




**«VALorization of Mediterranean small-scale FARMs by cropping wild UnExploited species»**

**Project Number:** 1436

**Project Acronym:** Valuefarm

# Deliverable D.4.1

## Proximate composition and chemical profile of the different WEP's

## Document Information

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| **Deliverable Number** | D4.1 |
| **Deliverable name** | Proximate composition and chemical profile of the different WEP's |
| **Contributing WP** | WP4: Evaluation of quality, environmental footprint, and nutritional value of WEPs |
| **Contractual delivery date** | M36, August 2023 |
| **Actual delivery date** | M36, August 2023 |
| **Dissemination level** | Public |
| **Responsible partner** | IPB |
| **Reviewers** | All partners |
| **Version** | 1 |

## 1. Explanation of the work carried out in WP4

### 1.1 Work Package 4

#### 1.1.1 Task 4.1 Characterization of physical properties and quality

UTH and CUT are responsible for characterizing the physical properties and quality of WEPs on plant tissues. CUT is progressing in the characterization of physical properties and quality of the studied WEPs on plant tissues harvested at each growing period of WP 2. Physical characteristics and quality of the final products (size and texture, total soluble solids, and ascorbic acid) have been assessed.

#### 1.1.2 Task 4.2 Assessment of the nutritional value and chemical composition of the final products

The Instituto Politécnico de Bragança as a beneficiary leader of WP4 has evaluated the nutritional profile and chemical composition (Task 4.2) of Wild Edible Plants (WEPs) cultivated and harvested in 3 partner countries of the project, namely, Greece (UTH), Cyprus (CUT) and Spain (CSIC).

UTH has already posted samples of 1$^{st}$ and 2$^{nd}$ harvesting. Regarding CUT's contribution, a big part of measurements related to minerals from CUT experimental studies, has been completed, analyzing the nutrient content in leaves and stems. The activity is in progress: Nitrate levels, N bioaccumulation, N translocation from roots to leaves, and N tolerance index of N were included in the analyses. Moreover, the mineral concentration of the hydroponic nutrient solution was also measured. On other hands, IPB just received the samples from Spain in June 2023 and is progressing with the analyses.

The leaves of *Cichorium spinosum*, leaves, and roots of *Scolymus hispanicus*, leaves of *Sonchus oleraceus*, leaves and stems of *Portulaca oleracea* and aerial parts of *Crithmum maritimum* grown under different agricultural systems and different cultivation parameters are under study. So far, only the leaves of *Sonchus asper* harvested from the wild have been analyzed. **Table 1** shows a summary of the fertilization type applied for each WEP grown in the ValueFarm project.

Among the species presented in **Table 1**, IPB has analyzed the nutritional and chemical profile of 139 samples collected in Greece and Cyprus and received another 100 from Greece and 36 from Spain.

**Table 1.** Description of the fertilization type proposed for each Wild Edible Plant species grown under the ValueFarm project.

| Fertilization type | Wild Edibles Species |
|---|---|
| Field experiment for irrigation requirements | *S. hispanicus*(Leaves and roots) |
| Field experiment for crop rotation and irrigation requirements | *C. spinosum* |
| Field experiment for crop rotation | *C. spinosum*, *S. oleraceus*, and *P. oleracea (*Leaves and stems*)* |
| Pot experiment for fertilization requirements | *C. spinosum*, *S. hispanicus* (Leaves and roots), *S. oleraceus*, *C. maritimum*, and *P. oleracea* (Leaves and stems) |
| Pot experiment manure, zeolite, and no amendment | *S. oleraceus*, *S. hispanicus* (Leaves and roots), *P. oleracea* (Leaves and stems), and *C. spinosum* |
| Pot $NH_4$ experiment | *S. oleraceus* (Two harvestings) and leaves and stems of *P. oleracea* (Two harvestings) |
| Pot Nitrogen experiment | *S. oleraceus* and *P. oleracea* (Leaves and stems) |
| Pot experiment with different genotypes | *S. hispanicus* (Leaves and roots) |
| Pot experiment with biostimulants with or without salinity | *S. hispanicus* (Leaves and roots), *S. oleraceus*, and *C. spinosum* |
| Pot experiment with different irrigation and mulching levels | *S. hispanicus* (Leaves and roots), *C. spinosum*, and *P. oleracea* (Leaves and stems) |

