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SEA FENNEL FOR MED

Deliverable title	D1.10 3rd year (progress) Report
Deliverable Lead:	UNIVPM
Related Work Package:	WP1 - Project coordination and overall management
Related Task:	Task 1.3. Communication with PRIMA call secretariat and the funding Agencies
Author(s)	Lucia Aquilanti
Dissemination level	PU
Due Submission Date:	29.05.2025
Actual submission:	29.05.2025
Start date of project	**30.05.2022**
Duration	36 months
Summary of Deliverable D1.10 – Third Year Progress Report	The third and final year of SEAFENNEL4MED marked the consolidation of three years of research, innovation, and collaboration into a set of tangible achievements with lasting impact for Mediterranean agriculture and food systems. The consortium successfully closed the loop from biodiversity conservation to cultivation, product innovation, socio-economic validation, and sustainability assessment. In biodiversity research (WP3), sea fennel populations from across the Mediterranean were fully sampled, characterized, and compared. Morphological, chemical, and genetic analyses confirmed clear distinctions between Mediterranean and Atlantic groups, while also revealing the richness of local ecotypes shaped by coastal habitats and environmental stress. This work created a valuable germplasm resource for future farming and breeding. In cultivation trials (WP4), sustainable organic practices proved successful, with biostimulants significantly enhancing root growth, biomass, and nutritional quality. Field results in Italy, Croatia, Türkiye, and Tunisia demonstrated the adaptability of sea fennel under challenging conditions and produced practical guidelines for organic production. The project also made impressive strides in food innovation (WP5), with pilot-scale prototypes ranging from fermented kimchi, pickled fennel, and jams to beer, pasta, noodles, and snacks. Sensory evaluations confirmed consumer interest, especially for products that blend tradition with modern appeal. In parallel, by-product valorization (WP6) yielded extracts, essential oils, and encapsulated ingredients with antioxidant, antimicrobial, and even photoprotective properties, paving the way for applications in foods, nutraceuticals, cosmetics, and animal feed. On the socio-economic side (WP7), consumer research and business model evaluations highlighted both the opportunities and challenges of introducing sea fennel to broader markets.

	Effective strategies—such as show cooking, free tastings, engaging packaging, and strong supply chains—were identified as key to boosting awareness and acceptance. Meanwhile, environmental assessments (WP8) confirmed the low footprint of organic sea fennel cultivation and processing, with recommendations to further improve sustainability through renewable energy, eco-packaging, and efficient resource use. Beyond science, the third year was also rich in dissemination and outreach: the consortium published over 20 open-access papers, contributed to conferences, produced videos and newsletters, and even released a sea fennel cookbook. These efforts ensure that results will live on beyond the project.

Versioning and Contribution History

Version	Date	Modified by	Modification reason.
v1.0	29/05/2025	Lucia Aquilanti	First version

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1. List of participants

Participant No *	PI name	Organisation	Country
1 (**Coordinator**)	Lucia Aquilanti	UNIVERSITÀ POLITECNICA DELLE MARCHE (acronym: UNIVPM)	Italy
2	Antonio Raffo	CONSIGLIO PER LA RICERCA IN AGRICOLTURA E L'ANALISI DELL'ECONOMIA AGRARIA -CENTRO DI RICERCA ALIMENTI E NUTRIZIONE (acronym: CREA-AN)	Italy
3	Luca Galeazzi	RINCI Srl (acronym: RINCI)	Italy
4	Ivana Generalić Mekinić	UNIVERSITY OF SPLIT (acronym: UNIST)	Croatia
5	Branimir Urlić	INSTITUTE FOR ADRIATIC CROPS AND KARST RECLAMATION (acronym: IACKR)	Croatia
6	Christian Magné	UNIVERSITÉ DE BRETAGNE OCCIDENTALE (acronym: UNIBRE)	France
7	Abdelhamid Khaldi	INSTITUT NATIONAL DE RECHERCHE EN GÉNIE RURAL, EAUX ET FORĚTS (acronym: INRGREF)	Tunisia

8	Özlem Karahan Uysal	UNIVERSITY OF EGE (acronym: UNIEGE)	Türkiye

2. Explanation of the work carried out by the beneficiaries and overview of the progresses achieved in the monitoring period (from 30.05.2022 to 29.05.2023)

WP1 Project coordination and overall management

OBJECTIVES

The objective of WP1 was to ensure optimal co-ordination and management of SEAFENNEL4MED, as well as collaboration among Partners, with the final aim of maximising progress of knowledge and innovation outputs.

