VIII International conference
SUSTAINABLE POSTHARVEST AND FOOD TECHNOLOGIES - INOPTEP 2023
Subotica – Palić, hotel Elitte Palić, 23. – 28. april 2023.

COLD PLASMA TREATMENTS FOR MINIMALLY PROCESSED LEAFY VEGETABLES: DECONTAMINATION OF PROCESSING WASH WATER AND EFFECTS ON PRODUCT SAFETY AND QUALITY

Beatrice CELLINI, Elia GHIRARDELLI*, Francesca PATRIGNANI*,**, Santiago CONDON ABANTO***, Eva PETRI ORTEGA***, Raquel VIRTO RESANO***, Ines ECHEVERRIA GONI***, Santina ROMANI*,**, Marco DALLA ROSA*,**, Rosalba LANCIOTTI*,**, Pietro ROCCULI*,**, Lucia VANNINI*,***

** Department of Agricultural and Food Sciences, University of Bologna, Italy*
*** Interdepartmental Centre for Agri-Food Industrial Research, University of Bologna, Italy*
**** CNTA, Navarra, Spain*
e-mail: lucia.vannini2@unibo.it

INTRODUCTION

Consumption of green leafy vegetables has increased in recent years, along with consumers and legislative criticism on production methods and sustainability. Washing is one of the crucial steps in the production of ready-to-eat vegetables. It is currently based on chlorinated substances, which are known to be hazardous to humans and the environment, and have the potential to cause antimicrobial resistance. Economically and environmentally sustainable alternatives have been developed, e.g. UV, ozone, Cold Atmospheric Plasma (CAP) and Plasma-Activated Water (PAW). PAW has been shown to significantly affect bacterial contamination, with even more than 2.5 Log reduction on leafy vegetables[1]. This ability is linked to the presence of reactive oxygen species, and to the lowering of the pH of the water[2]. In contrast to CAP, PAW is reported to have minor effects on food quality. For these reasons, PAW was tested from a microbiological and technological point of view on rocket leaves (*Eruca sativa*) washed for different times.

MATERIAL AND METHOD

Treatments on 400 ml of distilled water were performed with a corona discharge plasma prototype for 4 min at 5 kHz, 18 kV and 500 rpm to produce PAW. Rocket samples were washed with PAW for 0 (control), 10, 20, 30 minutes (two replicates). The PAW-treated samples were used for microbiological analyses targeting **total mesophilic count** (**CMT**), ***Enterobacteriaceae*** (**ENT**) and **total psychrophilic count** (**PSI**). Samplings were carried out immediately after treatments (t0) and after two days (t2) of storage at 4°C; **pH** was measured on PAW and washed leafy samples.

CONCLUSION

This study showed that this non-thermal treatment had a low impact on pH and visual quality of the leafy product. On the contrary, it significantly affected the indigenous microbiota resulting in an immediate inactivation and further lowering of its growth.

Future activities will be focused on the use of PAW not only for the direct decontamination of leafy vegetables, but also to inactivate the spoilage and pathogenic microbiota of wash water after its use. This would make its reuse in multiple washing cycles feasible, after assessing whether there are improvements from the environmental point of view.

Key words: Plasma technology, wash water, decontamination, water saving.

DISCUSSION

Washing with PAW resulted in an immediate inactivation of **CMT**, **PSI** and **ENT**. Significant reductions of ~1.2 Log CFU/g were observed after 10 min for **CMT** and **PSI**, and of ~1.7 Log units for **ENT** (Fig. 1A,B,C). Longer treatments did not cause any significant additional reduction in cell loads. After 2 days at 4°C, the samples washed for 30 min showed growths of 1-1.5 Log units lower than the control vegetables. PAW production resulted in a 4 units **pH** decrease of the water, which remained constant close to pH 3 throughout the 30-min washing treatments (Fig. 1D). No significant changes were detected either in pH values, or in visible aspect of the vegetable after the washing. After 2 days, only the 30-min samples appeared slightly more yellowed than the other ones.

