



Exploring food safety of fresh-cut vegetable processing and water disinfection with ultraviolet and free chlorine

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Background

Climate change and water scarcity demand an efficient use of our freshwater. During vegetable processing, large amounts of water are used. Reducing water consumption and maintaining food safety is a challenge. In some countries, like the Netherlands, decontaminating fruits and vegetables is not permitted, and consideration must be given to safe water reuse. Water disinfection technologies can help maintain the water quality and prevent produce from being contaminated with food pathogens like *Listeria monocytogenes*.

Objective

In the fresh-cut vegetable setting, we aim to reduce water use and ensure that it is microbiologically safe by applying water disinfection technologies. Our research evaluates the use of ultraviolet (UV) and free chlorine from electrolysis (FC) to reduce *Listeria innocua* during fresh-cut lettuce processing at pilot scales.

Introduction and methods

Four pilot tests were performed to test the applicability of UV, FC (7-8 ppm), UV + FC (7-8 ppm), and UV + FC (2-3 ppm) with modified washing to reduce the presence of inoculated *L. innocua* (5-6 log) during fresh-cut lettuce processing (± 300 kg/h of a 50:50 Romaine and Iceberg lettuce mix). Figure 1 depicts the processing line with a wash tank of ± 820 L (SW-50/350, Sormac, Venlo, NL). UV, FC (7-8 ppm), and UV + FC (7-8 ppm) were tested for 60 min, with *L. innocua* inoculations at 9- and 39-min. UV + FC (2-3 ppm) with modified washing was tested for 180 min, with *L. innocua* inoculations at 39, 99, and 159 min. During the UV + FC (2-3 ppm) pilot, a modified processing line was used, which included two dewatering belts with vacuum slits and an additional rinse after cutting. The water quality was monitored for temperature, pH, chemical oxygen demand (COD), UV transmission, FC, total viable count, and *Listeria* spp.