TASKS AND STATUS

Task 1.1. Organization of general Project meetings **COMPLETED**
Task 1.2. Project coordination, management, supervision, and quality control **COMPLETED**
Task 1.3. Communication with PRIMA call secretariat and the funding Agencies **COMPLETED**
Task 1.4 Preparation of mid-term and final reports **COMPLETED**

DELIVERABLES

	Deliverable	Status	Comment
WP 1	D1.1 General Project meeting n.1 (Kick off meeting) Report	Delivered	
	D1.2 Quality Assurance Plan	Delivered	
	D1.3 General Project meeting n.2 Report	Delivered	
	D1.4 1st year (progress) Report	Delivered	
	D1.5 General Project meeting n.3 Report	Delivered	
	D1.6 General Project meeting n.4 Report	Delivered	
	D1.7 2nd year (progress) Report	Delivered	
	D1.8 General Project meeting n.5 Report	Delivered	
	D1.9 General Project meeting n.6 (Final workshop)	Delivered	
	D1.10 3rd year (final) Report	In progress	

BRIEF DESCRIPTION OF WORK DONE IN THE REPORTING PERIOD

- **The Coordinator drafted the 2nd year Report** with the contributions of all Partners (see D1.7).
- **The Coordinator organized and scheduled the General meeting N5**, held in presence at UNIVERSITE DE BRETAGNE OCCIDENTALE (address 6, Avenue Victor Le Gorgeu, Brest, France) on December 13, 2024 with the participation of all the partners (see D1.8).
- **The Coordinator organized and scheduled the final general meeting N6,** which was held on 10th April 2025 at 9:30 AM. The Principal Investigators (PIs) and research team members of the SEAFENNEL4MED Consortium met at the University of Split (Split, Croatia).
- The Coordinator reviewed the **periodic reports** prepared by the WP leaders to verify their consistency with the project tasks, in view of their assembling and transmitting to PRIMA-IS and the funding agencies on behalf of the Consortium.

WP2 Multi-actor internal and external communication and technology transfer

OBJECTIVES

The objectives of WP2 are to ensure participation of stakeholders, as well as dissemination and exploitation of SEAFENNEL4MED outputs. A distinction can be made between objectives of internal and external communication/technology transfer. Objectives of internal communication (within the Project) are: i) communicate project results within the Consortium so that all partners are updated timely on the knowledge generated by all WPs and tasks; ii) coordinate the use of participatory approaches to utilise stakeholder and research knowledge and innovation to prioritise research activities within the project. Objectives of external communication (to Stakeholders) are: i) use participatory approaches to utilise stakeholder and research knowledge to prioritise dissemination and training activities; ii) communicate and disseminate project outputs to stakeholders and create a dairy farm-level observatory and knowledge exchange network; iii) build capacity through technology transfer to ensure that the industry can effectively use the outputs from the project. iv) create a roadmap for future implementation and exploitation of project outputs at dairy farm, on regional and Mediterranean scales and for further research. As a whole these actions aim to promote participation and effectively translate the Project outputs to meet the needs of the Mediterranean small farms and food industries and so that the results are disseminated in a way that can be promptly implemented and exploited by the following stakeholder groups: farmers, crop producers, "wanna-be" farmers and entrepreneurs (including women and young people), food industries, food operators, associations and business incubators, retail and consumers, general public; non governative organisations, scientists, policy makers, etc..

