

Modelling of *Alicyclobacillus acidoterrestris* inactivation in apple juice using thermosonication technologies

A. Tremarin¹, T. R. S. Brandão² and C. L. M. Silva^{2*}

¹Federal University of Santa Catarina, Department of Chemical Engineering and Food Engineering, Florianópolis/SC, 88040-901, Brazil
²CBQF – Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa/Porto, Rua Arquitecto Lobão Vital, 172, 4200-374 Porto, Portugal *clsilva@porto.ucp.pt

Introduction

A. acidoterrestris

- Thermo-acidophilic bacteria.
- Survives to pasteurization processes.
- Suggested as the target to be used in the design of adequate pasteurization processes.

Heat processing

- Adverse effects on sensory and nutritional characteristics of foods.

Non-thermal technologies

- Potential for inactivating spoilage and pathogenic microorganisms.
- Minimizing quality losses in terms of flavour, colour and nutritional compounds.

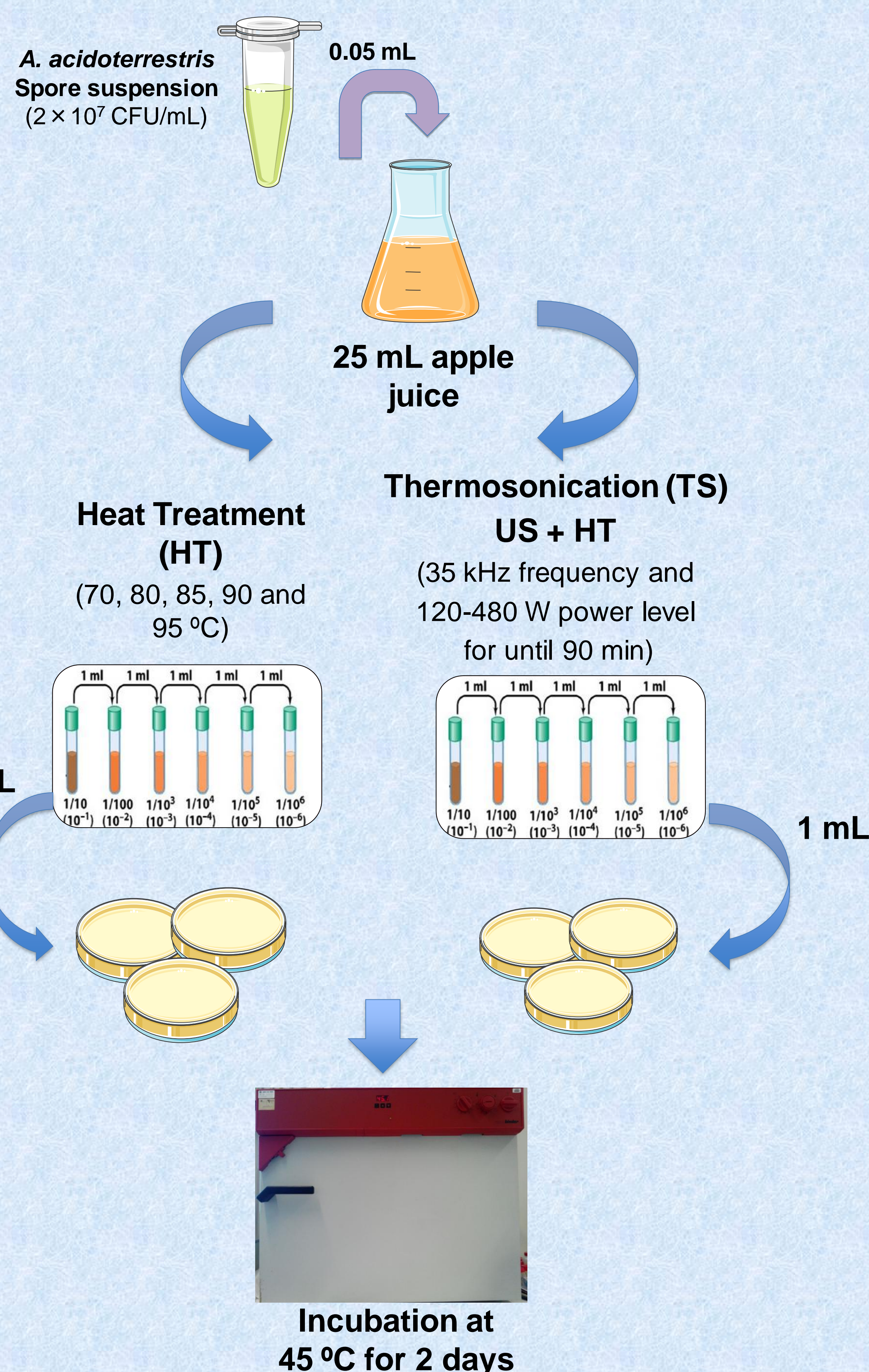
Ultrasound (US)

- Power ultrasound is capable of inducing cavitation to inactivate microorganisms in foods.

Objectives

The objective was to study the influence of ultrasounds (35 kHz frequency, 120-480 W power levels) and combinations with thermal treatments (thermosonication - TS) at 70, 80, 85, 90 and 95 °C on *A. acidoterrestris* spores inactivation in apple juices.

