

Intermittent load of 2-fluorophenol in saline wastewater shapes aerobic granular sludge microbiome and reactor performance

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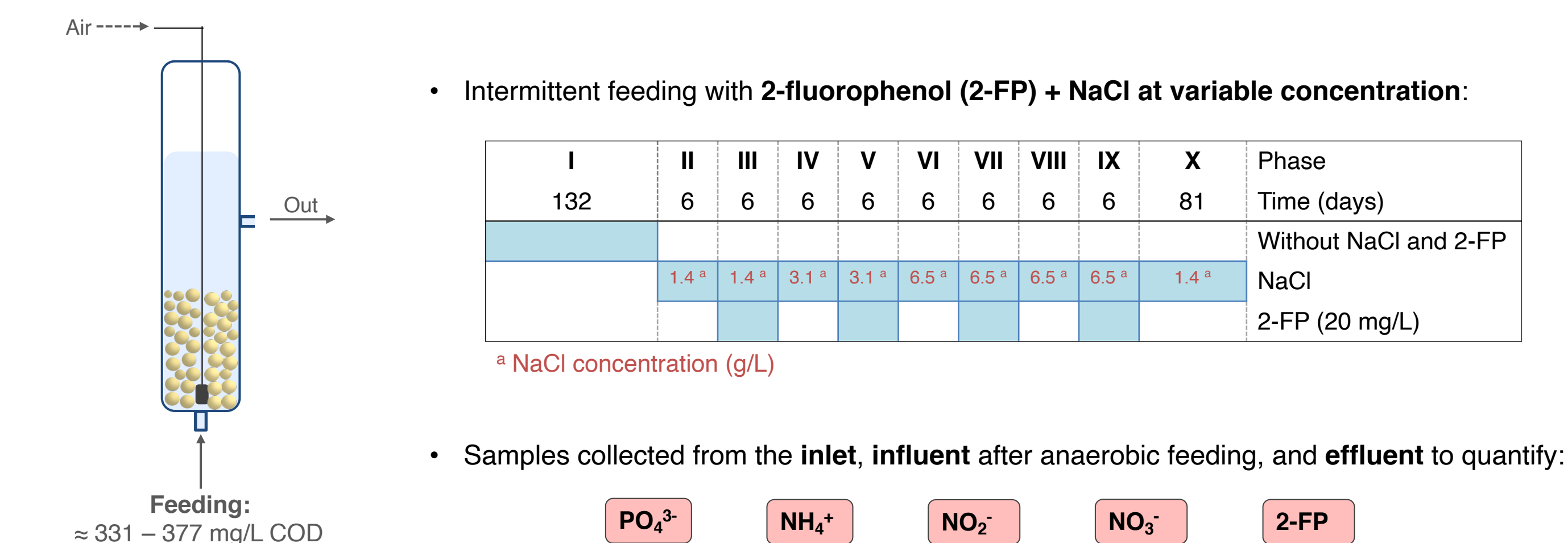
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Introduction

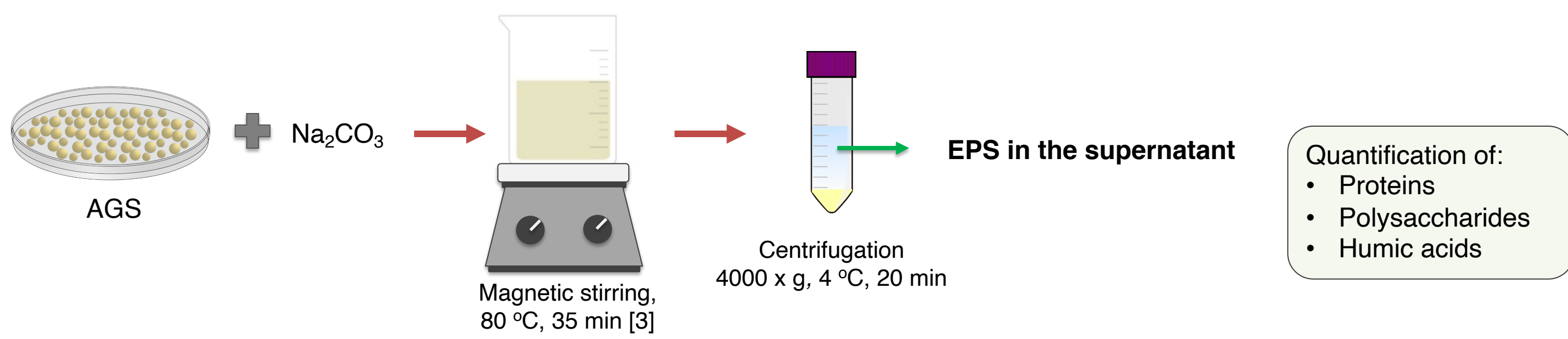
Industrial effluents often contain organic pollutants and variable salinity levels, making their treatment challenging [1]. Aerobic granular sludge (AGS) is an innovative and compact wastewater treatment technology for the treatment of domestic and industrial water streams. The high content of extracellular polymeric substances (EPS) in AGS composition is thought to protect, to some extent, the microbial communities from stressful conditions in external environment [2]. This work aimed to evaluate the robustness of AGS systems in terms of nutrient removal performance and to unravel the protective role of EPS towards transient feeding with a toxic pollutant (2-fluorophenol - 2-FP) in saline wastewater. Moreover, the taxonomic and functional patterns of the AGS microbiome were characterized and linked with nutrient removal performance and EPS production. In order to mimic transient states of composition typical of industrial effluents, the reactor inlet medium periodically varied regarding to 2-FP presence and salt concentration.