TASKS AND STATUS

Tasks:

Task 2.1 Start-up activities **COMPLETED**
Task 2.2 Establishment of a stakeholder-platform and knowledge exchange network **COMPLETED**
Task 2.3 Installation and continuous up-date of SEAFENNEL4MED website **COMPLETED**
Task 2.4 Production of dissemination materials **COMPLETED**
Task 2.5 Documentation of scientific results **COMPLETED**
Task 2.6 Demonstration activities **COMPLETED**

DELIVERABLES DELIVERED

	Deliverable	Status	Comment
WP 2	D2.1 Project logo and communication templates	Delivered	
	D2.2 Public SEAFENNEL4MED website	Delivered	
	D2.3 SEAFENNEL4MED intranet	Delivered	
	D2.4 Press release at Project launch for the wide public	Delivered	
	D2.5 Establishment of a stakeholder platform for knowledge exchange network	Delivered	
	D2.6 SEAFENNEL4MED Data Management Plan	Delivered	
	D2.7 Demonstration activity 1: sea fennel harvesting campaign involving students	Delivered	
	D2.8 Demonstration activity 2: presentation of sea fennel-based recipe book	Delivered	
	D2.9 Collection of 12 newsletters	Delivered	
	D2.10 At least 2 articles in divulgative journals/magazines	Delivered	
	D2.11 At least 4 open access papers published in international peer-reviewed journals	Delivered	
	D2.12 At least 4 conference proceedings	Delivered	
	D2.13 At least 1 downloadable Project leaflet	Delivered	
	D2.14 At least 1 video on new sustainable organic sea fennel cropping systems and applications of the new crops for production of food/food ingredients/nutraceuticals	Delivered	
	D2.15 Press release at Final Workshop	In progress	
	D2.16 Attendance at almost 1 event/exhibition aimed at promoting Mediterranean agri-food products	Delivered	

BRIEF DESCRIPTION OF WORK DONE IN THE REPORTING PERIOD

Regarding **D2.8**, The short version of sea fennel cookbook was published via official website seafennel4med.com and the full version is planned to be printed through the editorial office.
Regarding **D2.9**, to date, **12 newsletters** have already been sent to the SEAFENNEL4MED Stakeholder platform (one every 3 months, as planned; 1 newsletter in the reporting period).
Regarding **D2.10,** to date, **11 articles** have been published in journals/magazines destined to professionals in the field of crop and/or food production and/or to the open public (see the following lists of articles, grouped by Consortium partner).
Regarding **D2.11** to date, **22 open access papers** (grouped by Consortium partner) to date published in international peer-reviewed journals with key data collected throughout the project SEAFENNEL4MED.

	UNIVPM	CREA-AN	UNIST & IACKR	UNIBRE	INGREF	UNIEGE	TOTAL
Press releases	1		3		5	2	**11**
Publication in divulgation journal/magazine	7		4				**11**
Open access publication in international peer-reviewed journal	7	1	11	2	1		**22**
Contribution at national/international conferences	9	3	12			4	**28**
Attended event/exhibition	2		7		1		**10**
Video	3						**3**
Workshop	1	1	1	1	1	1	**6**
Interview			2		2		**4**

WP3 Characterization of Mediterranean sea fennel ecotypes

OBJECTIVES

The objective of WP3 is the characterization of Mediterranean sea fennel populations based on qualitative and quantitative morphological, chemical, and genetic traits, identification and further selection of different ecotypes based on traits of interest for the project purposes.

TASKS AND STATUS

Task 3.1 (RES). Sampling and morphological characterization of spontaneously growing sea fennel populations **COMPLETED**
Task 3.2 (RES) Chemical analysis of dried sea fennel aerial parts/seeds **COMPLETED**
Task 3.3 (RES). Molecular analysis of sea fennel aerial parts **COMPLETED**
Task 3.4 (RES) Elaboration of morphological, chemical, and genetic data for potential identification of different ecotypes **ON-GOING**