Materials and Methods



Weibull model

$$\log(N/N_0) = -(t/\delta)^\beta \quad (1)$$

where N_0 is the initial microbial load of the juice (CFU/mL), N the microbial load (CFU/mL) at a given treatment time t (min), δ is the scale parameter and β the shape parameter

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Results and Discussion

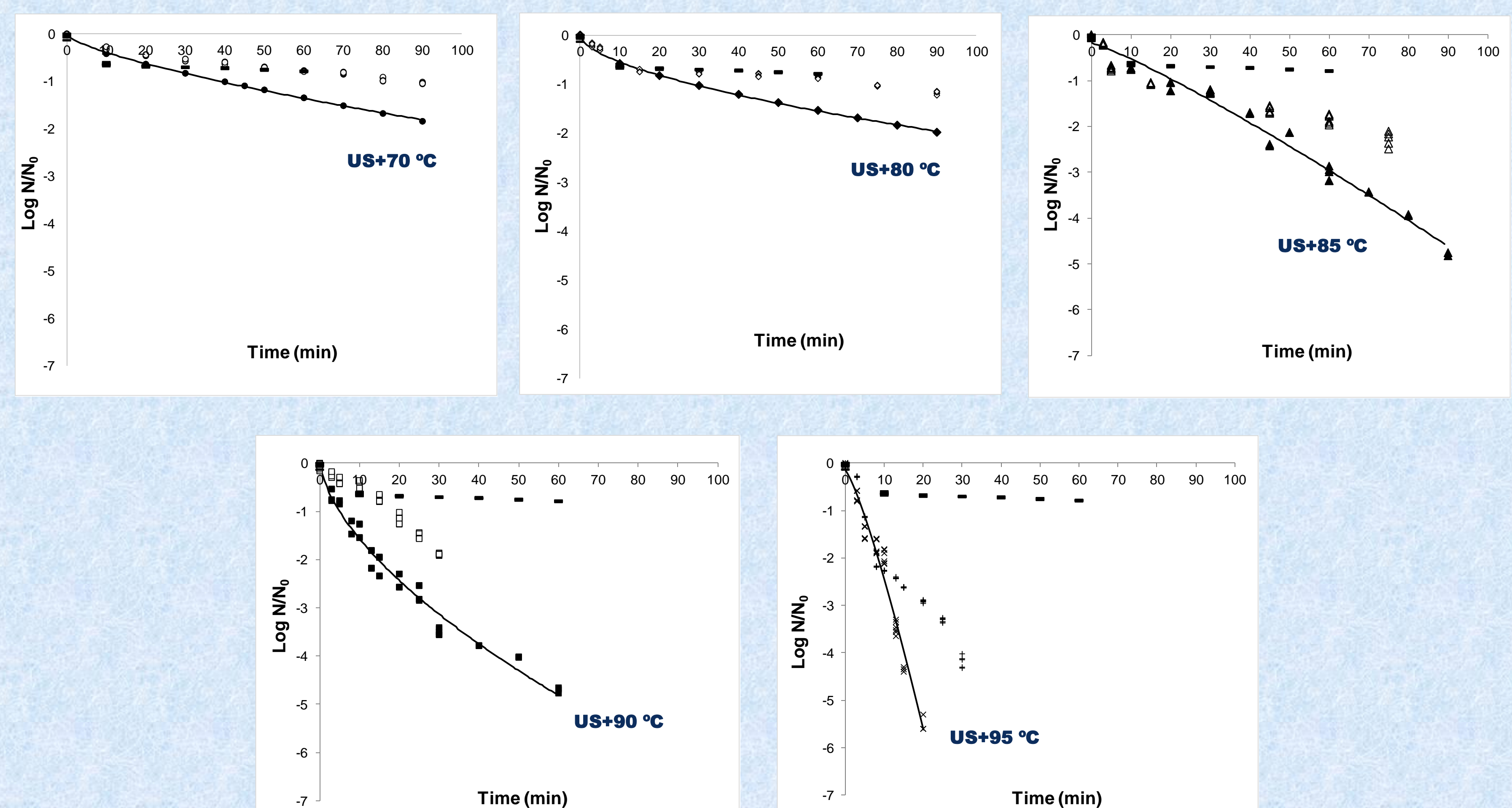


Figure 1 - *A. acidoterrestris* inactivation curves in apple juice using ultrasound alone (35 kHz, 120/480 W), heat treatment and thermosonication. The conditions used are (○) 70 °C, (●) US+70 °C; (◇) 80 °C, (◆) US+80 °C; (△) 85 °C, (▲) US+85 °C; (□) 90 °C, (■) US+90 °C, (+) 95 °C, (X) US+95 °C and (-) US alone. Curves were fitted using the Weibull model (solid line).

Table 1 Parameters and statistical indices of the Weibull model.

Treatment	δ (min) \pm CI _{95%} /2	β (min) \pm CI _{95%} /2	R ²
US+70 °C	38.53 \pm 0.34	0.70 \pm 0.01	1.00
US+80 °C	28.10 \pm 0.27	0.58 \pm 0.01	1.00
US+85 °C	21.07 \pm 1.63	1.05 \pm 0.07	0.98
US+90 °C	4.87 \pm 0.48	0.63 \pm 0.03	0.97
US+95 °C	4.67 \pm 0.46	1.18 \pm 0.10	0.97

CI_{95%} is the confident interval of the parameter at 95%.

Conclusions

- ✓ Ultrasound is not an efficient method in case of single application, reducing bacteria counts by only 0.8-log after 60 minutes of treatment.
- ✓ Thermosonication was found to be the most effective method in comparison with independent sonication or thermal treatment. At higher temperatures, and after a few minutes of thermosonication treatment a decrease of around 1 or 2 log was observed.
- ✓ The Weibull model fitted well the thermosonication inactivation kinetic data.
- ✓ It can be concluded that thermosonication is a promising treatment, with a drastic impact on the loads of *A. acidoterrestris* in apple juices.