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ANNUAL MEETING + FOOD EXPOSM

Impact of thermal blanching and thermosonication treatments on watercress (*Nasturtium officinale*) quality: process optimisation and microstructure evaluation

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Watercress (*Nasturtium officinale*)



- Family Cruciferae (mustard family), grows in and around water
- consumed in salads, soups and other recipes
- prevention of cancer and related diseases
- short shelf life of nearly seven days

Freezing allows a longer period for distribution and storage



Pre-Treatment

Hot water immersion

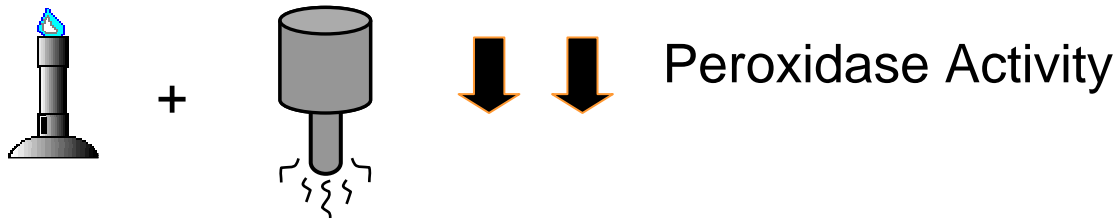
- stabilises foods
- destroys microorganisms
- inactivates enzymes

- impairs sensory properties
- reduces the contents or bioavailability of some nutrients



Thermosonication

Heat + Ultrasound



Thermosonication is more effective than thermal treatments in watercress peroxidase inactivation

	90 °C	Heat (1.15 min)	Thermosonication (4.4 s)
Peroxidase		↓ 90%	↓ 90%
Vitamin C retention		29.1%	94.4%

Thermosonication treatments can be a good alternative to the traditional heat blanching processes



Objective

Study:

- Watercress blanching optimisation



Materials and Methods

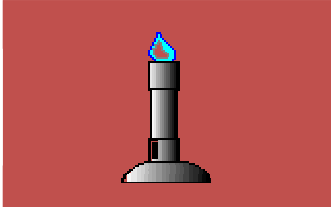
- Vitamin C retention maximisation - **objective function**
- 90% inactivation in watercress peroxidase - **constraint**
- Colour *a*-value
- Microstructure analysis



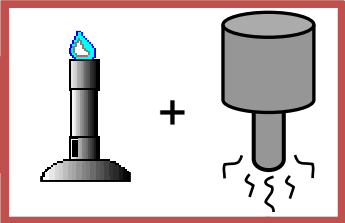
Materials and Methods



Heat blanching



Thermosonication (heat+ultrasound) blanching



(20 kHz; 125 W)

T °C	82.5
	85
	87.5
	90
	92.5

Time range
0-2 min



Table 1- Studied watercress kinetic parameters for heat and thermosonication treatments

Quality parameter	Treatment	Model	Kinetic parameter	Reference
Peroxidase	Heat	<i>Biphasic first-order</i>	C_{01} ($\mu\text{mol}\cdot\text{min}^{-1}\cdot\text{mg protein}^{-1}$) 0.49±0.08 $k_{1\ 84.6\text{ }^\circ\text{C}}$ (min^{-1}) 18.01±13.98 E_{a1} ($\text{kJ}\cdot\text{mol}^{-1}$) 420.72±114.94 C_{02} ($\mu\text{mol}\cdot\text{min}^{-1}\cdot\text{mg protein}^{-1}$) 0.48±0.06 $k_{2\ 84.6\text{ }^\circ\text{C}}$ (min^{-1}) 0.24±0.14 E_{a2} ($\text{kJ}\cdot\text{mol}^{-1}$) 351.65±80.91 R^2 0.94	Cruz et al. (2006)
	Thermosonication*	<i>First-order</i>	C_0 ($\mu\text{mol}\cdot\text{min}^{-1}\cdot\text{mg protein}^{-1}$) 1.01±0.05 $k_{87.5\text{ }^\circ\text{C}}$ (min^{-1}) 9.64±2.21 E_a ($\text{kJ}\cdot\text{mol}^{-1}$) 496.45±65.52 R^2 0.97	
Colour (<i>a</i> parameter)	Heat	<i>Reversible first-order</i>	C_0 0.96±0.01 C_e 1.01±0.02 E_a ($\text{kJ}\cdot\text{mol}^{-1}$) 422.37±126.63 $k_{87.5\text{ }^\circ\text{C}}$ (s^{-1}) 0.028±0.024 R^2 0.99	Cruz et al. (2007)
	Thermosonication*	<i>Reversible first-order</i>	C_0 1.01±0.01 C_e 1.09±0.01 E_a ($\text{kJ}\cdot\text{mol}^{-1}$) 187.70±160.07 $k_{87.5\text{ }^\circ\text{C}}$ (s^{-1}) 0.28±0.18 R^2 0.99	
Vitamin C	Heat	<i>First-order</i>	C_0 1 E_a ($\text{kJ}\cdot\text{mol}^{-1}$) 150.47±42.81 $k_{87.5\text{ }^\circ\text{C}}$ (min^{-1}) 0.75±0.10 R^2 0.98	Cruz et al. (2008)
	Thermosonication*	<i>First-order</i>	C_0 1 E_a ($\text{kJ}\cdot\text{mol}^{-1}$) 136.20±60.97 $k_{87.5\text{ }^\circ\text{C}}$ (min^{-1}) 0.58±0.11 R^2 0.97	

