



Deliverable title	D1.4 1st 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:	30.06.2023
Actual submission:	30.06.2023
Start date of project	30.05.2022
Duration	36 months
Summary of Deliverable D1.4 – First Year Progress Report	The project has successfully built its governance and communication framework, established expert groups and stakeholder platforms across all partner countries, and launched a vibrant online presence with a website, intranet, newsletters, and press outreach that already raised awareness about sea fennel as a crop of the future. On the scientific front, major progress has been made in characterizing Mediterranean sea fennel diversity. Populations were sampled in Italy, Croatia, France, Tunisia, and Türkiye, with seeds catalogued, stored in seed banks, and genetic and morphological analyses underway. This effort has already identified promising ecotypes for cultivation trials. Parallel to this, experimental fields have been prepared in four countries, where different ecotypes are being tested under Mediterranean conditions using organic and sustainable practices. While germination rates presented some challenges, adjustments have been made to ensure continuity of the trials. The project has also taken its first steps in innovation. Laboratory prototypes of new food products - such as kimchi-like preserves, vinegar-based pickles, pesto, dried spice blends, and even orange jam with sea fennel - have been developed and tested for quality, safety, and sensory traits. Tunisian partners experimented with harissa enriched with sea fennel, while Turkish teams began producing noodles and snacks incorporating fennel powder. At the same time, research on by-products has shown promising bioactive compounds and essential oils with antioxidant and antimicrobial properties, paving the way for applications in foods, nutraceuticals, and even animal feed. Beyond technical outcomes, the first year has also focused on socio-economic and environmental dimensions. A Delphi survey has been launched to capture consumer and stakeholder perspectives, while preparations for Life Cycle Assessments are ongoing to measure the

	sustainability of both cultivation and food innovations. These steps will ensure that the project's innovations are viable, desirable, and environmentally sound. Overall, SEAFENNEL4MED's first year demonstrates a lively and collaborative partnership. With strong foundations in science, communication, and stakeholder engagement, the project is steadily shaping sea fennel into a sustainable and innovative crop that can enrich Mediterranean diets, diversify farming systems, and support local economies.
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Versioning and Contribution History

Version	Date	Modified by	Modification reason.
v1.0	15/05/2023	Lucia Aquilanti	First version
V2.0	30/06/2023	Lucia Aquilanti	Comments after peer review process

Table of contents

1. List of participants	2
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)	3

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 FORÊTS (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 IN THE REPORTING PERIOD

Task 1.1. Organization of general Project meetings **ON-GOING**

Task 1.2. Project coordination, management, supervision, and quality control **ON-GOING**

Task 1.3. Communication with PRIMA call secretariat and the funding Agencies **ON-GOING**

Task 1.4. Preparation of mid-term and final reports **ON-GOING**

DELIVERABLES DELIVERED IN THE REPORTING PERIOD

D1.1 General Project meeting n.1 (Kick off meeting) Report (month 2) **DELIVERED ON 17.06. 2022**

D1.2 Quality Assurance Plan (month 3). **DELIVERED ON 16.06.2022**

D1.3 General Project meeting n.2 Report. **DELIVERED ON 30.05.2023**

D1.4 1st year (progress) Report **DELIVERED ON 30.05.2023**

BRIEF DESCRIPTION OF WORK DONE IN THE REPORTING PERIOD

- **The Coordinator organized and scheduled the Kick off meeting**, which was held in Italy at Botanic garden "Selva di Gallignano" Agugliano (AN) - Dipartimento di Scienze Agrarie Alimentari e Ambientali (D3A), Università Politecnica delle Marche (UNIVPM), via Brece Bianche 60131 Ancona, Italy on with the participation of all partners. All the details about the meeting are reported in the Deliverable 1.1.
- The project Coordinator was ensuring the role of Project supervision with the help of the Steering Committee and the Project Management Committee. General coordination of the Project includes monitoring of the overall project progress and management of communication and knowledge transfer between participants. The quality management system was based on current practices applied at PARTY 1 institution, e.g. University and standard operating procedures applied in other EU funded projects.