DELIVERABLES

	Deliverable	Status	Comment
WP 3	D3.1 Dried sea fennel biomass (leaves, stems, flowers) from at least 5 Mediterranean spontaneous sea fennel populations	Delivered	
	D3.2 Catalogued and stored seeds (> 2500) from at least 5 Mediterranean sea fennel populations	Delivered	
	D3.3 Selected Mediterranean sea fennel germplasm (at least 1 ecotype) for cultivation	Delivered	
	D3.4 Report with elaborated data overall collected within WP3	Delayed	Waiting for NGS sequencing results

BRIEF DESCRIPTION OF WORK DONE IN THE REPORTING PERIOD

Sea fennel populations were studied across Tunisia, Italy, Türkiye, France, and Croatia, focusing on:

- Morphological variation – influenced by coastal environment (cliffs, volcanic rock, beaches) and substrate (granite, limestone, dolomite).
- Genetic diversity – shaped by geographical isolation and environmental stressors (temperature, salinity, soil).
- Chemical composition – variation in bioactives (phenolics, essential oils, vitamins, fatty acids) linked to genotype, habitat, climate, and biotic/abiotic stresses.

Preliminary statistical evaluation of genetic and morphometric data suggested clear distinction between Mediterranean and Atlantic populations with further distinctions among populations from specific geographic location within the Mediterranean basin.

WP4 Sustainable production of organic sea fennel crop

OBJECTIVES

Starting from previous experiences of the applicants from national and international projects, this WP is aimed to develop protocols for sustainable production **of organic sea fennel crops** within the cooperation area, **in agreement with the zero-pollution ambition for a toxic-free environment.** This objective will be reached by carrying out three-year-cultivation trials in demo and open field **with no chemical inputs according to the principles of organic cropping**.

TASKS AND STATUS

Task 4.1 (R). Sustainable production of sea fennel crop in demo field (month 6 – 24). **COMPLETED**
Task 4.2 (D). Sustainable production of sea fennel crop in open field (month 12 – 35). **COMPLETED**
Task 4.3. (D) Analysis of the new sea fennel crops (month 6 – 35). **COMPLETED**
Task 4.4. (D) Statistical analysis (month 18 – 35). **ON-GOING**

DELIVERABLES

	Deliverable	Status	Comment
WP 4	D4.1 Experimental plan design of cultivation trials	Delivered	
	D4.2 Fresh biomass (edible aerial parts) from the new organic sea fennel crops	Delivered	
	D4.3 By-products (old leaves and fibrous stems) from the new organic sea fennel crops	Delivered	
	D4.4 Recommendations and guidelines on sustainable production of new organic sea fennel crops in the Mediterranean basin	Delivered	
	D4.5 Report with the elaborated data overall collected within WP4	In progress	

BRIEF DESCRIPTION OF WORK DONE IN THE REPORTING PERIOD

Biostimulant effect on sea fennel spontaneous ecotypes was studied and the variables were measured in controlled environments such as:

1. Incubator
2. Greenhouse
3. Open field

Biostimulant increased:
Root weight (+85%), diameter (+25%), and length (+128%) in the incubator
Root weight (+66%), diameter (+25%), and length (+75%) in the greenhouse
In the open field, BS boosted biomass (+93%) and SPAD values (+44%), indicating a more favourable nutritional status.

Fresh biomass harvested from new organic sea fennel crops during the 2023 and 2024 growing seasons showed promising results, especially with the use of biological fertilizers. Analysis of the edible aerial parts from three different sea fennel populations revealed a 19% increase in average biomass in plots treated with a biostimulant. These findings underscore the effectiveness of biostimulant application in enhancing yield and sustainability in sea fennel cultivation.

WP5 Exploitation of sea fennel edible aerial parts for manufacturing of innovative sea fennel-based foods

OBJECTIVES

The main objective of this WP is the development of sustainable innovative foods by exploiting the new sustainable sea fennel crops. More specifically several innovative sea fennel-based food products (shelf-stable fermented and unfermented preserves) will be developed – first at laboratory scale and subsequently at pilot-scale - using edible aerial parts (young leaves and sprouts) of the new organic sea fennel crops produced in WP4. Hence, the pilot-scale prototypes will be analysed immediately after production and during their shelf life (up to 6 months) for their chemical, gross compositional, functional, microbiological, and sensory traits as well as consumer perception through panel tests carried out by trained assessors.

