Effect of non-thermal methods on the safety of strawberries (*Fragaria anannassa*) and watercress (*Nasturtium officinale*)

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Objective

- The main objective of this work was to study the influence of ultrasonication, and its combination with a milder heat treatment (thermosonication), and UV-C irradiation on the safety of strawberries and watercress.

Introduction

Non-thermal technologies have been studied as an attempt to substitute thermal methods on fruits and vegetables processing. Besides attaining improved quality retention of products, paramount importance must always be given to the safety of the processed goods. The application of technologies like ultrasonication and ultraviolet radiation, as a pre-treatment of the minimally processed foods, seems a good solution for the increase of safety and quality retention.

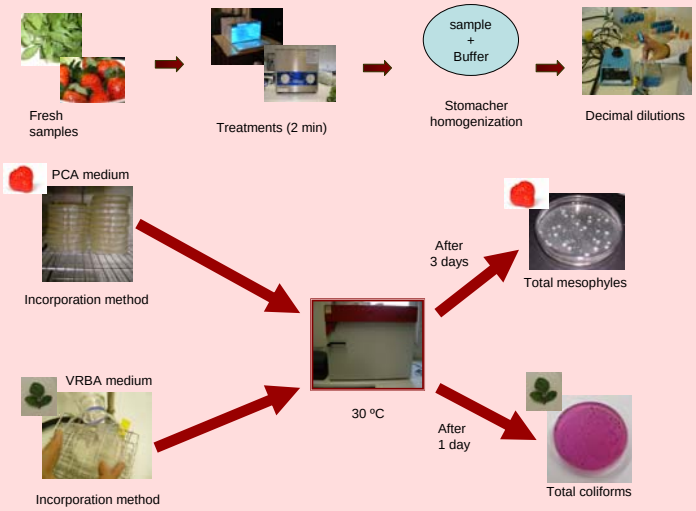
Ultrasound is defined as sound waves with a frequency over 20 kHz, which is about the upper limit of human hearing. Ultrasonication in food industry is innovative. Moreover, ultrasounds have a proven antimicrobial effect, specially when combined with temperature (i.e. thermosonication; Ordoñez et al. (1984)). Some works reveal 5 to 6 log-reductions in number of microbial cells for liquid foods treated with power ultrasounds combined with mild heating (Baumann et al., 2005; D'Amico et al., 2006)

Ultraviolet radiation at 200-280 nm (UV-C) has a germicide action. This technology has been used to control post-harvest contaminations in fruits and vegetables, aiming at extending products' shel-life (Erkan et al., 2001; Marquine et al., 2002; Allende et al., 2006;).

Materials and Methods

- Strawberries (*Fragaria anannassa*) and watercress (*Nasturtium officinale*) were acquired in a local market. Analyses were carried out in fresh untreated samples and after treatments.
- Ultrasonication (US) and thermosonication treatments were performed in an ultrasound equipment (Bandelin Sonorex RK 100H) at 32 kHz. Samples were treated for 2 minutes at 20 ºC (ultrasonication) and at 50-65 ºC (thermosonication). Control water treatments at the same temperatures were also performed.
- UV-C treatments were performed for 2 minutes in an UV-C chamber (conceived by University of Algarve, Portugal) with 4 germicide lamps (average intensity of 12,36 Wm^{-2}; TUV G30T8, 16 W, Philips). The intensity of flux and dose of exposure (*timexintensity*) were continuously measured by an UV digital photometer (DO 9721 Delta Ohm).
- Safety of strawberries and watercress was assessed by total mesophyles (NP 4405) and total coliforms (NP 3788) counts, respectively.

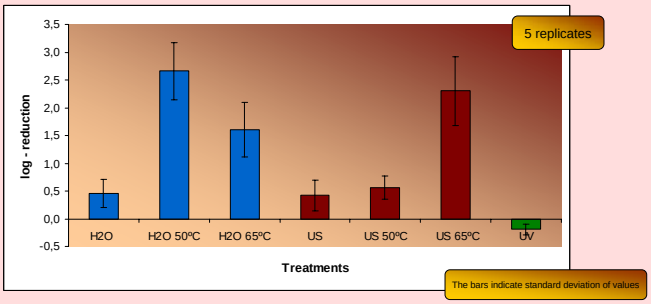
Experimental Description



Results

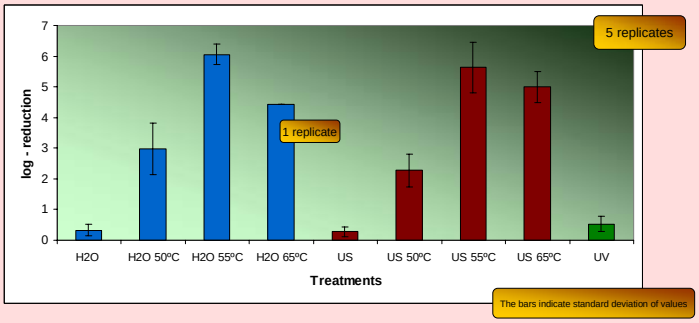
The treatment effects were assessed by calculation of log-reduction of microbial content, in relation to fresh untreated samples.

Strawberries – Total mesophyles counts



- US treatments (at 20 ºC) and thermosonication at 50 ºC were equivalent to a water-washing, reducing in average 0.5 log-cycles.
- Thermosonication at 65 ºC reduced approximately 2.5 log-cycles. The treatment was more efficient than a water-washing at the same temperature.
- For water-washings at 50 and 65 ºC, reductions in total mesophyles counts were higher at the lowest temperature. This can be explained by different thermal resistances of the microoganisms included in mesophyles enumeration.
- UV-C radiation did not inactivate mesophyles in strawberries. Further investigation is required for validation of these results.

Watercress – Total coliforms counts



- US treatments (at 20 ºC) and UV-C were equivalent to a water-washing, reducing in average 0.3 log-cycles.
- No significant differences were detected between water-washings and thermosonication at the same temperatures (50, 55 and 65 ºC).
- The most efficient processes were water-washing and thermosonication at 55 ºC, reducing approximately 6 log-cycles.

Conclusions

Strawberries Total mesophyles

- Ultrasonication was only efficient when carried out at 65 ºC. However, results were equivalent to the ones obtained by water-washings at 50 ºC.
- UV-C results were not conclusive.

Watercress Total coliforms

- For the same ultrasonication conditions, greater reductions were obtained in watercress coliforms than in strawberries mesophyles.
- Thermosonication at 55 ºC was the most efficient process (however, equivalent to a water-washing at the same temperature).
- UV-C action was equivalent to a water-washing at 20 ºC.

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