SEAFENNEL4MED Project Management Committee				
P1	UNIVPM	ITALY	Prof. Lucia Aquilanti (PI of UNIVPM) and Project Coordinator	email: l.aquilanti@univpm.it phone: +39 071 2204959 mobile phone: +39 340 3380366
P2	CREA-AN	ITALY	Dr Antonio Raffo (PI of CREA-AN)	email: antonio.raffo@crea.gov.it mobile phone: +39 347 9906198
P3	RINCI	ITALY	Dr Luca Galeazzi (PI of RINCI)	email: l.galeazzi@rinci.it mobile phone: +39 3289325821
P4	UNIST	CROATIA	Prof. Ivana Generalić Mekinić (PI of UNIST)	email: ivana.generalic-mekinic@ktf-split.hr mobile phone: +385 95 9131939..... Telephone: +385 21 329 458
P5	IACKR	CROATIA	Dr Branimir Urić (PI of IACKR)	email: branimir.uric@krs.hr mobile phone: + 385 98 896 362..... Telephone: +385 21 434 478.....
P6	UNIBRE	FRANCE	Prof. Christian Magné (PI of UNIBRE)	email: christian.magne@univ-brest.fr mobile phone: +33 673 68 62 88 Telephone: +33 298 01 72 25

P7	INRGREF	TUNISIA	Prof. Abdelhamid Khaldi (PI of INRGREF)	email: khalditn@yahoo.fr mobile phone: +216 97425066 Telephone: +21671709033.....
P8	UNIEGE	TÜRKİYE	Prof. Özlem Karahan Uysal (PI of UNIEGE)	email: ouysal4@gmail.com mobile phone: + 90 533 545 02 23 Telephone: + 90 232 311 29 72

- **Members of the National Expert Groups**, each comprising at least 3 members for each country, were nominated for all countries, with a Chairman who is a representative from the scientific partners and at least one expert from public bodies and one from industry. National Expert groups were acting as advisory bodies. Nominations for members of the national Expert Groups were proposed by the SEAFENNEL4MED participants; the Steering Committee evaluated and approved them. The main tasks of nominated members are: (i) to be an active linkage between the Steering Committee and the main related stakeholders (academia, ministries, industries, local authorities, etc.); (ii) to have an advisory role and assist Steering Committee for the current priorities for the project implementation; (iii) to consult the Steering Committee on issues related to the evaluation of project results.

The composition of each National Expert group is detailed as follows:

SEAFENNEL4MED National Expert groups				
ITALY	1. Academy	Raffaele Zanolì	Full Professor Agri.food economics UNIVPM	r.zanolì@univpm.it
	2. Industry/Farm	Ettore Drenaggi	Expert sea fennel crop production at RINCI	etdrenaggi@gmail.com
	3. Public institution	Antonio Raffo	CREA-AN	antonio.raffo@crea.gov.it mailto: andrea.mosconi@marche.camcom.it
CROATIA	1. Academy	Maja Jukić Špika	IACKR	Maja.Jukic.Spika@krs.hr
	2. Industry/Farm	Ana Marija Dropulić	ZRNO SOLI (food industry)	anamarija.dropulic@gmail.com
	1. Public institution	Martin Bučan	Split-Dalmatia county	martin.bucan@dalmacija.hr
FRANCE	1. Academy	Christian Magne	UNIBRE	christian.magne@univ-brest.fr
	2. Industry/Farm	Yves Bleunven	ABYCEAN (sea fennel crop producer)	yves.bleunven@abycean.fr
	3. Industry/Farm	Bue Manu	Groupement des Agriculteurs Biologiques du Finistère (GAB29) (ORGANIC CROP PRODUCER ASSOCIATION)	m.bue@agrobio-bretagne.org
	4. Industry/Farm	Martinaud Estelle	Ferme de la mignonne (ORGANIC CROP PRODUCER)	estelle.martinaud@gmail.com
TUNISIA	1. Academy	Abdelhamid Khaldi	Full Professor Forestry	khalditn@yahoo.fr
	2. Industry/Farm	Lassaad Ben Slimane	Food industrial	benslimane@yahoo.fr
	3. Public institution	Habib Kachouri	Assistant Director (Regie d'Exploitation Forestière)	kachourih22@yahoo.com
TÜRKİYE	1. Academy	Funda Turan	Full Professor at Iskenderun Technical University	funda.turan@iste.edu.tr
	2. Industry/Farm	Şerife Yılmaz	Head of Antalya Gaziosmanpaşa Limited Liability Women's Initiative Production and Business Cooperative	gazipasakadingirisimi@gmail.com
	3. Public institution	Ayfer Tan	Ministry of Agriculture, Aegean Agricultural Research Institute	ayfer_tan@yahoo.com
	4. Industry/Farm		LimonLimon Co., Mersin	limonilimon33@gmail.com
	5.R&D Company	Oğuz Bayraktar	Natco Natural Ltd. Co	info@natconatural.com