Methods

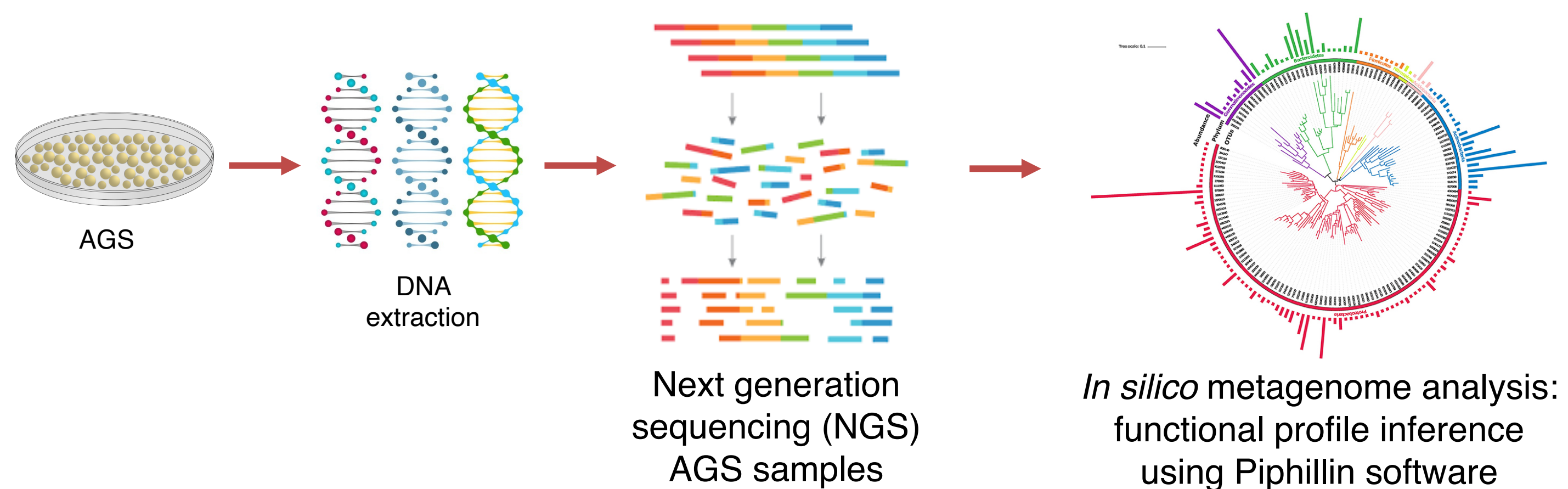
AGS sequencing batch reactor operation and nutrient removal analysis



