Thermosonication Applied to Kiwi Peel – a Healthy Source of Nutrients

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Introduction

The peels of many fruits are not commonly consumed being, however, important sources of nutrients. Finding approaches to add value to such non-edible parts and preventing them from being discarded is interesting. This may include the development of processes that allow the retention of nutrients and guarantee the product's safety from a microbiological point of view.

Objectives

To apply thermosonication processes to kiwi peel and evaluate the impact on:

- **Key nutrients**
  - Fibers
  - Proteins
  - Minerals (Ca, K, Mg, Na, and P)
- ***Listeria innocua*** survival, which was used as a non-pathogenic surrogate of ***L. monocytogenes.***

Materials & Methods

Samples Preparation and Treatments

Actinidia deliciosa cv. Hayward

peels were manually cut into small pieces

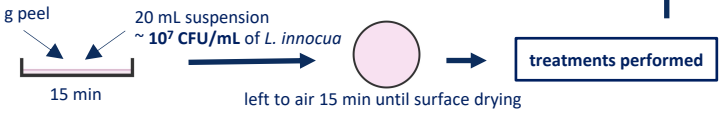
treatments - 3 replicates -

Thermosonication *35 kHz*
55 °C for 30 min | **US + T55**
60 °C for 15 min | **US + T60**

Thermal Treatments
55 °C for 30 min | **T55**
60 °C for 15 min | **T60**

Microbiological Analysis

- **Kiwi peel was inoculated with *L. innocua* before treatments**



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

Nutrients	proteins	total fibers	minerals
	Kjeldahl Method - nitrogen determination	Enzymatic-gravimetric method - dietary fiber kit	Microwave digestion inductively coupled plasma optical emission spectrometry

Data Analysis

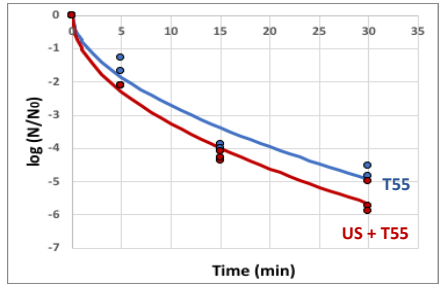
- **Weibull model** | *L. innocua* survival data
- One-way ANOVA + Post-Hoc tests | treatment effects

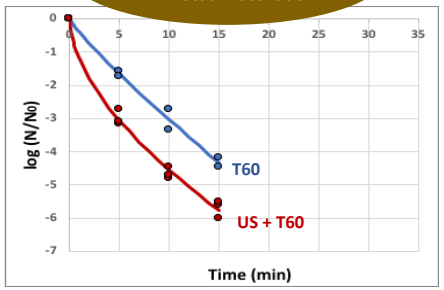
$$log\left(\frac{N}{N_0}\right) = -\left(\frac{t}{D}\right)^{n}$$

shape parameter
first decimal reduction time
N - microbial load
N₀ - initial load
t - time

Results

- ***Listeria innocua* inactivation**





The Weibull model successfully described *L. innocua* inactivation

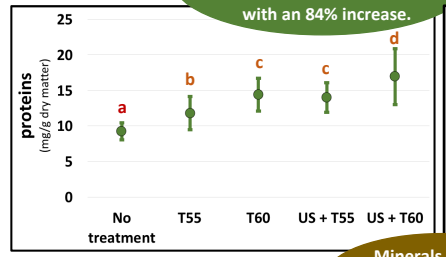
Treatment	D (min)	n	R^2
T55	1.60 ± 1.71	0.54 ± 0.22	0.960
US + T55	0.97 ± 0.54	0.51 ± 0.09	0.985
T60	2.82 ± 0.90	0.88 ± 0.19	0.989
US + T60	0.73 ± 0.29	0.58 ± 0.08	0.993

mean values ± confidence level at 95% / 2

Temperature coupled to ultrasound is more effective in *L. innocua* inactivation

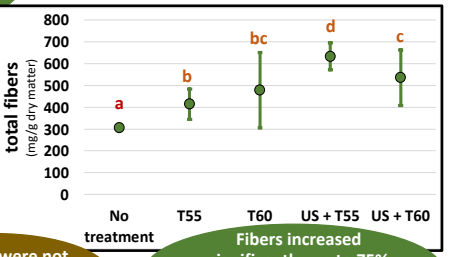
Thermosonicated samples had lower D-values

- **Proteins**



Protein content increased after all treatments. US+T60 was the most effective with an 84% increase.

- **Total fibers**



Fibers increased significantly, up to 75% after US+T60 and doubling after US+T55

values with different letters differ significantly ($p < 0.05$)

- **Minerals** (mg/g dry matter)

Minerals were not significantly affected by thermosonication

Treatment	P	Mg	Ca	Na	K
No treatment	3.30 ± 0.36	3.15 ± 0.45	9.01 ± 1.20	0.37 ± 0.10	93.84 ± 12.38
US + T55	3.91 ± 0.23	3.16 ± 0.21	10.69 ± 1.34	0.33 ± 0.04	74.03 ± 5.32
US + T60	3.81 ± 0.25	2.88 ± 0.15	9.84 ± 0.38	0.42 ± 0.03	88.67 ± 1.95

mean values ± standard deviation

Conclusion

Applying thermosonication to kiwi peel is more effective than thermal treatments in reducing *L. innocua* loads while allowing retention and even increasing essential healthy nutrients.

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