*Ultrasound at 20 kHz and 125 W



Results

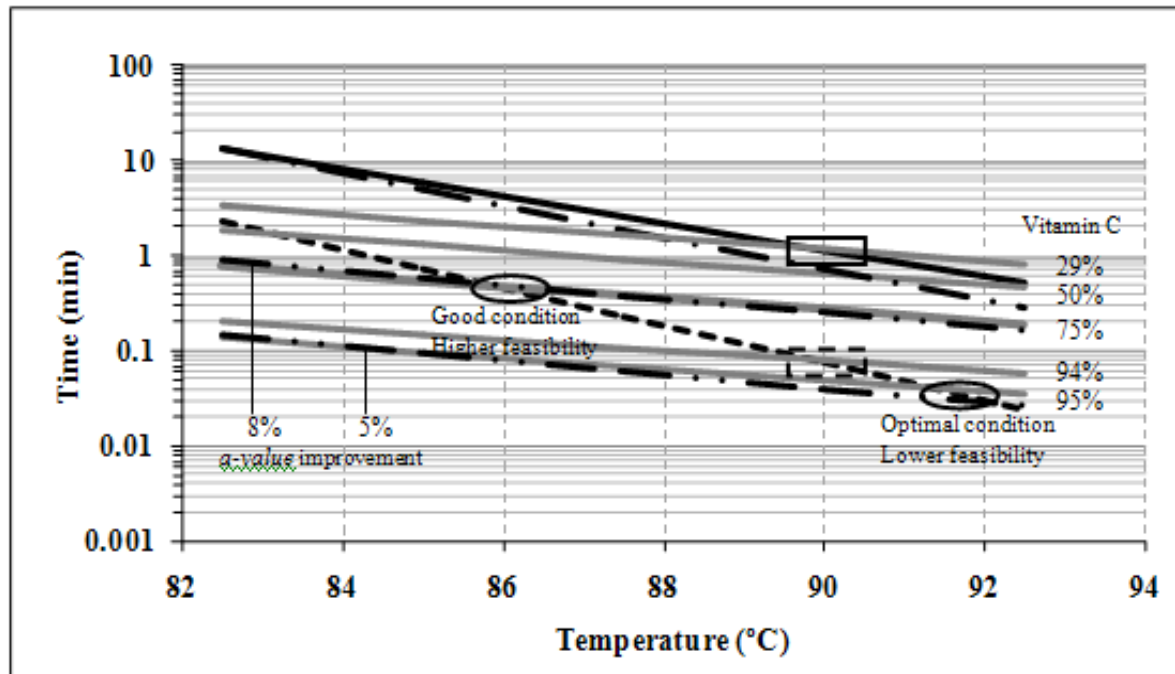


Figure 1- Graphical optimisation for heat and thermosonication watercress blanching in the temperature range of 82.5 to 92.5 °C: (—) 90% of peroxidase inactivation with heat treatment; (--) 90% of peroxidase inactivation with thermosonication treatment. The grey lines correspond to 29, 50, 75, 94 and 95% of vitamin C retention for both treatments. 5% of greenness improvement with heat treatment is represented by the dashed dotted line; 5% and 8% of greenness improvement with thermosonication treatment are represented by the dashed double dotted lines. The continuous and dashed rectangular markers compare two time-temperature combinations at 90 °C for heat and thermosonication, respectively. The elliptic markers indicate two time-temperature thermosonication combinations: 92 °C, 2 s; 86 °C, 30 s.



