

Quality Assessment and Anti-Listeria Efficacy of Cold Plasma Treatment on Fresh Lettuce

Ekin Ersoylu • Cristina L.M. Silva • Joana C. Barbosa • Teresa R.S. Brandão

Universidade Católica Portuguesa, CBQF - Centro de Biotecnologia e Química Fina - Laboratório Associado, Escola Superior de Biotecnologia, Porto, Portugal

1. Introduction

Ensuring microbial safety of fresh leafy vegetables while preserving quality remains a major challenge for the food industry, driving interest in non-thermal decontamination technologies.

This study evaluates the potential of cold plasma as an alternative to heat-based processing for the decontamination of lettuce.

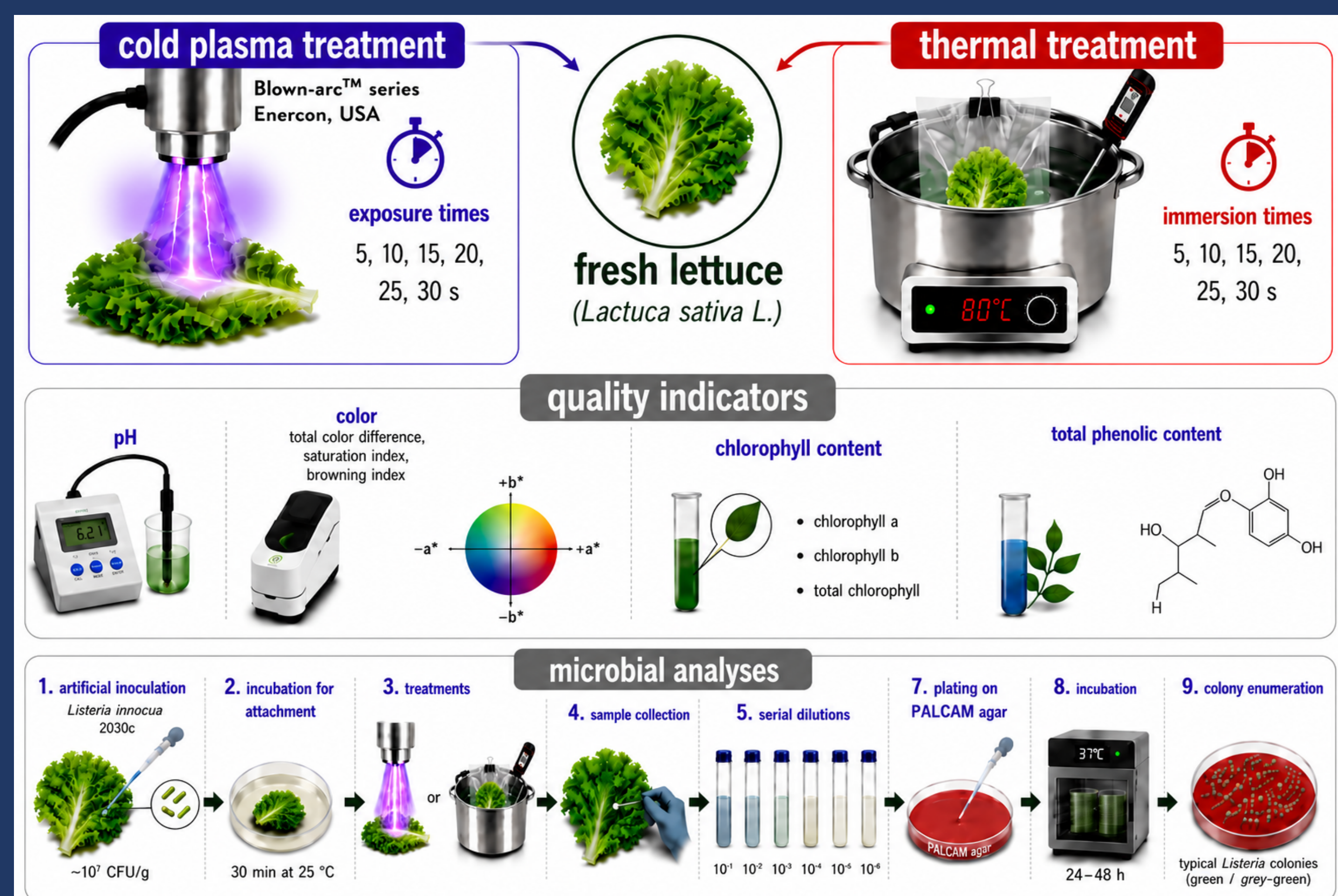
Lettuce serves as an ideal model for evaluating cold plasma treatments due to its common raw consumption (which increases the risk of contamination) and its short shelf life.