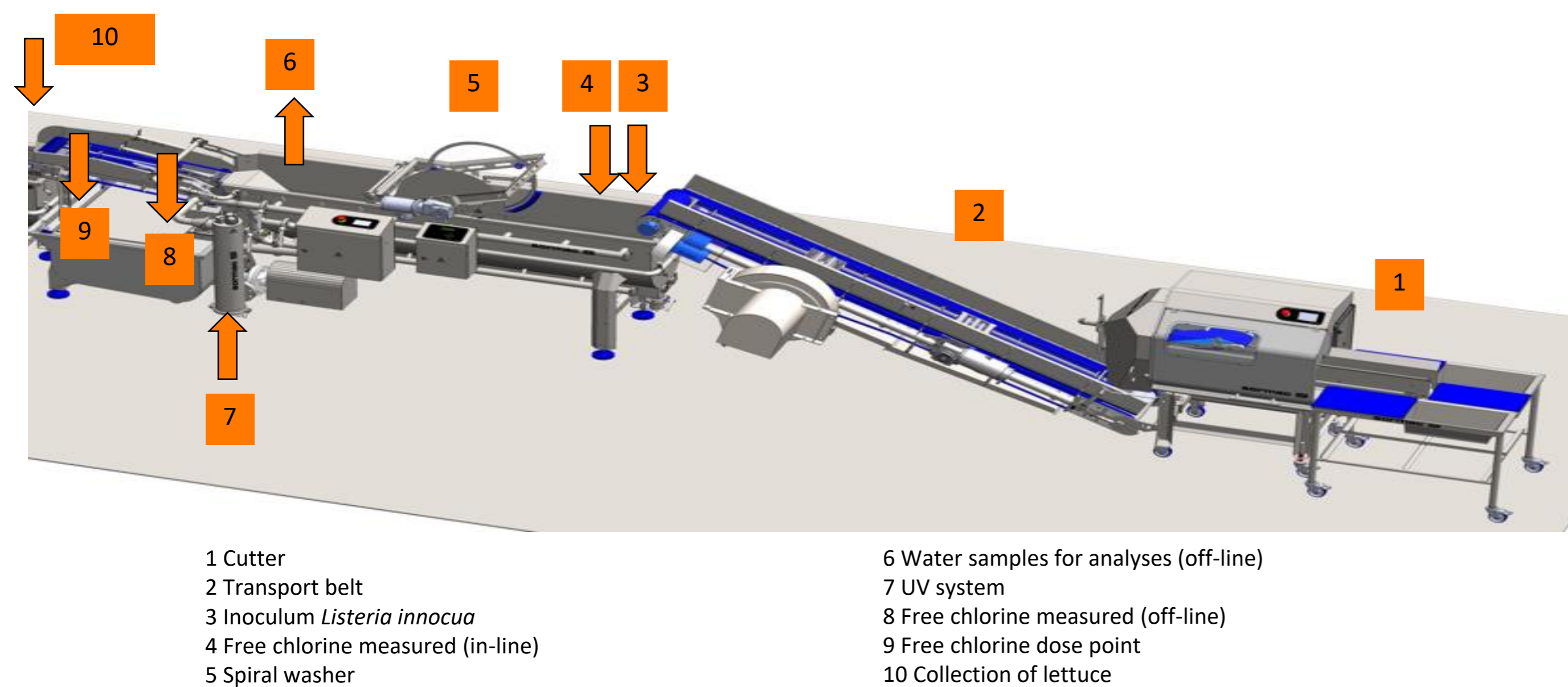


Figure 1. Schematic overview of pilot processing setup.

Results

Wash water temperature (10.3-19.0 °C) and pH (7.2-8.0) were stable within each pilot. Figure 2 represents *Listeria* spp. in the washing water. Figures 3 and 4 show, respectively, the COD and UV transmission in the washing water.

Results

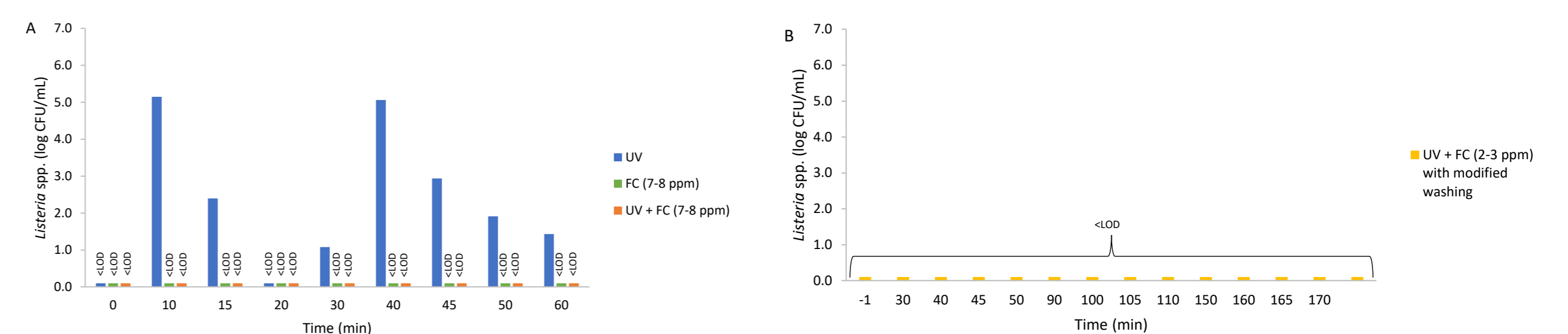


Figure 2. *Listeria* spp. in the washing water during treatments with UV, FC at 7-8 ppm, UV + FC at 7-8 ppm (2A), and UV + FC at 2-3 ppm with modified washing (2B). Results depict an average of two samples. Values at zero are below the detection level (LOD) of c.a. 1 log CFU/mL.

