# Inactivation kinetics of *Listeria innocua* in thermosonicated kiwi juice

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## Introduction

Kiwifruit (*Actinidia deliciosa*), also known as 'Chinese gooseberry' is a fruit with high nutritional and bioactive properties due to its composition. It is widely processed into juices in the fruit juices industry. Juices are one of the food products susceptible to chemical, physical, and microbiological changes due to their thermal sensitivity. Therefore, it is essential to produce juices that are both microbiologically safe and healthy, and highly nutritious and possess natural characteristics.

In fruit juice processing, traditional heat treatments such as pasteurization are usually used. However, this processing method may often induce undesirable quality changes in fruit juices. Alternatively, thermosonication has been found to have a great potential in microbial inactivation and fruit juices' quality retention.

## Objective

The aim of this study was to evaluate the impact of thermosonication and traditional pasteurization processes on Kiwifruit juice, assessing:

- Inactivation kinetics of *Listeria innocua* 2030c (a surrogate of the pathogenic *Listeria monocytogenes*) in both treatments.

## Conclusions

- ✓ Thermosonication applied at 55° C can be considered as the best process due its potential impact on *L. innocua* inactivation, causing a 5 log-cycle reduction after 3 mins of exposure.
- ✓ The results proved the existence of a synergistic effect between temperature and ultrasounds, making it possible to apply mild heat treatment processes and improve the final product's quality.
- ✓ Since thermosonication treatment was effective in *L. innocua* inactivation, this technology can be considered a successful alternative to fruit juices' conventional thermal treatment.

## Materials & Methods

### Sample preparation & Treatments

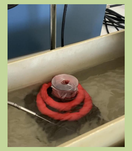
*Actinidia deliciosa cv. Hayward*

Peel was manually removed and cut into small pieces

Juice was extracted using domestic centrifuge

Thermosonication at constant frequency of 20 kHz, 80% amplitude and discontinue pulsation (10s on, 5s off):
45 °C for 15 min
50 °C for 10 min
55°C for 3 min

Thermal treatment at:
45 °C for 60 min
50 °C for 25 min
55°C for 10 min



Kiwi juice

### Microbiological analysis

Juice samples were artificially inoculated with ***L. innocua*** before the treatments

1 ml of *L. innocua* suspension

$N_0 \approx 10^7$ CFU/mL

19 mL kiwi juice

***L. innocua* was enumerated in kiwi juice before and after each treatment**

**Data analysis** **Three replicates** were performed

**Weibull model** was used to fit all *L. innocua* log-survival data, based on regression analysis

$$\log\left(\frac{N}{N_0}\right) = -\left(\frac{t}{\delta}\right)^n$$

N= microbial load
$N_0$= initial microbial load
t = time
δ = first decimal reduction time
n= shape parameter

## Results and Discussion

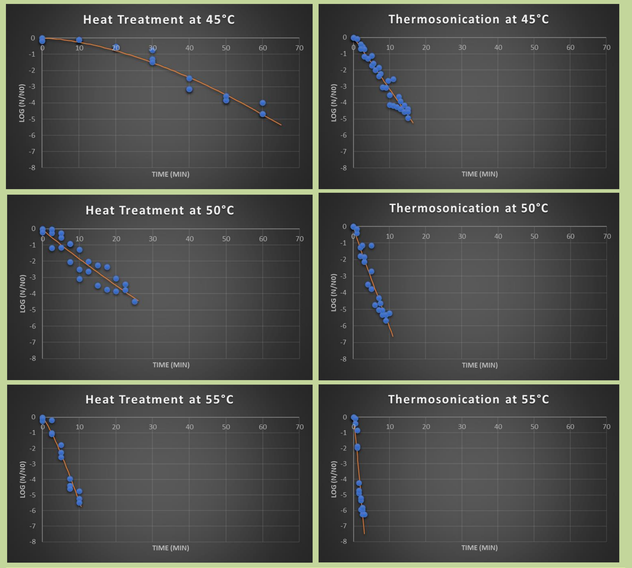



**Figure 1.** Inactivation of *L. innocua* in kiwi juice after thermosonication and thermal processing. The orange line represent the model fit.

**Table 1**. Estimated parameters obtained from the data fit of the Weibull model. The values are mean ± margin of confidence interval at 95%.

| Treatment | δ (min) | n | $R^2$ |
|---|---|---|---|
| Heat treatment at 45° C | 23.31 ± 3.51 | 1.64 ± 0.30 | 0.955 |
| Thermosonication at 45° C | 3.19 ± 0.59 | 1.01 ± 0.14 | 0.951 |
| Heat treatment at 50° C | 5.06 ± 1.73 | 0.91 ± 0.25 | 0.855 |
| Thermosonication at 50° C | 1.47 ± 0.59 | 0.94 ± 0.23 | 0.907 |
| Heat treatment at 55°C | 2.50 ± 0.70 | 1.22 ± 0.27 | 0.957 |
| Thermosonication at 55°C | 0.46 ± 0.21 | 1.08 ± 0.32 | 0.902 |

**5-log reduction of *L. innocua***

- In thermosonication, this goal was achieved after 15, 10 and 3 mins at 45°, 50°and 55°C, respectively
- Using only thermal treatment, 60, 25 and 10 mins were needed for the same temperatures

The Weibull model was successfully used to describe *L. innocua* inactivation behaviour

Thermosonication treatment showed to be more efficient in *L. innocua* inactivation as compared to thermal treatment alone since lower D-values were attained

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