Results

Watercress initial values:

Vitamin C (50.40 ± 5.77 mg.100 g fw⁻¹) *a*-value (-9.66 ± 1.08)

Thermosonication	Optimal condition 92 °C 2 s	Better condition 86 °C 30 s
Peroxidase	↓ 90%	↓ 90%
Vitamin C retention	95%	75%
<i>a</i> -value improvement	5%	8%



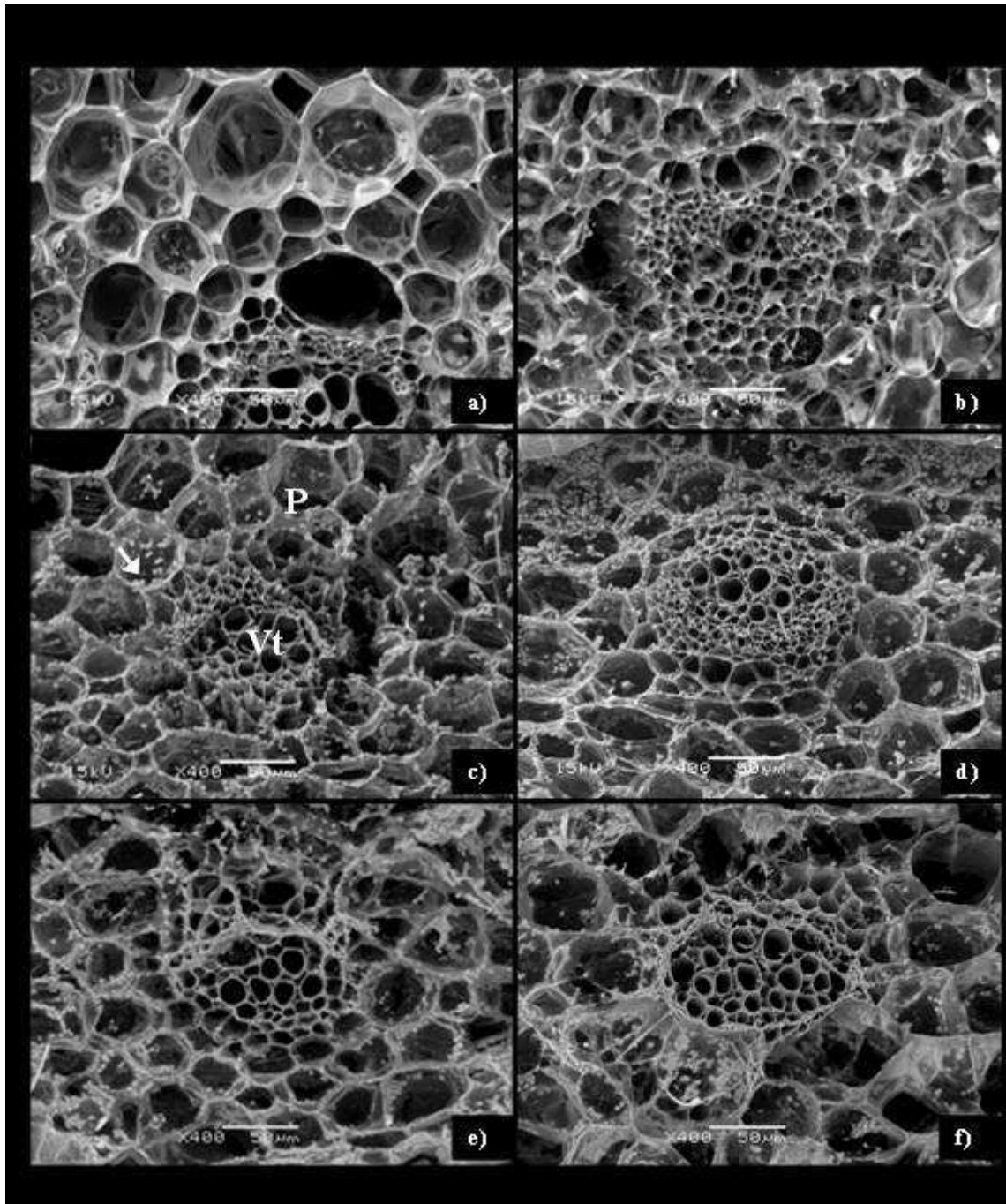


Figure 2- SEM micrographs of watercress cross section tissue at 400x magnification level: (a)-Fresh watercress; (b)-Thermosonicated watercress at 50 °C, 60 s; (c)-Thermosonicated watercress at 92 °C, 2 s; (d)-Heat blanched watercress at 92 °C, 2 s (control); (e)- Thermosonicated watercress at 86 °C, 30 s; (f)-Heat blanched watercress at 86 °C, 30 s (control). P= parenchyma cells, Vt= vascular tissue, white arrow indicates the chloroplasts.



Conclusion

The proposed optimal thermosonication blanching conditions will improve the blanched watercress quality and consequently, contribute to the development of a high quality new frozen product.

A suitable scale-up study is mandatory for industrial production.



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Thank You!