Objectives

To evaluate cold plasma as a non-thermal decontamination method for fresh lettuce

- Determine the antimicrobial effectiveness of cold plasma against *L. innocua* at different exposure times
- Compare the microbial inactivation of cold plasma with a conventional hot water treatment (blanching @ 80 °C – as a reference to illustrate the effects of extreme thermal effect and provide a benchmark for microbial inactivation)
- Assess the impact of cold plasma on key quality parameters: pH, color, chlorophyll content, and total phenolic content

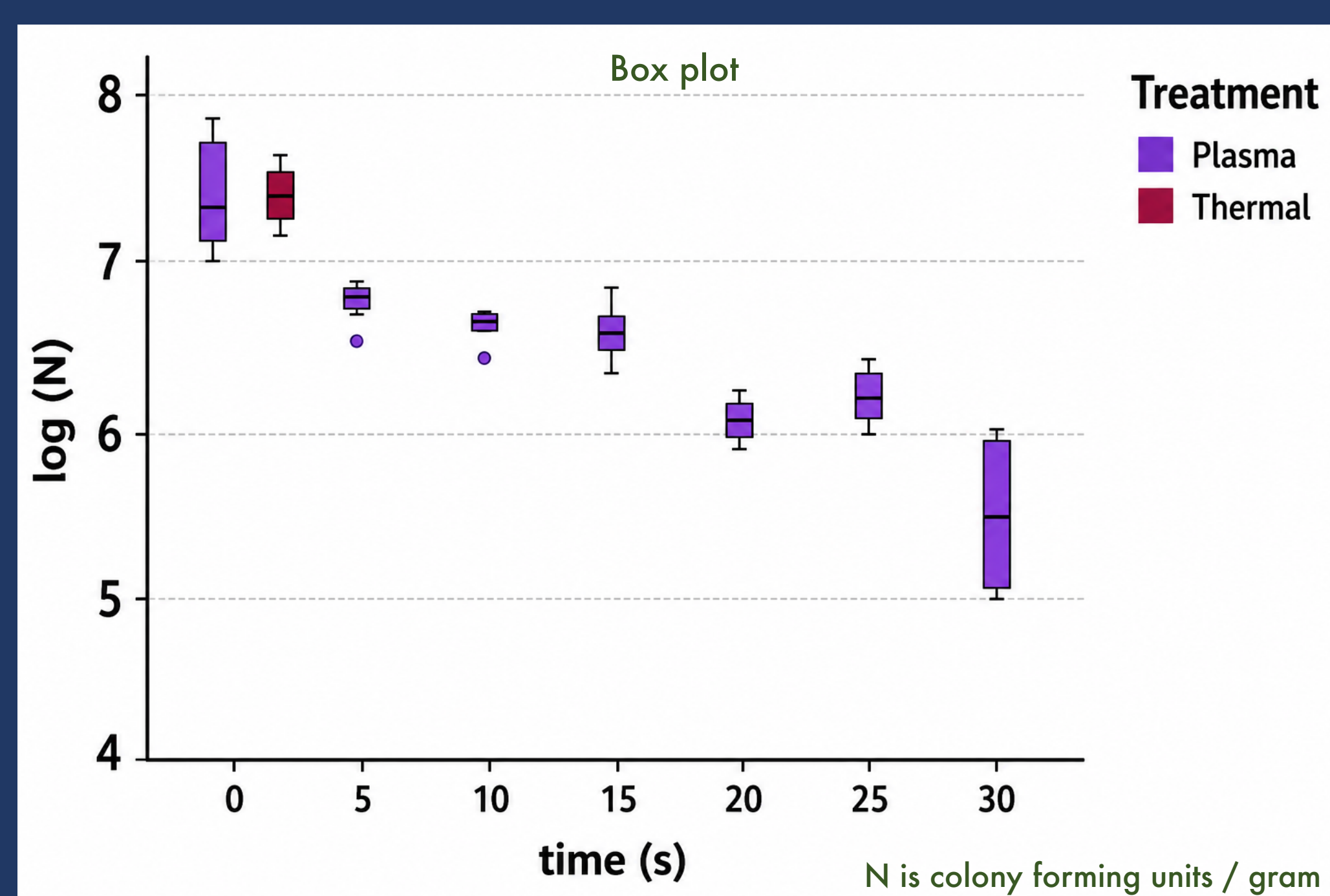
2. Materials & Methods



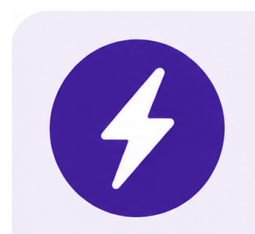
All analyses were conducted at least in triplicate → t-Student test & ANOVA + Post-hoc tests

3. Results | Anti-listeria efficacy

Listeria innocua survival



thermal treatment achieved complete *L. innocua* inactivation (approximately 7-log reduction) within 5 s



cold plasma resulted in a slower decline, reaching approximately 2-log reduction after 30 s.

