Optimization of ultrasounds preservation treatment applied to whole tomato fruits (*Solanum lycopersicum*, cv. Zinac)

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Introduction

Extension of fruits shelf-life is a continuous challenge for producers, distributors and industries. Ultrasound (US) is an example of emerging technology, which has the ability to inactivate microorganisms at room temperature, thereby avoiding the deleterious effects that heat has on the overall quality and nutritional value of foods. The involved mechanism, for microbial and enzyme inactivation, associated with US is called cavitation (formation, growth and sudden collapse of bubbles in liquids).

OBJECTIVE:

Modelling the effects of US treatments on tomato (*Solanum lycopersicum*, cv. Zinac) quality: (colour (CIE lab parameters), firmness (maximum force, N), total phenolic content (TPC, mGAE.100g^{-1}) and microbial load (Log$_{10}$ cfu.g^{-1})) by response surface methodology (RSM), based on three-variable central composite rotatable design: power level (10-100 %), treatment time (1-19 min) and storage period (1-15 days at 10 ºC).

Materials and methods

Tomato fruits → Ultrasounds → Storage

Cv. Zinac / maturity stage: green

Constant frequency - 45 kHz / Power level: 10-100% Treatment time: 1-19 min

10 ºC / 1 -15 days

Fig. 1 – US treatment flow-chart

- Modelling the effects of US treatments by **response surface methodology (RSM)**.
- Studied variables were: **power level** (10-100%), **treatment time** (1-19 min) and **storage period** (1-15 days at 10 ºC).
- **Tomato quality**: colour (a* value), firmness (maximum force, N), total phenolic content[1] (TPC, mGAE.100g^{-1}) and microbial load[2] (Log$_{10}$ cfu.g^{-1})).

Results

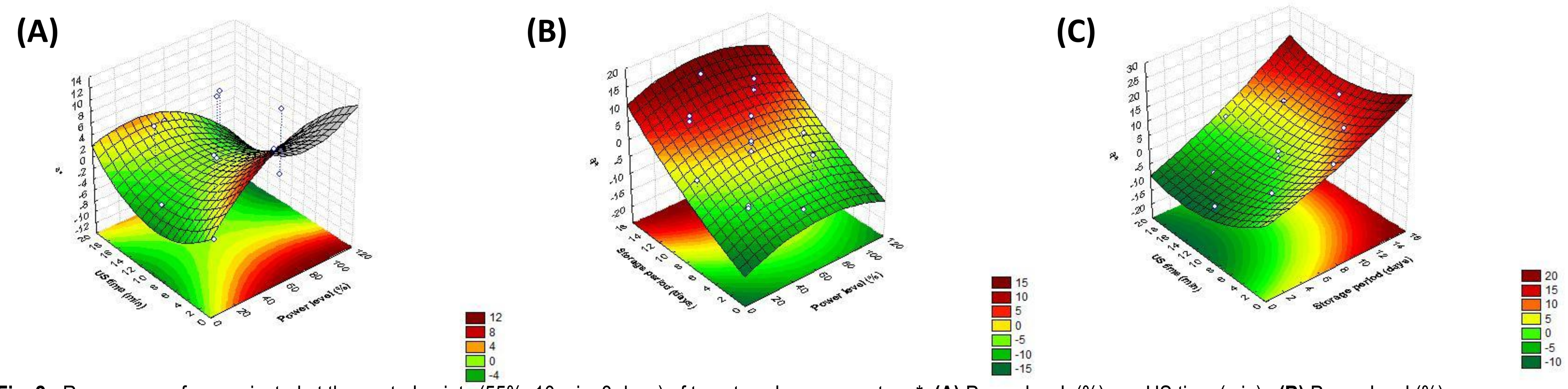

Fig. 2 - Response surface projected at the central points (55%, 10 min, 8 days) of tomato colour parameter a*: **(A)** Power level (%) *vs.* US time (min), **(B)** Power level (%) *vs.* Storage period (days) and **(C)** Storage period (days) *vs.* US time (min).