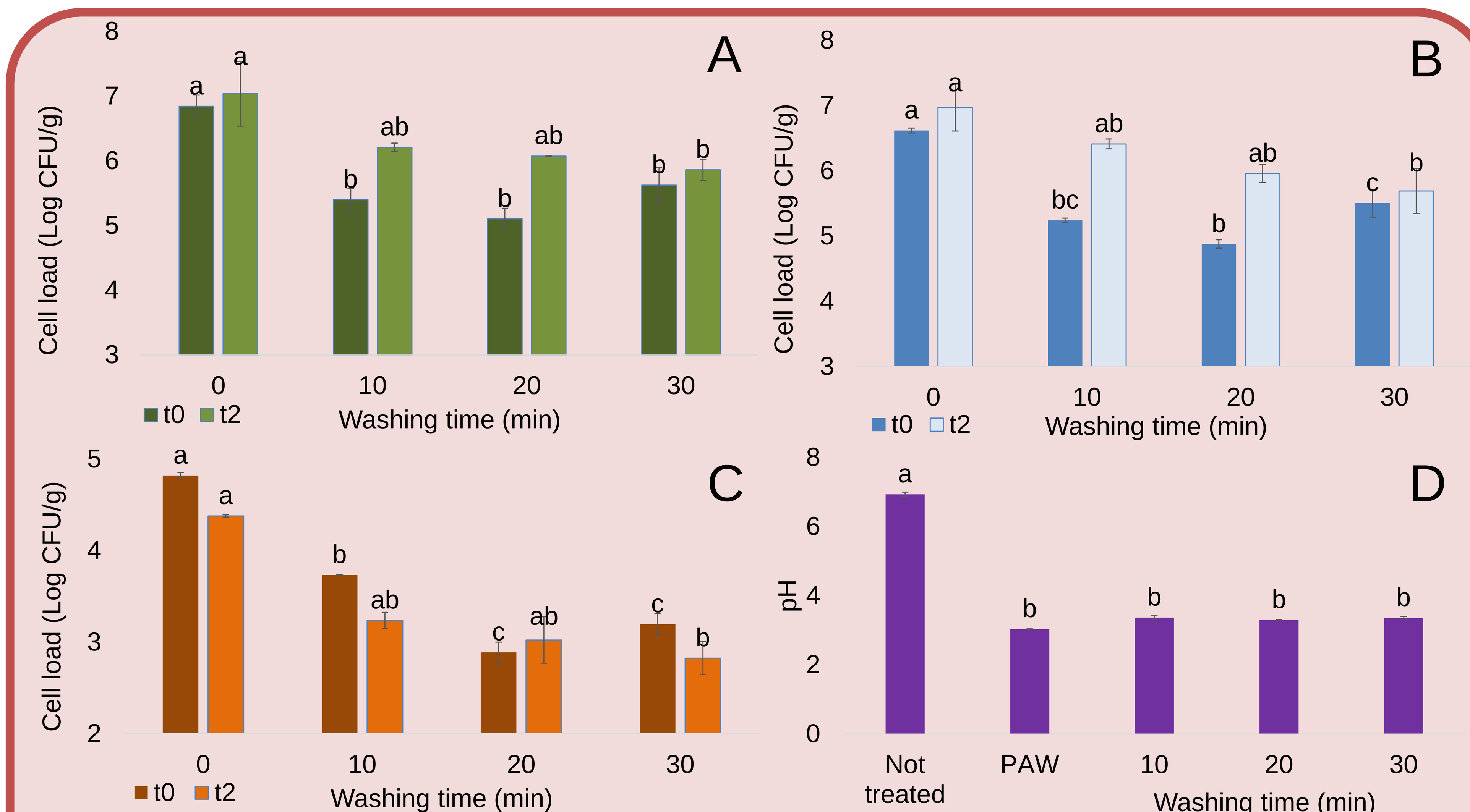

Fig. 1. **Total mesophilic counts** (A), **Total psychrophilic counts** (B) and ***Enterobacteriaceae*** (C) cell loads immediately after PAW treatment and after storage at 4°C for 2 days. (D) **pH** of PAW washing water ($p<0.05$)

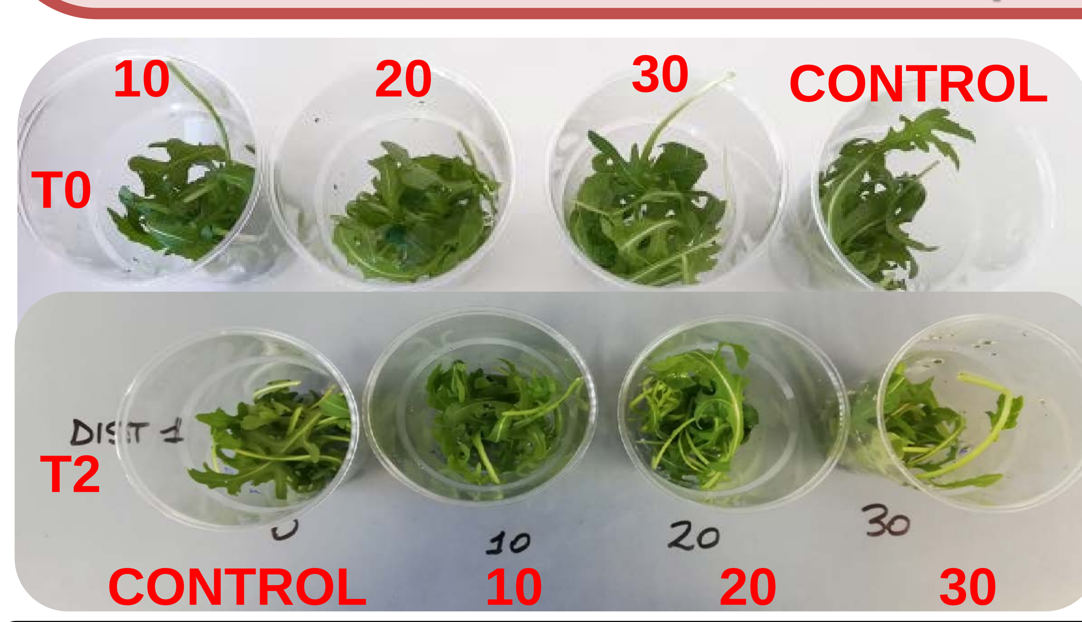

Fig. 2. Sample of rocket leaves immediately after washing with PAW (t0) and after 2 days of storage at 4°C (t2)

References:

[1] Han, Q.Y., Wen, X., Gao, J.Y., Zhong, C. S., & Ni, Y.Y. (2022). Application of plasma-activated water in the food industry: A review of recent research developments. *Food Chemistry*, 134797.

[2] Schnabel, U., Andrasch, M., Stachowiak, J., Weit, C., Weihe, T., Schmidt, C., Muranyi, P., Schlüter, O., & Ehlbeck, J. (2019). Sanitation of fresh-cut endive lettuce by plasma processed tap water (PPtW)–Up-scaling to industrial level. *Innovative Food Science & Emerging Technologies*, *53*, 45-55.

Acknowledgment: This work was carried out in the framework of the CO-FRESH project "CO-creating sustainable and competitive Fruits and vEgetableS' value cHains in Europe", "which has received funding from the European Union's Horizon2020 research and Innovation programme under the GA n° 101000852.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000852