TASKS AND STATUS

Task 5.1 (R) Laboratory scale manufacturing of fermented shelf-stable sea-fennel preserves at laboratory scale (month 1 – 20). **COMPLETED**
Task 5.2 (R) Laboratory-scale manufacturing of unfermented shelf-stable preserves (month 1 – 20). **COMPLETED**
Task 5.3 Pilot-scale manufacturing of fermented and unfermented shelf-stable sea-fennel preserves (D) (month 20 – 35). **COMPLETED**

DELIVERABLES DELIVERED IN THE REPORTING PERIOD

	Deliverable	Status	Comment
WP 5	D5.1 At least 2 pilot scale prototypes of sea fennel-based fermented shelf stable preserves	Delivered	
	D5.2 At least 2 pilot scale prototypes of sea fennel-based unfermented shelf stable preserves	Delivered	
	D5.3 Recommendations and guidelines for manufacturing of new sea fennel-based fermented shelf-stable preserves at pilot scale	Delivered	
	D5.4 Recommendations and guidelines for manufacturing of new sea fennel-based unfermented shelf-stable preserves at pilot scale	Delivered	
	D5.5 Report with elaborated data overall collected within WP5	Delivered	

BRIEF DESCRIPTION OF WORK DONE IN THE REPORTING PERIOD

The following prototypes of new fermented and unfermented food products were manufactured at laboratory and pilot scale using sea fennel as a key ingredient:

SEA FENNEL-BASED FERMENTED SHELF STABLE PRESERVES

ITALIAN PROTOTYPES

1. Sea fennel-based BEER
2. Kimchi-like preserve
3. Fermented sea fennel sprouts in vinegar

SEA FENNEL-BASED UNFERMENTED SHELF STABLE PRESERVES

CROATIAN PROTOTYPES

1. Dried spices formulated with blends of sea fennel and other Mediterranean aromatic herbs

2. Aromatisation of plant-oils by dry sea fennel powder
3. Dalmatian paté
4. Pickled sea fennel

TURKISH PROTOTYPES

1. Snacks obtained by extrusion starting from (a) doughs made with sea fennel and other ingredients and (b) stuffed with sea fennel cream
2. Spiced noodles with sea fennel
3. Handmade pasta incorporated with sea fennel powder

TUNISIAN PROTOTYPES

1. Chili puree (Harissa)
2. Orange jam
3. Snack

WP6 Valorisation of sea fennel crop by-products for production of functional food ingredients/nutraceuticals/soil amendments

OBJECTIVES

The main objective of this WP is to valorise by-products (damaged or discarded aerial parts, seeds, flowers, autumn mowing) of the new crops for the formulation of functional food ingredients and nutraceuticals, given the acknowledged high content of no edible aerial parts in extractable bioactive compounds (carotenoids, tocopherols, phenolic compounds, vitamin C).

TASKS AND STATUS

Task 6.1 (R&D). Preparation and analysis of extracts from see fennel crop by-products (month 12 – 18). **COMPLETED**
Task 6.2 (R&D) Exploitation of the extracts as functional food ingredients and nutraceuticals (month 18 – 24). **COMPLETED**
Task 6.3 (R&D) Composting of residual sea fennel biomass (month 24 – 35). **COMPLETED**
New Task 6.4 (R&D) Production, analysis, and exploitation of essential oils (EOs) from sea fennel as food ingredients with antimicrobial activity/beneficial properties applied to the manufacture of Mediterranean foods (e.g.: cheeses, fermented sausages, ect). (month 24 – 35) **COMPLETED**

DELIVERABLES

	Deliverable	Status	Comment
WP 6	D6.1 At least 1 crude extract with antioxidant, antimicrobial and/or health-beneficial activity	Delivered	
	D6.2 Recommendations and guidelines for preparation of crude extracts with antioxidant, antimicrobial and/or health-beneficial activity from sea fennel	Delivered	
	D6.3 At least 1 soil amendment produced by composting of sea fennel crop residual biomass	Delivered	
	D6.4 Recommendations and guidelines for preparation of soil amendment by composting of sea fennel residual biomass	Delivered	
	D6.5 Report with elaborated data overall collected within WP6	In progress	Waiting for the results of accelerated shelf life analysis

