

Comparative assessment of post-secondary treatment processes to reduce the bacterial load in treated domestic effluents



CATOLICA

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PORTO



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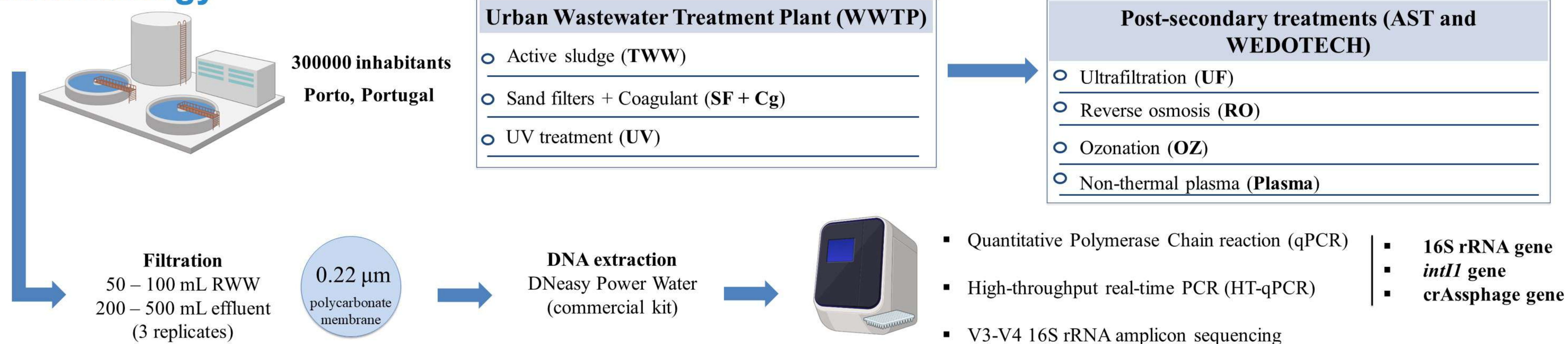
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Introduction

The reuse of treated wastewater is a solution to mitigate water stress, due to water pollution and scarcity. However, treated wastewater can contain antibiotic resistant bacteria (ARBs) and antibiotic resistance genes (ARGs), which may spread and accumulate in the downstream environment, representing a public health threat.

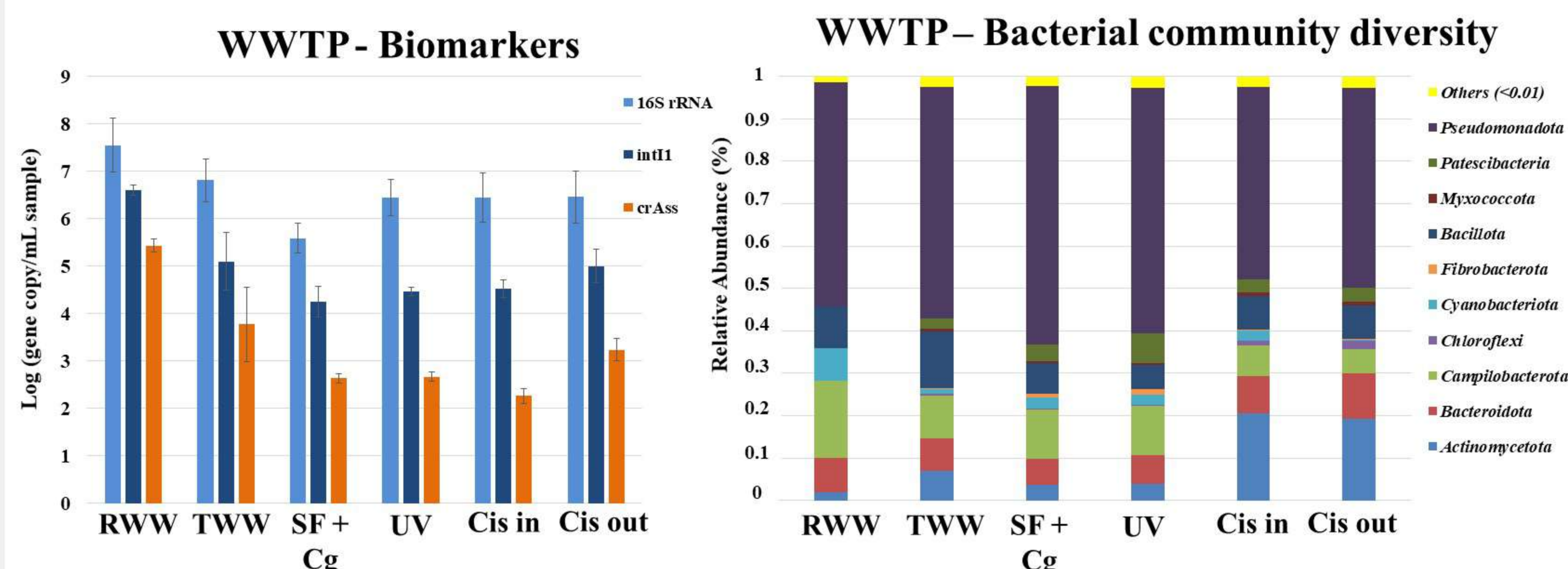
This study aimed to compare distinct post-secondary treatment processes - sand filters with coagulant, UV, ultra-filtration, reverse osmosis, ozonation, and plasma technology – and also the storage effect capacity to reduce the bacterial load in treated effluents and treated effluents after storage.

