

# Effects of Drought Stress on the Chemical Composition and Bioactive Properties of *Cichorium spinosum* L.

Beatriz H. Paschoalino<sup>1,2,3</sup>; Miguel A. Prieto<sup>3</sup>; Tânia C.S.Pires<sup>1,2</sup>; Ricardo Calheta<sup>1,2</sup>; Nikolaos Polyzos<sup>4</sup>; Spyridon A. Petropoulos<sup>4</sup>; Lillian Barros<sup>1,2</sup>; Maria Inês Dias<sup>1,2,\*</sup>

<sup>1</sup> Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal;

<sup>2</sup> Laboratório Associado para a Sustentabilidade e Tecnologia em Regiões de Montanha (SusTEC), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal;

<sup>3</sup> Grupo de Nutrición y Bromatología, Departamento de Química Analítica e dos Alimentos, Faculdade de Ciência e Tecnologia dos Alimentos, Universidade de Vigo, Campus de Ourense, 32004 Ourense, España;

<sup>4</sup> Department of Agriculture, Crop Production and Rural Environment, University of Thessaly, Fytokou Street, 38446 Volos, Greece.

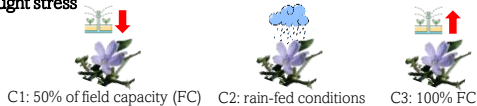
\*maria.ines@ipb.pt

## Introduction, Materials and Methods

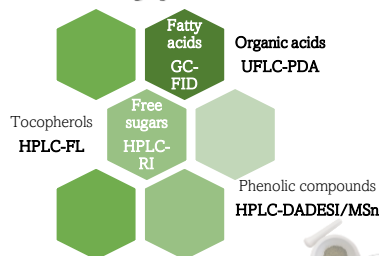
*Cichorium spinosum* L. (spiny chicory), is one of the most well-known wild edible plant (WEP) due to its valuable phytonutrient and macronutrient content;

In the search for sustainable agricultural systems, several studies have focused on deficit irrigation as an option for commercial cultivation of WEPs in marginal conditions.

### Drought stress



### Chemical Composition Chromatographic methods



Hydroethanolic extraction  
Maceration with ethanol:water (80:20 v/v)

### Bioactive properties

#### Antimicrobial activity

Colorimetric assay of *p*-iodonitrotetrazolium

#### Cytotoxicity and hepatotoxicity activities

Human tumour cell lines tested: AGS, CaCo2, MCF7, NCI-H460  
Non tumour cell line tested: porcine liver

#### Anti-inflammatory activity

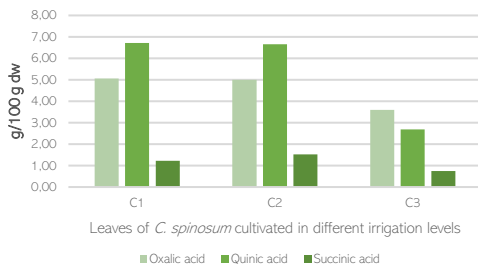
Producing nitric oxide formed in the mouse macrophage-like cell line RAW 264.7



## Results

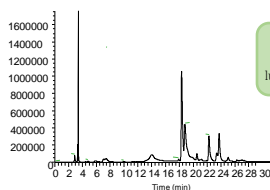
$\gamma$ -tocopherol was detected in higher concentrations than  $\alpha$ -tocopherol in the samples of *C. spinosum*. Therefore, the total tocopherol content was less than 0.5 g/100 g dry weight.

### Organic acids



Leaves of *C. spinosum* cultivated in different irrigation levels

The sample C1 showed the highest concentration of phenolic compounds due to the accumulation of secondary metabolites



Flavonoids and phenolic acids were found: O-glycosylated derivatives of quercetin, luteolin, kaempferol, and caffeoylquinic acids

Gram-positive bacteria showed greater sensitivity to the C3 hydroethanolic extract. *Escherichia coli* (gram-negative bacteria) showed only sensitivity to the C1 and C2 hydroethanolic extract

No anti-inflammatory, hepatotoxicity and cytotoxicity (except for the AGS tumour cell line) effects were found.

## Conclusions

These results emphasize the influence of water stress on the quality of plants, further underscoring the potential and significant added value of *C. spinosum* cultivated under marginal conditions. Additional research is required to establish the most effective cultivation methods that can enhance both yield and the quality of the plant.



**Acknowledgements:** The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support through national funds FCT/MCTES (PIDDAC) to CIMO (UIDB/00690/2020 and UIDP/00690/2020) and SusTEC (LA/P/0007/2021); to FCT for the financial support to the VALUEFARM project (PRIMA/0009/2019) - PRIMA Section 2 - Multitopic 2019; for the grant of B.H. Paschoalino and for the financial support within the scope of the Project PRIMA Section 2—Multi-topic 2019: VALUEFARM (PRIMA/0009/2019); L. Barros, M.I. Dias, R. Calheta thank FCT, P.I., through institutional scientific employment program-contract for their contracts (CEEC Institutional). To MICINN for the Ramón y Cajal fellowship of M.A. Prieto (RYC-2017-22891) and for the Juan de la Cierva Formación contract for T.C.S.P.P. (FJC20120-045405-I); This work was also funded by the General Secretariat for Research and Technology of Greece (Prima 2019-11) and PRIMA foundation under the project Valuefarm (project number 1436).