Extraction and characterization of EPS from granules

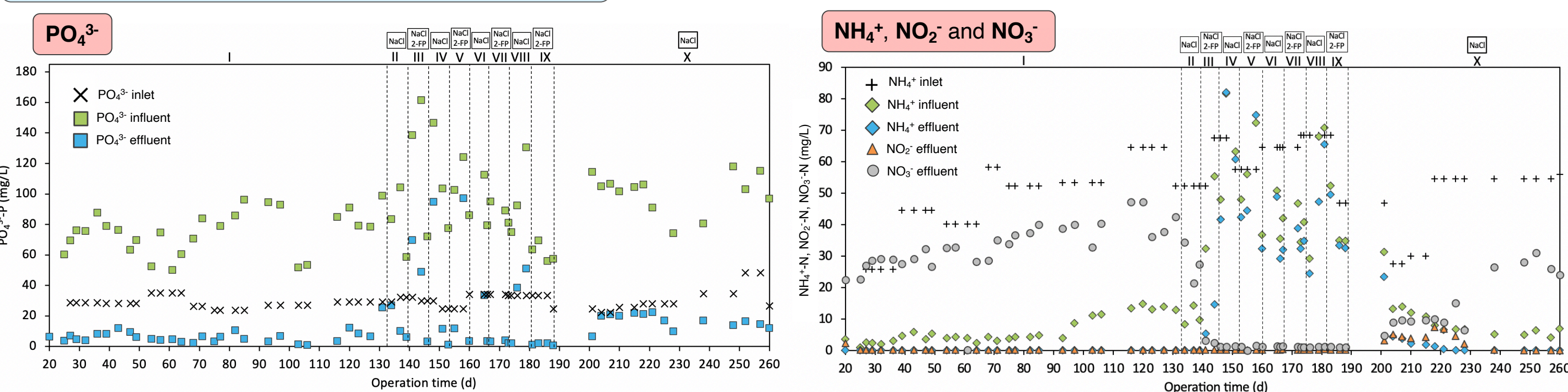


Microbiome analysis



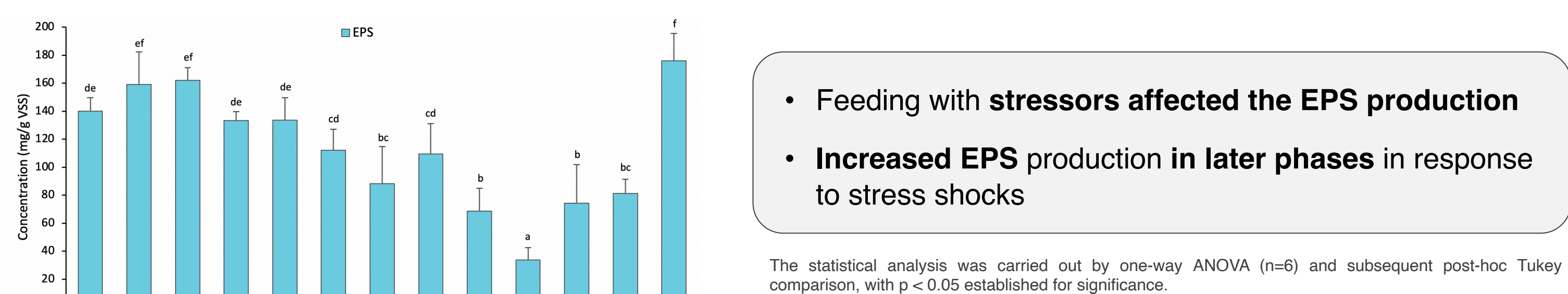
Results

NUTRIENT REMOVAL PERFORMANCE

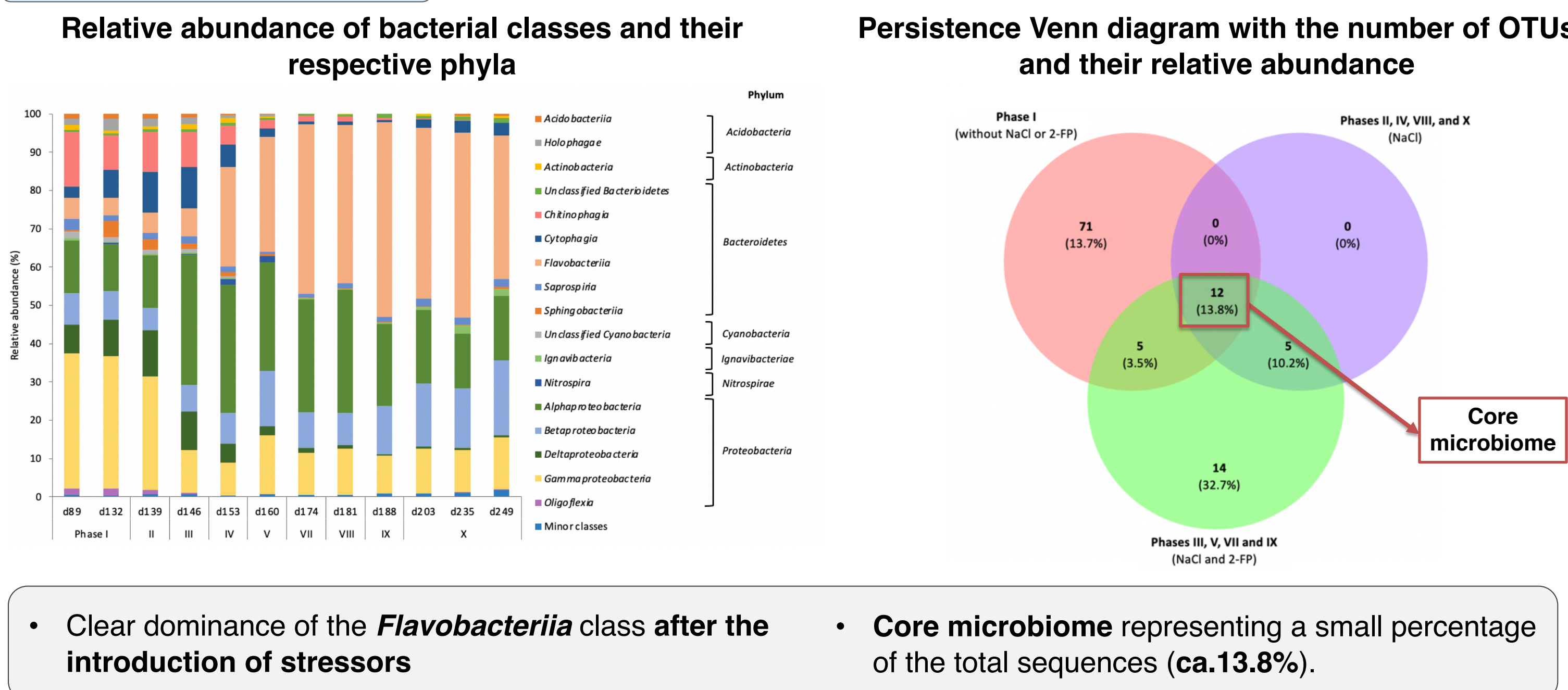


- 2-FP degradation did not occur (data not shown)
- Nitrification impaired by 2-FP, but re-established when 2-FP feeding ceased
- PO₄³⁻ removal recovered after the initial exposure to stress conditions. Phosphate removal inhibited during temporary nitrite accumulation

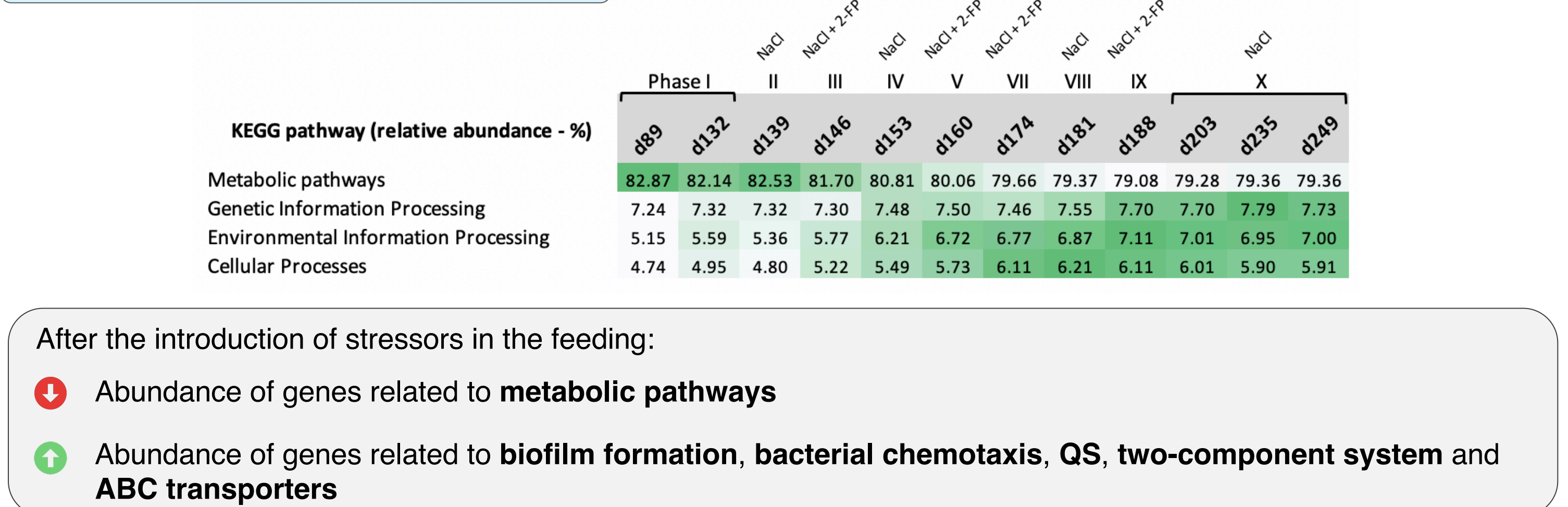
EPS PRODUCTION



MICROBIOME ANALYSIS



IN SILICO FUNCTIONAL INFERENCE



Conclusions

- AGS is a robust wastewater system able to adapt to the stepwise salinity increase and the intermittent presence of 2-FP, increasing the EPS production and restoring the nutrient removal efficiency after the withdrawal of 2-FP from the inlet stream.
- The bacterial population was dynamic and adaptable, ensuring the main nutrient removal processes and EPS production and contributing for the operational resilience of the system.
- The core microbiome detected may be fundamental to avoid the impairment of the ecosystem functions.
- Functional inference suggests the triggering of adaptative mechanisms, such as the motility of bacteria towards areas less exposed to the toxic, biofilm formation protecting the bacteria from exposure to toxics, and efflux of toxics.

Acknowledgements

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References

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