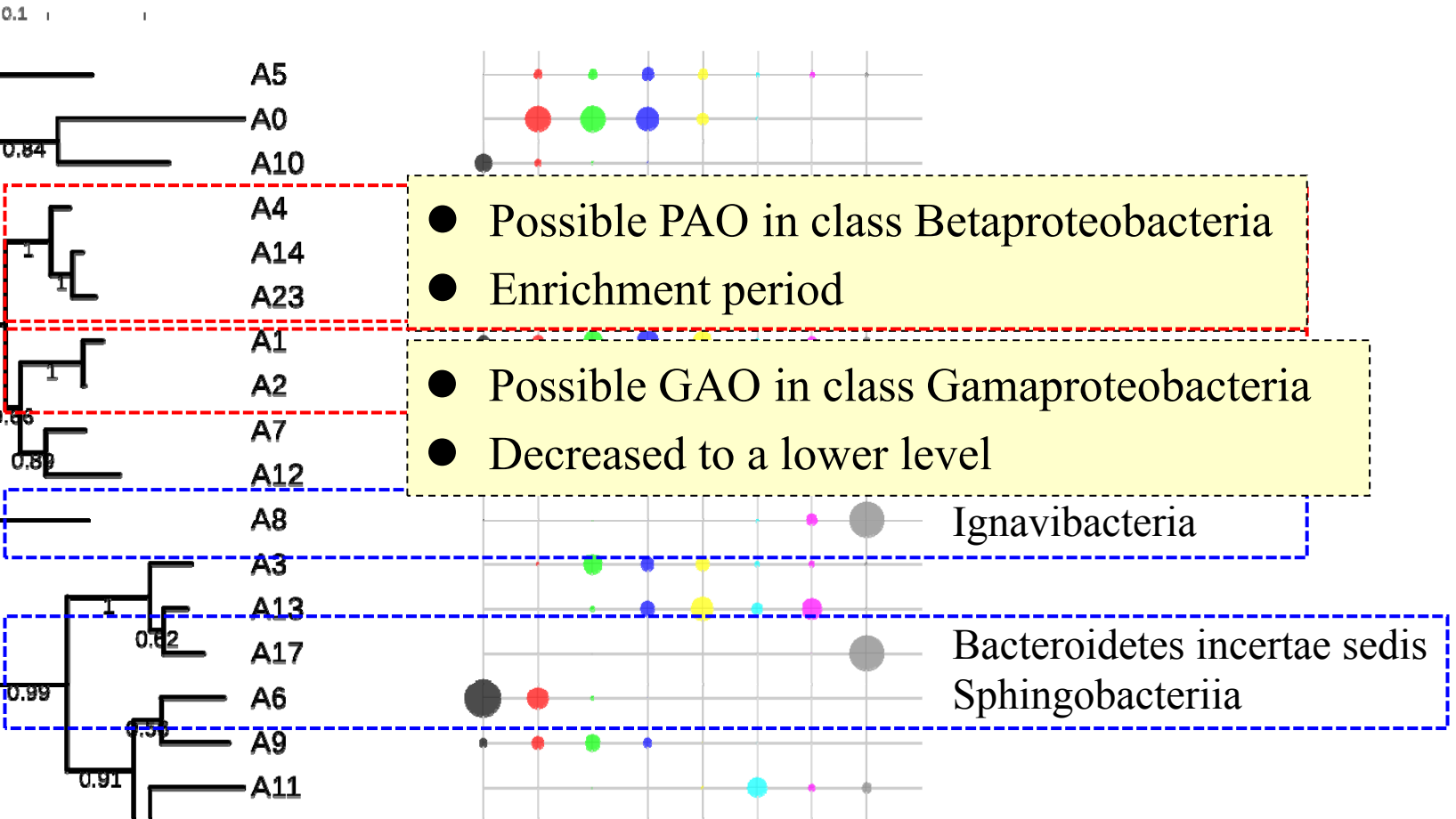
FISH for PAO and GAO



- PAO dominated in both reactors during steady state.
- The morphology of PAO in the 2 SBRs was different.