BRIEF DESCRIPTION OF WORK DONE (detailed for each Task and Partner)

ITALY (UNIVPM, CREA-AN, RINCI)

- Preparation and analysis of extracts from sea fennel by product – 2 types of extracts were successfully studied (D6.1)
- Exploitation of the extracts as functional food ingredients – the best formulation of edible capsules was selected and the microbiological analysis are ongoing (D6.5)
- Exploitation of extracts as nutraceuticals – spray-dried sea fennel aqueous extract can be potentially used in the formulation of nutraceuticals (D6.5).

CROATIA (UNIST, IACKR)

- Preparation and analysis of extracts from sea fennel by product – novel and conventional extraction methods were compared (D6.1).
- Preparation and analysis of essential oils from sea fennel crop by-product - The MHD method resulted in a higher yield of sabinene and limonene in the essential oil, and also led to a higher phenolic content in the wastewater, particularly an increased concentration of chlorogenic acid (D6.5).

Addition of Eos to different vegetable oils to prevent their degradation and as flavor component - the EO addition to the lipid medium had negative effect on its oxidative stability (D6.5).

- Soil amendment produced by composting of sea fennel crop residual biomass - it can be recommended to make mix with peat or peat based substrates to lower pH. Additional nitrogen input should be done (D6.3).

TUNISIA (INGREF)

- Use of sea fennel by products in animal feed formulas based on sea fennel or mixed with other products – the experiment was held on 5 rabbits and 2 different formulations were tested (D6.5).
- Use of sea fennel aqueous extracts for animal nutrition and evaluation of its effect on meat quality - this part of the study was not conducted due to the limited availability of plant material, which prevented the preparation of sufficient quantities of aqueous extract.

Use of sea fennel by-products' essential oil in manufacturing jelly candy - the addition of low doses of essential oil (EO 0.05) may enhance consumer satisfaction, while stronger doses may be off-putting (D6.5).

TURKIYE (UNIEGE)

- Evaluation of health-beneficial traits of a standardized crude extract - sea fennel extract could be effectively utilized in sunscreen formulations, moisturizers, or other dermatocosmetic products designed to protect the skin from harmful solar radiation (D6.5).
- Encapsulation of sea fennel extract - sea fennel (SF) extract-loaded zein nanoparticles were successfully prepared using the antisolvent precipitation method at three different Zein/SF mass ratios (D6.5).

FRANCE (UNIBRE)

- NMR analysis of aqueous extracts from sea fennel leaves - the neuroprotective property of sea fennel extract was evaluated (D6.5).

WP7 Demonstration of socio-economic benefits of the proposed innovations

OBJECTIVES

The aim of the WP is to provide an evaluation of the socio-economic impact of sea fennel sustainable farming along the supply chain (farm to fork) in a context of sustainable production approach.

TASKS AND STATUS

Task 7.1 (D) Identification of drivers and lock-ins for the development of sea-fennel products (month 1– 12). **COMPLETED**
Task 7.2 (D) Assessment of consumer attitudes and acceptance of sea fennel products (month 13–30). **COMPLETED**
Task 7.3 (D) Business model evaluation (month 24 – 35). **COMPLETED**

DELIVERABLES DELIVERED

	Deliverable	Status	Comment
WP 7	D7.1 Lock-ins and drivers for the development of sea-fennel products	Delivered	
	D7.2 Report on consumer research on the attitudes and acceptance of sea-fennel products	Delivered	
	D7.3 Report on Business Model Evaluation	Delivered	

BRIEF DESCRIPTION OF WORK DONE

Effective distribution through specialty food stores, online platforms, and restaurants, combined with marketing strategies such as show cooking events, free tastings, informative packaging, and dedicated websites, is key to increasing product visibility and consumer engagement. To ensure market success, the development of the sea fennel sector must include consumer education, reliable supply chain partnerships, and thorough laboratory testing. Addressing low consumer awareness through strategic marketing and stakeholder collaboration is essential for unlocking the full potential of sea fennel in both food and nutraceutical markets.