Methodology



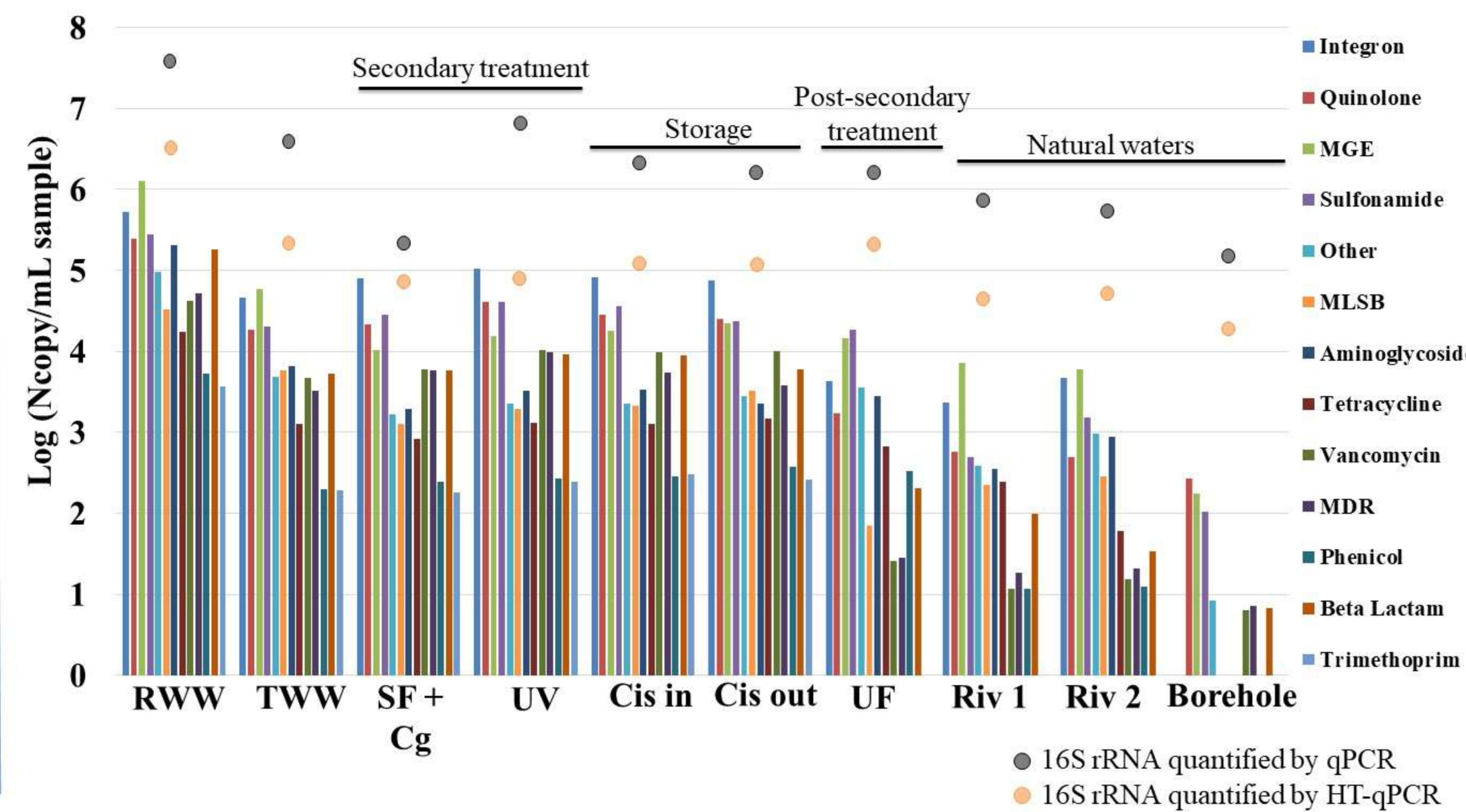
Results

Wastewater treatment until sand filters and coagulant addition resulted in bacterial reductions of 2 log units/ mL. Changes in the bacterial community composition were most pronounced after secondary treatment and storage.

