UV-C radiation as an effective non-thermal process for 'Cantaloupe' melon juice decontamination

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Introduction

Fruit juices are one of the most consumed beverage worldwide. They are considered essential for a well-balanced diet due to their nutritional characteristics. Nevertheless, when fresh fruit juices are not subject to any decontamination treatment, they become more susceptible to microbial spoilers and pathogens, which may affect human health.

Thermal pasteurization is considered an extremely effective process for juices decontamination. However, it has negative impacts on overall quality characteristics of these beverages. UV-C radiation technology has a germicidal effect and has been applied to eliminate undesirable microorganisms in food products. This process is particularly effective in liquid foods, being an alternative non-thermal processing that can be applied to fruit juices.

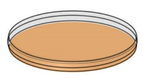
Objectives

The main goal of this study was to evaluate the effect of UV-C radiation on some quality characteristics and microbiological decontamination of *Cantaloupe* melon (*Cucumis melo* L. var. *reticulatus*) juice:

- Microbiological indicators – *Alicyclobacillus acidoterrestris* spores (spoiler indicator), *Listeria innocua* (non-pathogenic surrogate of *L. monocytogenes*) and intrinsic microflora (total mesophylls, and yeasts and moulds);
- Quality characteristics - some physic-chemical characteristics (pH, colour and soluble solids content), total phenolics and antioxidant capacity.

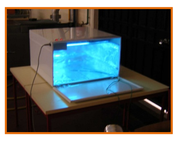
Methods

Sample



25 mL melon juice

UV-C treatment

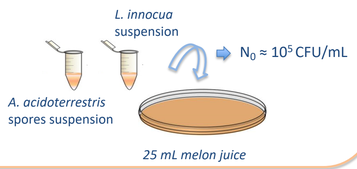


UV-C radiation
for 5 and 20 min;
intensity of 13.44 W/m²

Microbiological and Quality Analysis

Microbiological Analysis

A. acidoterrestris spores and *L. innocua* were inoculated separately before UV-C exposure and determined after treatment



Indigenous microflora (total mesophylls and yeasts and moulds $N_0 \approx 10^5$ and 10^3 CFU/mL, respectively) were determined after UV-C exposure

Quality Analysis

Physic-chemical parameters

pH

pH meter
GL 22

SSC (ºBrix)

Refractometer
Palette PR-32

Colour

Colorimeter
Minolta CR-400

- L^* lightness value: 0 (black) to 100 (white)
- a^* measures red (+) and green (-)
- b^* measures yellow (+) and blue (-)
- $Total\ colour\ difference = TCD = \sqrt{(L_0^* - L^*)^2 + (a_0^* - a^*)^2 + (b_0^* - b^*)^2}$

Total phenolics & Antioxidant activity

Extraction with
methanol 100%

Spectrophotometer
Model 5625, ATI Unicam

Total phenolics λ = 750 nm

Antioxidant activity λ = 734 nm

Data analysis

Three replicates were performed ; ANOVA + Post-hoc tests

Results and Discussion

Decontamination

Table 1. *A. acidoterrestris* spores, *L. innocua*, total mesophylls and yeasts and moulds log-cycles reduction after different UV-C exposure times. The values are mean ± margin of confidence interval at 95%.

Treatment time (min)	*Log-cycle reduction*			
	***A. acidoterrestris* spores**	***L. innocua***	***Total mesophylls***	***Yeasts and Moulds***
5	0.8 ± 0.1	3.9 ± 0.7	no reduction	no reduction
20	4.7 ± 0.1	below detection limit	2.9 ± 0.5	1.4 ± 0.2

Reductions of 0.8±0.1 and 4.7±0.1 log-cycles were observed after 5 and 20 minutes of radiation, respectively, for *A. acidoterrestris* spores. For *L. innocua*, a reduction of 3.9±0.7 log-cycles was attained after 5 minutes and, for the highest exposure time, no cells were detected.

Quality

Table 2. Physic-chemical and bioactive parameters of fresh and UV-C processed melon juice. The values are mean ± margin of confidence interval at 95%. For a given characteristic, values with different letters differ significantly ($p<0.05$).

Juice	L*	a*	b*	TCD	° Brix	pH
Fresh	32.8 ± 0.6 [a]	8.4 ± 0.8 [a]	21.9 ± 1.2[a]	-	11.4 ± 0.1[a]	6.3 ± 0.0[a]
UV - 5 min	34.8 ± 0.9 [ab]	8.6 ± 0.7 [a]	24.8 ± 0.9[a]	3.8 ±1.1 [a]	11.5 ± 0.2[a]	6.7 ± 0.1[b]
UV - 20 min	35.2 ± 0.8 [b]	8.5 ± 0.5 [a]	24.8 ± 0.8[a]	3.9 ± 1.0 [a]	11.7 ± 0.2[a]	7.0 ± 0.1[c]

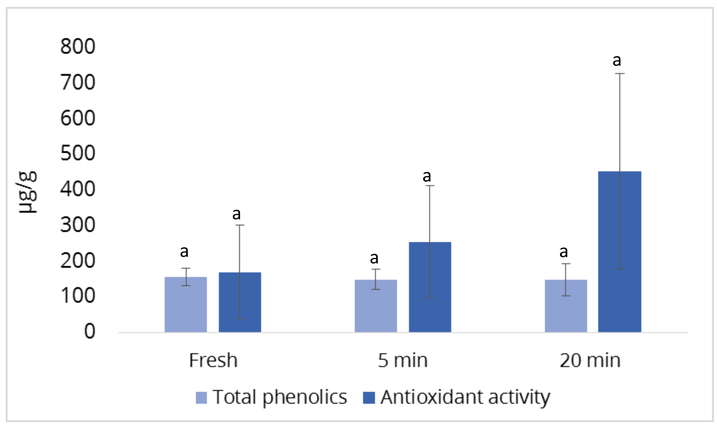


Figure 1. Total phenolics and antioxidant activity in fresh and ozone treated juice.
Data represents the mean values and bars the confidence interval at 95%.
For a given characteristic, values with different letters differ significantly ($p<0.05$).

- ✓ Exposure time significantly affected colour (very distinct alterations) and pH (slight increase with treatment time);
- ✓ The remaining quality characteristics were not affected by the radiation and were similar to the ones observed in fresh/untreated juice.

Conclusions

- ✓ UV-C radiation was effective on *A. acidoterrestris* spores and *L. innocua* inactivation in *Cantaloupe* melon juices;
- ✓ Total phenolics, antioxidant activity and soluble solids content were not affected by UV-C treatment;
- ✓ This technology can be considered as a promising alternative to traditional pasteurization of fruit juices.

Acknowledgements

Joana F. Fundo and Teresa R.S. Brandão gratefully acknowledge their Post-Doctoral Grants (SFRH/BPD/109519/2015 and SFRH/BPD/101179/2014, respectively) to Fundação para a Ciência e a Tecnologia (FCT). This work was supported by National Funds from FCT - Fundação para a Ciência e a Tecnologia through project UID/Multi/50016/2013.

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