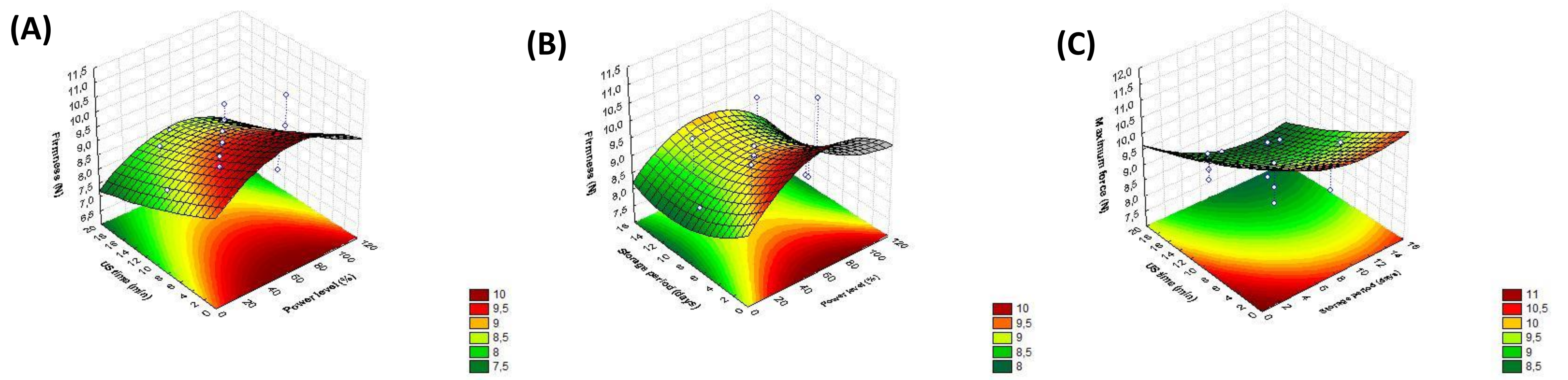

Fig. 3 - Response surface projected at the central points (55%, 10 min, 8 days) of tomato firmness (maximum force, N): **(A)** Power level (%) *vs.* US time (min), **(B)** Power level (%) *vs.* Storage period (days) and **(C)** Storage period (days) *vs.* US time (min).

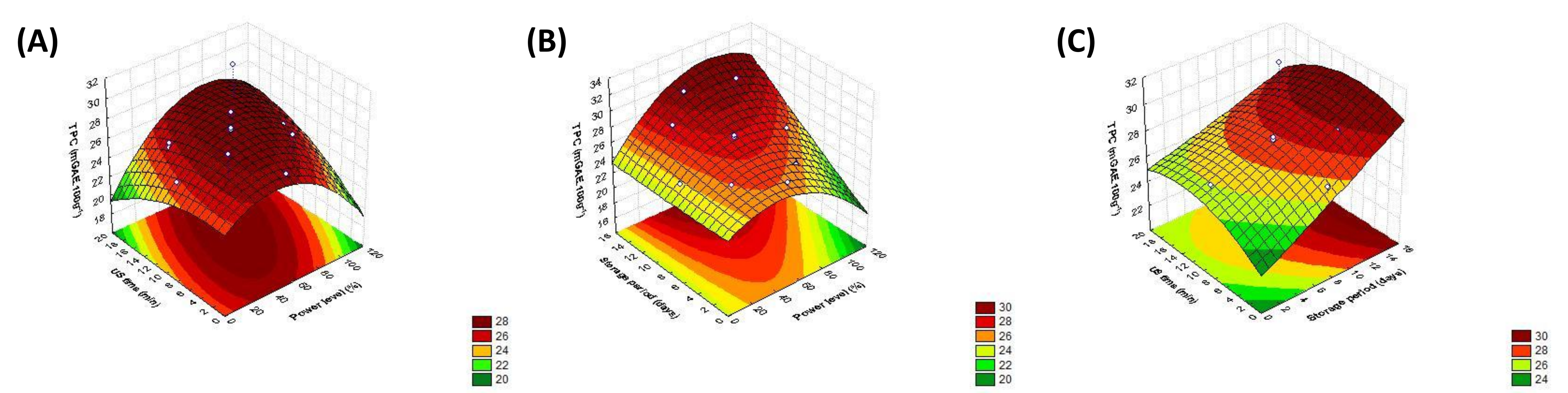

Fig. 4 - Response surface projected at the central points (55%, 10 min, 8 days) of tomato total phenolic compounds (mGAE.100g^{-1}): **(A)** Power level (%) *vs.* US time (min), **(B)** Power level (%) *vs.* Storage period (days) and **(C)** Storage period (days) *vs.* US time (min).