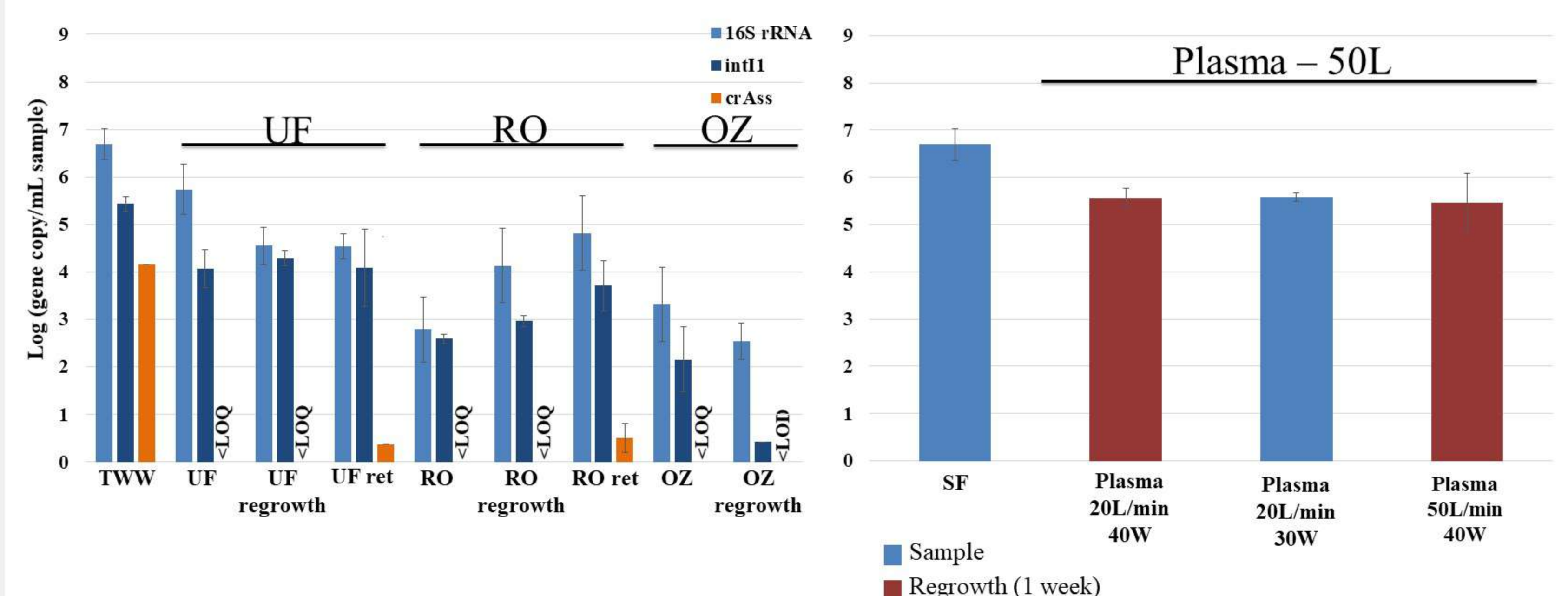


RWW – raw wastewater; TWW – secondary effluent; SF + Cg – sand filter + coagulant; UV – UV radiation after SF + Cg; Cis in – treated wastewater cistern inside; Cis out – treated wastewater cistern outlet; UF – ultrafiltration flow 9m³/h; Riv 1 – Miramar stream; Riv 2 – stream outside WWTP; Borehole – borehole in Febros WWTP; RO – reverse osmosis; UF ret – retained from ultrafiltration; RO ret – retained from reverse osmosis; OZ – ozonation (28.8 g O₃/m³); SF – sand filter; Plasma – application of non-thermal plasma technology; “re” – samples from 1 week regrowth (samples kept in a sterile flask in the dark); 16S rRNA – gene 16S rRNA (total bacteria); *intI1* - *intI1* gene (class I integron integrase); crAss – crAssphage gene (indicator of human fecal contamination).