WP8 Demonstration of environmental impacts and sustainability of the proposed innovations

OBJECTIVES

The data needed for the environmental sustainability assessment will be collected in close cooperation with all Partners, based on tasks 1.2 and 2.2. The main objective of this WP is the calculation of sustainability indices through the Life Cycle Assessment (LCA) method as defined by the ISO 14040 and ISO 14044 standards, using updated SimaPro software application and associated LCA database. Specific PEF-PCR documents will be considered if available. Different indices will be evaluated for the entire sea fennel supply chain including carbon footprint and water footprint.

TASKS AND STATUS

Task 8.1 (D) Sustainability assessment of sea fennel open field production (month 1-35). **COMPLETED**
Task 8.2 (D Sustainability assessment of new sea fennel-based foods/food ingredients (month 1-35). **COMPLETED**
Task 8.3 (D) Sustainability assessment of functional extracts for food ingredients/nutraceuticals (month 1- 35). **COMPLETED**

DELIVERABLES DELIVERED

	Deliverable	Status	Comment
WP 8	D8.1 Report on sustainability assessment of fresh sea fennel carried out by LCA from data collected thanks to WP4 activities	Delivered	
	D8.2 Report on sustainability assessment of processed sea fennel products carried out by LCA from data collected thanks to WP5 activities	Delivered	
	D8.3 Report on sustainability assessment of sea fennel residues extracts from data collected thanks to WP6 activities	Delivered	

BRIEF DESCRIPTION OF WORK DONE

The potential environmental impacts of sea fennel-based macrocapsules at lab scale were assessed. As expected, the main contributor to the impacts was energy consumption, which underscores the importance of focusing on energy efficiency and material optimization to reduce the environmental footprint of sea fennel-based macrocapsule production at commercial scale. Future research should explore the feasibility of integrating renewable energy sources, optimizing solvent recovery, and investigating alternative materials or methods with lower environmental impacts. Additionally, a comparative life cycle assessment of different production scenarios, including varying scales and process technologies, could provide valuable insights for guiding manufacturers toward more sustainable practices.

2. Update of the plan for exploitation and dissemination of result

The plan for exploitation and dissemination of results as described in the proposal submitted was not updated.

3. Update of the Data Management Plan (DMP)

No updates

4. Follow-up of recommendations and comments from previous review(s)

Not applicable

5. Deviations from original proposal

A few deviations from the original proposal have been foreseen; they are described as follows:

- For **WP3**, a minimum number of 4 sites per country (Italy, Croatia, France, Tunisia, and Türkiye) was set for the sampling of wild sea fennel populations, thus leading to the sampling of at least 20 populations across the Mediterranean. In the original proposal selected by PRIMA for funding, a significantly lower number of Mediterranean sea fennel populations were set to be sampled (> 6).

- For **WP4**, bio-stimulant consisting of selected bacterial strains known to improve soil quality and health as well as promoting crop yields was assayed in place of blends of effective microorganisms. Moreover, in addition to the application of the biofertilizer at the demo filed, the same bio-stimulant was also assayed for the bacterization of seeds, to evaluate the impact of the beneficial microorganisms inoculated on growth parameters of sea fennel roots.

- For **WP6**, in task T6.1 "Preparation and analysis of extracts from see fennel crop by-products (month 12 – 18)" the extraction and analysis of essential oils (EOs) was included (this activity was not foreseen in the original proposal). Accordingly, the exploitation of EOs for manufacturing of innovative foods/food ingredients/nutraceuticals has been added in Task 6.2.
This change, agreed by all the Consortium partners, was based on the great interest by the Scientific community and food/pharmaceutical industry toward essential oils and their potential applications for manufacturing of food ingredients/nutraceuticals/etc.

SEAFENNEL4MED Project Coordinator
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