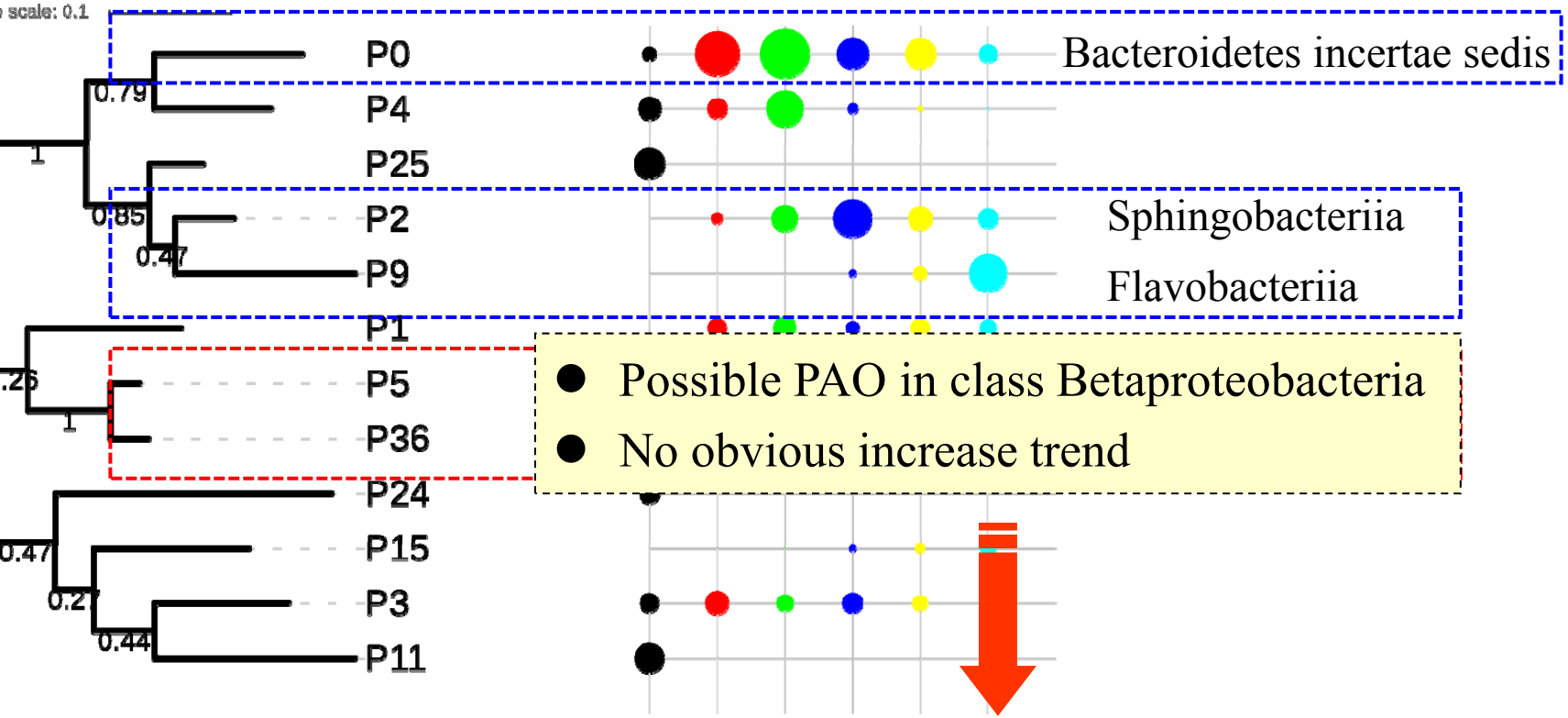
Results

icrobial community dynamics in C2 SBR



Results

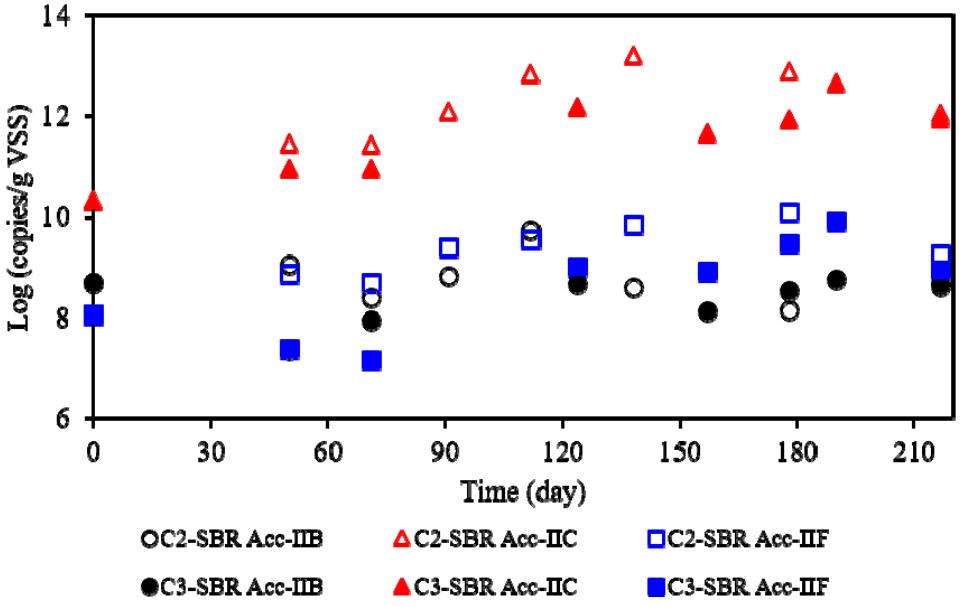
icrobial community dynamics in C3 SBR



Results

FISH and qPCR

Time (day)	C2-SBR PAO%	C2-SBR GAO%	Time (day)	C3-SBR PAO%	C3-SBR GAO%
71	30.16	25.75	71	20.19	10.32
138	74.65	9.54	157	53.29	2.28
178	52.51	20.55	190	31.57	8.12
306	63.92	20.76	319	11.04	35.91



microbial community structure was more stable in C2-SBR than C3-SBR

Conclusions

ed operation could support a good EBPR performance with C2 and C3 at mperature and C2 SBR was more stable

of the C and P transformation ratios of both reactors were higher at high rature than lower temperature

fractions of PHA and glycogen in biomass were lower with step-feeding pared with pulse feeding, high turnover rate

e microbial community structure was more stable in C2-SBR than that in C3-R

Thank you for your attention!