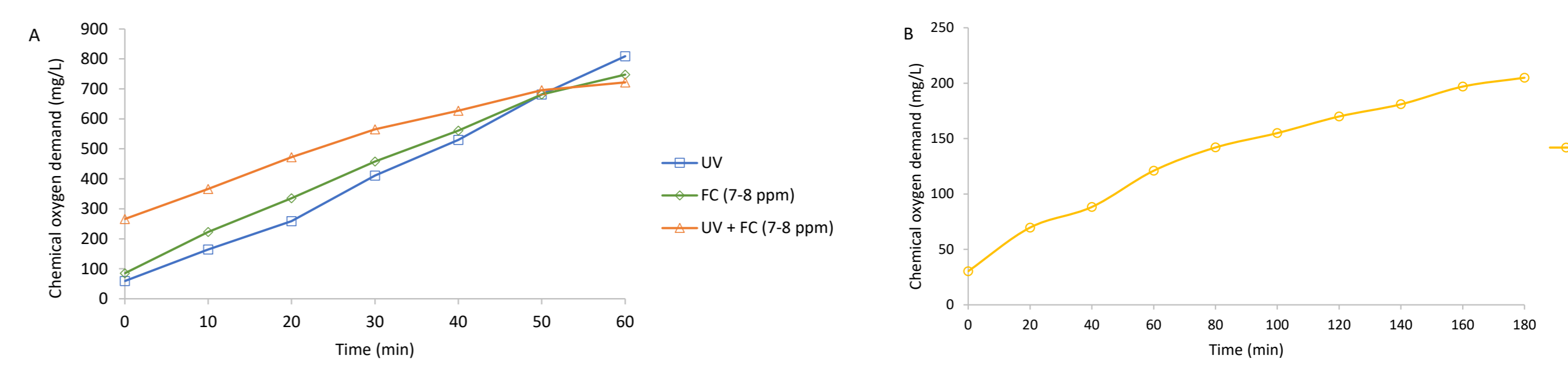


Figure 3. Chemical oxygen demand in the washing water during treatments with UV, FC at 7-8 ppm, UV + FC at 7-8 ppm (3A), and UV + FC at 2-3 ppm with modified washing (3B).

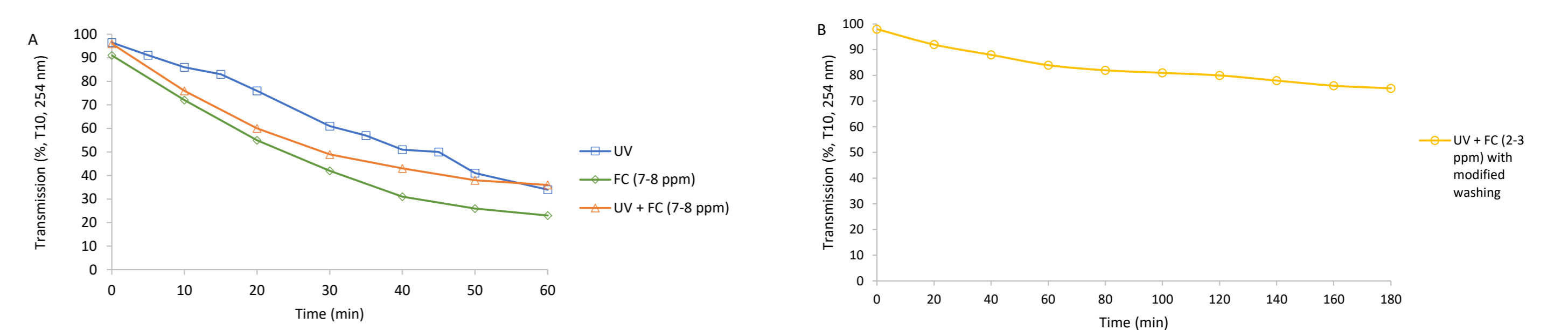


Figure 4. UV transmission in the washing water during treatments with UV, FC at 7-8 ppm, UV + FC at 7-8 ppm (4A), and UV + FC at 2-3 ppm with modified washing (4B).

Conclusions

- UV reduced *L. innocua* in the washing water by 3-4 log but is hampered by a decreasing transmission in time.
- FC (7-8 ppm) and UV + FC (7-8 ppm) reduced *L. innocua* in the washing water by ≥ 5 log.
- UV + FC (7-8 ppm) reduced COD by $\pm 25\%$.
- UV + FC (2-3 ppm) with modified washing reduced > 5 log of *L. innocua* in the washing water.
- UV + FC (2-3 ppm) with modified washing reduced COD concentrations and increased the transmission in the water.
- Modified washing combined with UV + FC (2-3 ppm) significantly improved the wash water quality. As a result, a lower FC could be used to obtain > 5 log reductions.

Acknowledgements

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