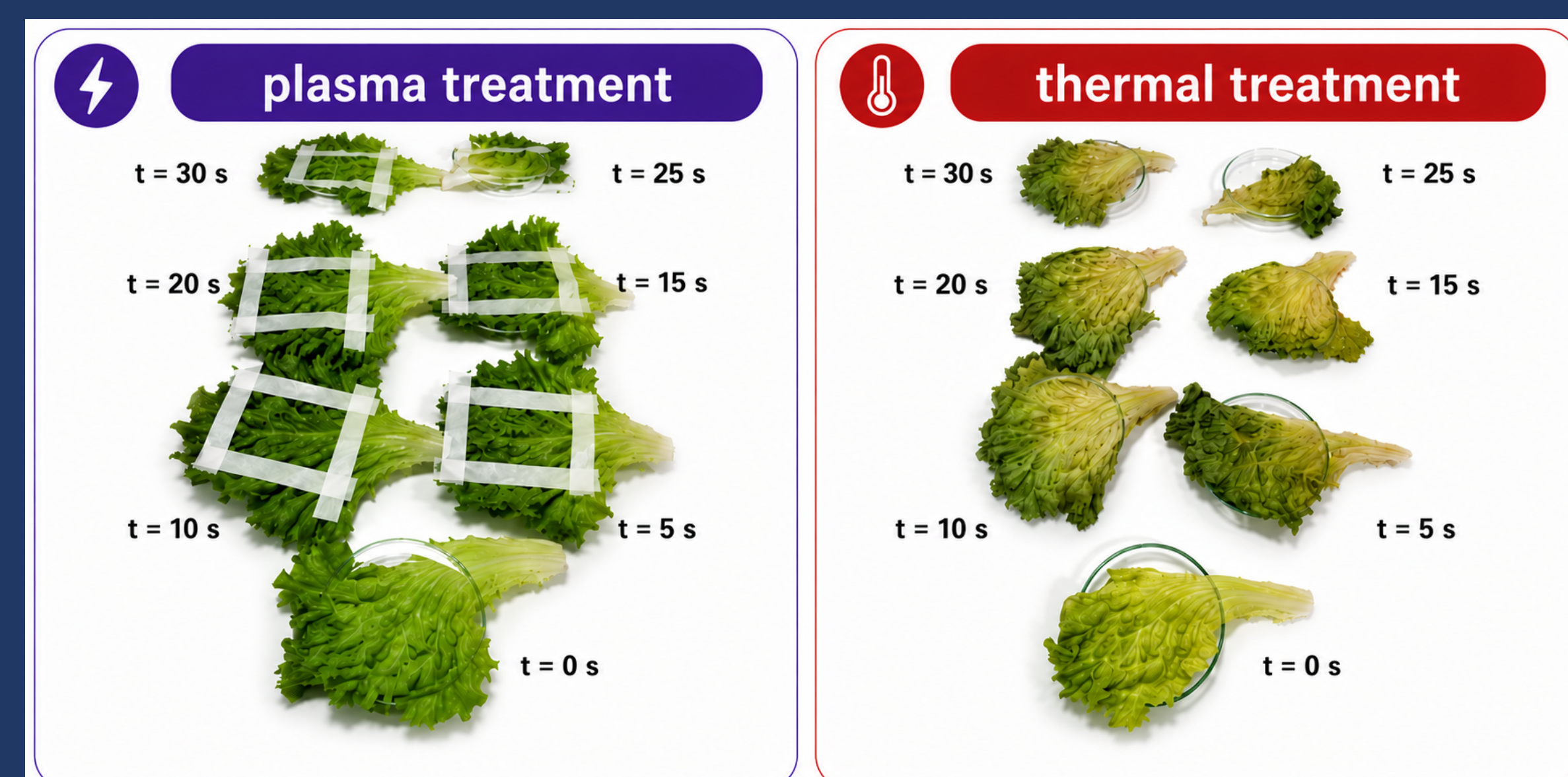
4. Conclusions

Although thermal processing ensured rapid decontamination of lettuce, cold plasma demonstrated superior preservation of physicochemical quality, highlighting its potential as a non-thermal strategy for lettuce with low microbial loads, provided its antimicrobial efficacy can be further optimized.