The nutritional profile analysis includes total fat, crude protein, ash, total dietary fiber (analyzed by official AOAC methods) and total carbohydrates by difference. The energetic value is calculated according to European Union Regulation No.1169 (2011) based on the equation: energy (kcal/100 g of dry weight) = 4 x (g crude protein + g carbohydrate) + 2 x g total dietary fiber + 9 x g of fat. Minerals (K, Na, Ca, Mg, Fe, Mn, Cu, Zn) were identified and quantified by atomic absorption spectrophotometry. The chemical profile in terms of organic acids, free sugars, tocopherols, and fatty acids were evaluated using high-performance chromatography coupled to different detectors (all the methodologies were previously optimized by the group of Centro de Investigação de Montanha- IPB):

- Organic acids by ultrafast liquid chromatography and photodiode detection (UFLC-PDA);
- Free sugars through high-performance liquid chromatography coupled to a refractive index detector (HPLC-RI);
- Tocopherols by high-performance liquid chromatography coupled to fluorescence detector (HPLC-FL);
- Fatty acids through gas chromatography coupled with a flame ionization detector (GC-FID).

The results obtained by the IPB team with the support of the UTH partner have already been published in two scientific articles in *Horticulturae*: "Domestication of Wild Edible Species: The Response of *Scolymus hispanicus* Plants to Different Fertigation Regimes" (2023, 9, 103, DOI: 10.3390/ horticulturae9010103) and "Fertilization of Pot-Grown *Cichorium spinosum* L.: How It Can Affect Plant Growth, Chemical Profile, and Bioactivities of Edible Parts?" (2022, 8, 890, DOI: 10.3390/horticulturee8100890); while another scientific article is under preparation referring to the results of the leaves of *S. hispanicus* cultivated with different levels of irrigation in the field.

In addition to the results already published, from species cultivated in Greece, the nutritional profile and chemical characterization of 6 leaves of *C. spinosum* grown in the field with crop rotation and different levels of irrigation (1st harvest), 2 leaves of wild *Sonchus asper*, 3 leaves and 3 stems of *P. oleracea* cultivated in the field with crop rotations (1st harvest) and 14 aerial parts of *C. maritimum* (1st and 2nd harvest) are under statistical analysis for future publications.

Currently, under analysis, there are:

i) 7 root samples of *S. hispanicus* grown in pots with different levels of nutrient solution and 3 root samples from plants grown in the field with different levels of irrigation (1st harvest);

ii) 6 leaves samples of *S. oleraceus* and 6 leaves and stems of *P. oleracea* grown in pots with different levels of nutrient solution grown in Cyprus. The leaves and stems of *P. oleracea* (12 samples plus 2 samples control) cultivated in Cyprus were also cultivated in Greece, which are also under analysis.

IPB is also responsible, together with partner 9 (Algeria, UM), for the determination of individual bioactive compounds (Task 4.3). Regarding the phenolic profile and bioactivity properties, the assays are complete for the following samples:

- 6 leaves of *C. spinosum* grown in the field with crop rotation and different levels of irrigation ($1^{st}$ harvest);

- 2 leaves of wild *S. asper* and 3 leaves and stems of *P. oleracea* cultivated in the field with crop rotations ($1^{st}$ harvest);

- 14 aerial parts of *C. maritimum* ($1^{st}$ and $2^{nd}$ harvest) and 7 roots of *S. hispanicus* grown in pots with different levels of nutrient solution and in the field with three different levels of irrigation ($1^{st}$ harvest);

- 6 leaves of *S. oleraceus* and 6 leaves and stems of *P. oleracea* grown in pots with different levels of nutrient solution and different levels of $NH^{4+}$.

It is expected that by the end of this year, the entire nutritional profile and chemical characterization of the species received by the IPB will be completed.

### 1.1.3 Task 4.3 Determination of individual bioactive compounds

UTH and CUT partners had already posted the samples to IPB for further biochemical analysis. The harvested plant tissues (leaves and stems) had been freeze-dried and ready for analysis.

### 1.1.4 Task 4.4 Environmental Footprint for WEPs

CUT had progressed the design of the questionaries' for collecting the relevant info for the Environmental footprint in different experiments performed by the consortium. The questionnaire involves the collection of inputs (e.g., fertilizer, energy, fuel, machinery use) and outputs for the different experimental studies, both on the field and in greenhouse conditions for different WEPs. CUT received relevant info from UTH for several experiments. One manuscript has already been submitted for publication (Vassilis D. Litskas, Antonios Chrysargyris, Nikolaos Tzortzakis, Menelaos C.

Stavrinides, Spyridon A. Petropoulos. 2023. Can the commercial cultivation of wild edible species contribute to sustainable food production? A case study of golden thistle (*Scolymus hispanicus* L.). *Journal of Cleaner Production*)