Watercress extract: antioxidant potential and impact of different drying methods

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Introduction & Objectives

Phytochemicals: a current strategy to prevent and treat chronic diseases, including cancer

Stand out

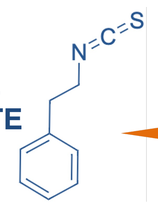
CRUCIFEROUS VEGETABLES have a ↑↑ content of **GLUCOSINOLATES (GLC)**

Conversion of GLC to ITC by Plant Myrosinase

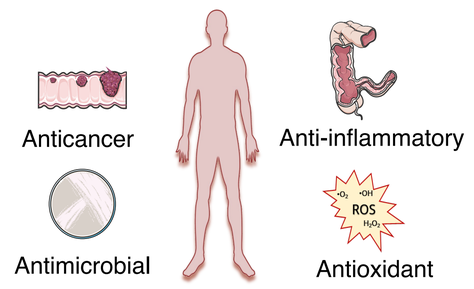
Phytochemicals: **ISOTHIOCYANATES (ITC)**

Watercress (*Nasturtium officinale*)

PHENYLETHYL ISOTHIOCYANATE (PEITC)



The main effects of PEITC on human health



The health-promoting effects of PEITC have been extensively studied by clinical trials and several *in vivo* and *in vitro* models. The chemopreventive action of PEITC in humans has been attributed to its antioxidant and anti-inflammatory effects and its ability to block the stages of carcinogenesis.

The MAIN GOAL of this work is to evaluate the antioxidant potential and biocompatibility of a watercress extract obtained by a green extraction technique. Furthermore, in order to obtain a dry product, different drying techniques were tested, as well as their impact on the compound of interest (PEITC). Finally, polymeric microparticles were developed using the electrospraying technique to develop food-grade delivery vehicles for PEITC extracts.

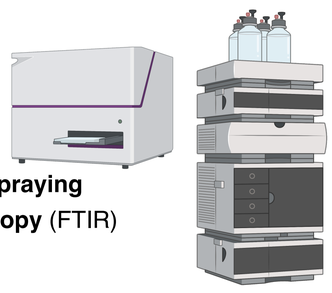
PEITC was obtained in a circular economy context by valorising watercress by-products.

Methods & Results

Watercress by-products were provided by Vitacress Portugal S.A. The extraction was performed using a green technique.

ANALYSIS

- Antioxidant activity: **ABTS**, **DPPH** and **ORAC** assays
- Biocompatibility (or cytotoxicity): **resazurin assay**
- PEITC identification and quantification: **HPLC-DAD**
- Drying techniques: **freeze drying**, **nano spray drying**, and **electrospraying**
- Dry extracts' infrared spectra: **fourier-transform Infrared spectroscopy** (FTIR)
- **Scanning electron microscopy** (SEM)



Watercress extract

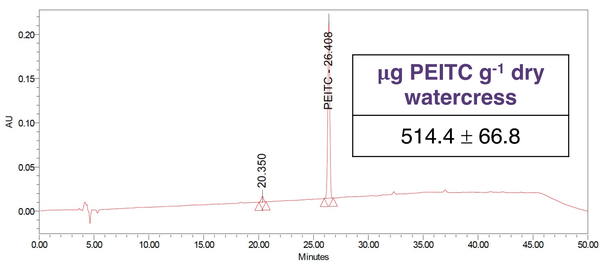


Figure 1. A typical HPLC chromatogram of PEITC identified in watercress extract at a wavelength of 245 nm.

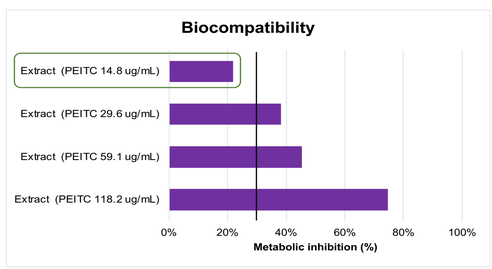


Figure 2. Metabolic inhibition of watercress extract at different equivalent concentrations of PEITC for 24h against Caco-2 cells. The black vertical line represents the 30% inhibition limit.

Table 1. Antioxidant activity determined by ABTS and DPPH assays of watercress extract.

	ABTS			DPPH		
	Linear equation	R^2	EC50 (µg/ml)	Linear equation	R^2	EC50 (µg/ml)
Trolox (control)	y= 8.2256x + 0.0571	0,999	53.8	y=20.687x – 0.062	0.995	27.1
Watercress extract	y= 0,5144x + 0,076	0,994	824.3	y= 0,5746x + 0,1412	0,983	624.4

EC 50: the effective sample concentration that can decrease the concentration of ABTS or DPPH by 50%.