COLOUR

- RSM for colour parameters a* (Fig. 2) and hue showed a good correlation coefficient (R^2 = 0.98 and Adj-R^2 = 0.94), confirming the model adequacy.
- Only the independent variable storage period conducted to a significant change on colour parameter a*.
- The lowest a* values were achieved when storage period was combined with US time higher than 10 min.

FIRMNESS & TPC

- For tomato firmness and TPC (Fig. 3 & 4), the RSM models indicated that a US treatment at 45 kHz and 80% of power level leads to texture and bioactive compounds preservation, *ca* 10N and 24 mGAE.100g^{-1}, respectively.
- Storage period (Fig. 4.C) induces significant changes (<0.05) of TPC.

MICROBIAL COUNT

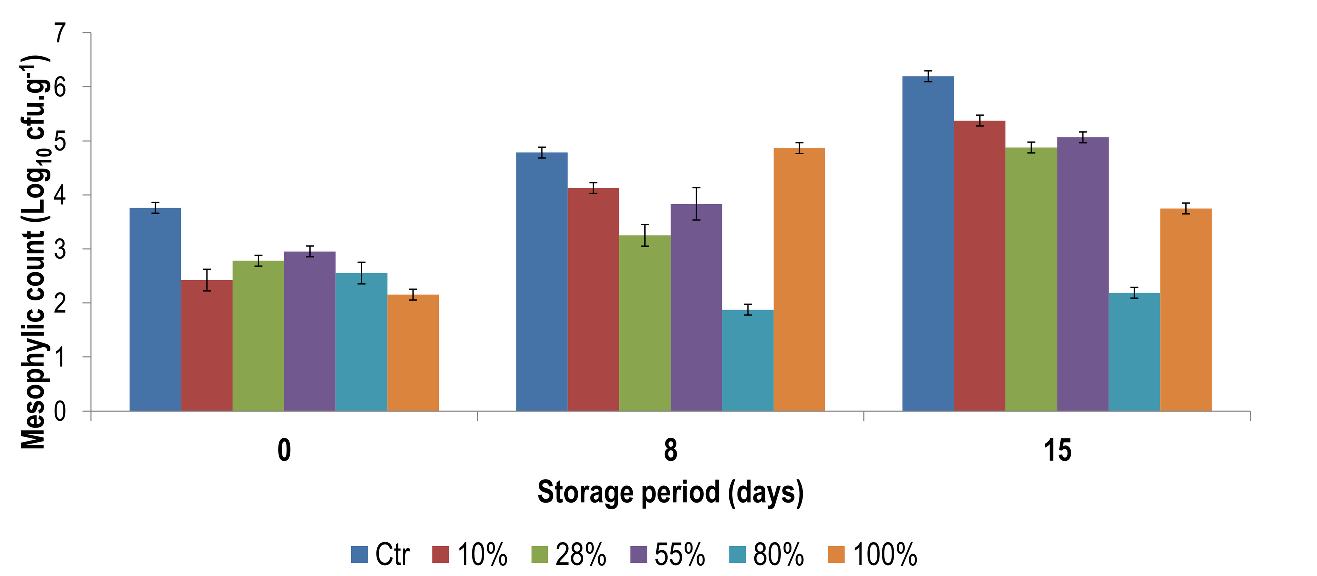

Fig. 5 – Tomato Mesophylic count (Log$_{10}$ cfu.g^{-1}) of untreated (Ctr) and US treated samples (Power level: 10%, 28%, 55%, 80%, 100%) during 15 days at 10 ºC. Vertical bars denote standard deviation.

At 15th storage day a decrease on microbial count was achieved for all tested US treatments, in comparison with Ctr sample (6 Log$_{10}$ cfu.g^{-1}), being the most efficient at 80% (2 Log$_{10}$ cfu.g^{-1}).

Conclusion

In general, US treatment contributes to reduce tomato changes with consequent microbial control and quality maintenance. Combined US with heat (thermosonication) is another interesting test to complement this study.

References

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