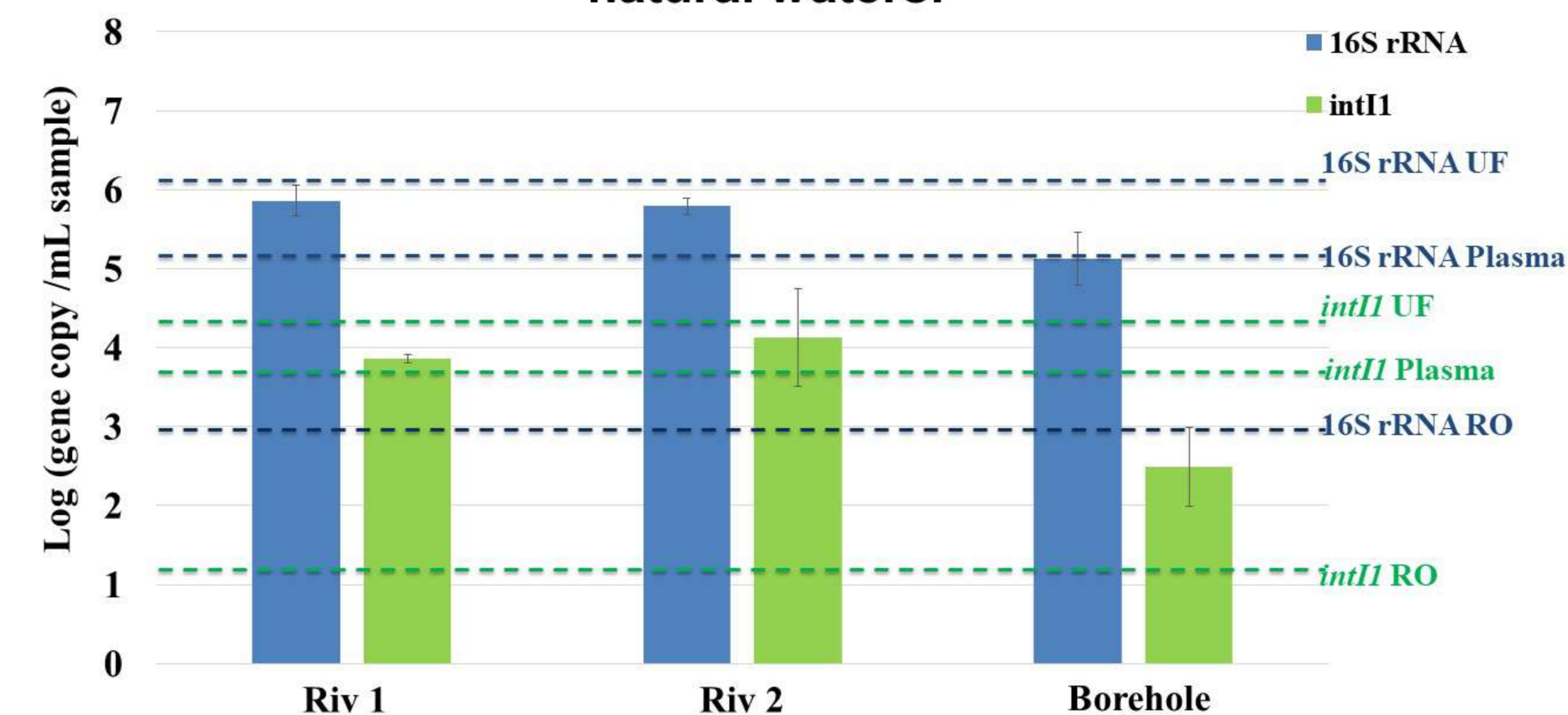
Natural waters have lower levels of ARGs than treated wastewater.



Higher log removal with ultrafiltration (UF) and reverse osmosis (RO) compared to non-thermal plasma.



Non-thermal plasma, UF and RO can help reduce the bacterial and *intI1* gene load in treated effluent to levels comparable to natural waters.



Conclusions

- The highest bacterial load was removed after secondary treatment (TWW) and sand filters plus coagulant (SF + Cg). No changes were observed after UV and storage (Cis).
- Among the advanced processes tested non-thermal plasma technology was less effective than ultrafiltration, with log-removal values (per volume) of total bacteria and *intI1* gene of 1.3 and 0.9 log units for non-thermal plasma and 1.4 and 1.4 log units for ultrafiltration.
- Advanced treatment (UF, RO or non-thermal plasma) may produce wastewater with ARGs abundance similar to that observed in natural waters (e.g. river water).

Acknowledgements

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