Regarding the EC_{50}, the results demonstrated that the extract was less effective for scavenging than trolox; Moreover, according to the international standard, ISO 10993–5, the threshold value for a sample to be cytotoxic is a metabolic inhibition of 30%. It is possible to observe that PEITC below 14.8 µg/mL slightly inhibited cell metabolism, corresponding to 21.78% ± 0.10%, but did not show cytotoxicity.

Dried extract

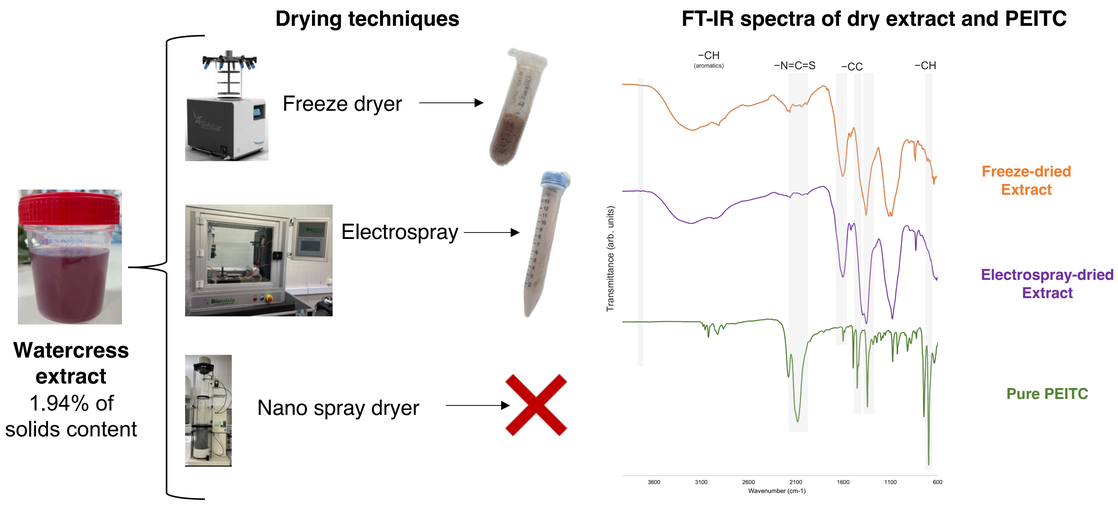


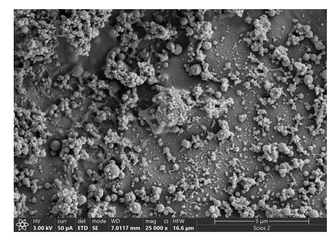
Figure 3. Dried watercress extract obtention by freeze dryer, electrospray, and FTIR analysis of the respective samples.

Regarding drying techniques, nano spray drying was not the best to obtain a dry extract. Drying the extract with a 1% maltodextrin solution was also tested, but it was not very effective in getting a powder. Besides, nano spray drying works with high temperatures, which is a disadvantage since some substances are thermosensitive, such as phenolic compounds. Electrospray drying allowed for obtaining a powder with small and homogeneous particles. Figure 1 also shows pure PEITC and dry extracts' infrared spectra (FTIR). In the samples, it is possible to observe characteristic peaks of PEITC, such as the characteristic peak of the isosulfocyanic group (N=C=S) between 2182 cm^{-1} and 2083 cm^{-1} .

Table 2. Antioxidant activity determined by ORAC assay of dried extracts.

	Freeze-dried extract	Electrosprayed extract
µmol trolox equivalent / g dry extract	341 ± 39	499 ± 34

The electrosprayed extract showed a higher antioxidant potential. Furthermore, polymeric microparticles were developed and chitosan was chosen as encapsulation matrices as biocompatible, biodegradable, and gastro-resistant. The optimal chitosan concentration for electrospray conditions was 4% (w/v). It was found that samples with chitosan at >4% (w/v) tend to start forming nanofibers in addition to microparticles.



Microparticles with watercress extract and chitosan

Chitosan concentration (w/v %)	Voltage (kV)	Flowrate (µl/h)	Tip-to-collector distance (cm)
4	23	110	16

Figure 4. SEM image of the electrosprayed chitosan microparticles.

Conclusions & Future Work

According to the results, the obtained watercress extract is a promising source of PEITC. Regarding drying techniques, electrospray allows for obtaining a more homogeneous powder than the freeze-drying technique, with higher antioxidant activity. Further, the preliminary work in producing watercress extract microparticles showed potential and promising results, namely in producing microparticles on a pilot scale. Furthermore, future research will be carried out to characterise the dried extracts and the microparticles.

References

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