3. Results | Impact on Quality

pH both treatments maintained lettuce pH in a stable and similar range (5.6 – 6.0)

Visual appearance & Color



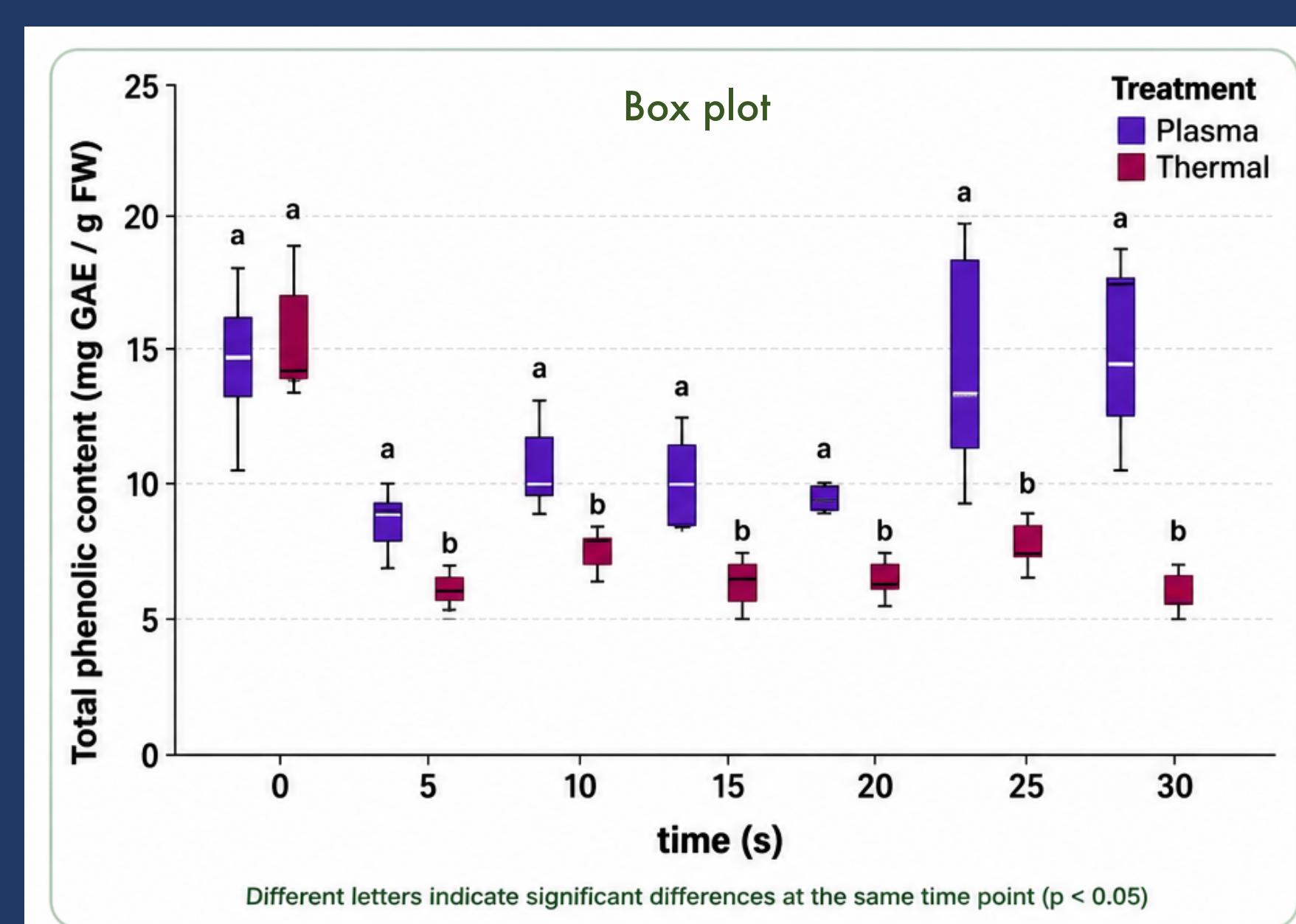
- maintains fresh green color and texture over time
- more vivid, less brown
- lower total color differences vs. fresh at shorter times

- noticeable bowing and degradation over time
- higher total color differences vs. fresh

Chlorophyll content

- Chlorophyll a remained relatively stable under both treatments
- Chlorophyll b was better preserved after plasma treatment
- Thermal treatment reduced total chlorophylls by 42% after just 5 s

Total phenolic content

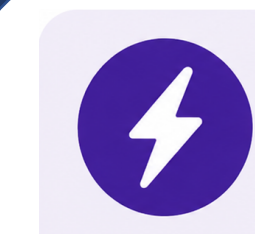


GAE is gallic acid equivalent
FW is fresh weight



thermal treatment

- significant reductions
- content dropped 59% after just 5 s



cold plasma

- preserved phenolic compounds
- similar to fresh lettuce