- The Coordinator organized and scheduled the **General meeting N2**, held via teleconference (using TEAMS platform) on 11st May 2023 with the participation of all the partners. All the details about the meeting are reported in the Deliverable 1.3.
- 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.
- The Coordinator drafted the 1st year Report with the contributions of all Partners.

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, "wannabe" 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 IN THE REPORTING PERIOD

Tasks:

Task 2.1 Start-up activities **ON-GOING**

Task 2.2 Establishment of a stakeholder-platform and knowledge exchange network **ON-GOING**

Task 2.3 Installation and continuous up-date of SEAFENNEL4MED website **ON-GOING**

Task 2.4 Production of dissemination materials **ON-GOING**

Task 2.5 Documentation of scientific results **ON-GOING**

Task 2.6 Demonstration activities **NOT STARTED**

DELIVERABLES DELIVERED IN THE REPORTING PERIOD

D2.1 Project logo and communication templates (month 1); **DELIVERED ON 30.06.2022**

D2.2 Public SEAFENNEL4MED website (month 2); **DELIVERED ON 30.07.2022**

D2.3 SEAFENNEL4MED intranet (month 2); **DELIVERED ON 16.07.2022**

D2.4 Press release at Project launch for the wide public (month 3); **DELIVERED ON 30.06.2022**

D2.5 Establishment of a stakeholder platform for knowledge exchange network (month 6); **DELIVERED ON 30.11.2022**

D2.6 SEAFENNEL4MED Data Management Plan (month 6); **DELIVERED ON 30.11.2022**

BRIEF DESCRIPTION OF WORK DONE IN THE REPORTING PERIOD

As detailed in the Communication, Dissemination and Exploitation Plan described in Section 2.2 of the proposal, different tools were adopted to ensure that the outputs of the Project are communicated to the public, the relevant stakeholders, etc.

The following achievements can be reported for the reporting period.

- A visual identity defining the Project's graphic character, logo, fonts, colours was designed including compulsory logos that must be used by all Partners for communication about SEAFENNEL4MED activities. For details on Project logo, fonts and communication templates see D2.1 Project Logo and communication templates.
- A Project website for external communication and dissemination was established by the PARTY 1 at a suitable server to:
 - Present information on Project structure and outputs;

II. Allow interaction between Partners and Stakeholders;

III. Act as the Project website for SEAFENNEL4MED.

The SEAFENNEL4MED website (<https://seafennel4med.com/>) currently contains:

- Project objectives, list of Partners (including contact details and web site links) and Project description;
- Press releases and latest news (these latter including also information on Project events)
- List of scientific publications, presentations from conferences and proceedings;
- List of delivered deliverables with regular update on results-outputs of the Project including recommendations, guidelines, and technical notes, from the Project activities.

For more details on the Project website see D2.2 Public SEAFENNEL4MED website.

- Two systems were implemented for internal communication between Consortium partners and sharing of protocols/procedures/results/documents, being SharePoint as interoperable system and Google Drive as consultation system, respectively.

SharePoint

(<https://univpm.sharepoint.com/sites/SEAFENNEL4MED-sharedplatform/Shared%20Documents/Forms/AllItems.aspx>) was used for editable files and work in progress documents where the PIs and their team members were given access upon request. This system is interoperable and controlled. The tracking of the modification and the simultaneous editing features of SharePoint allows a collaborative approach and easy exchange of feedbacks. The SharePoint site is organized in folders according to the WPs where drafts of Deliverables are stored. These drafts are made available by WP leaders for collaborative and online editing of Deliverables up to their delivery. Once delivered, they are stored in the Google drive repository.

Google Drive was used to create a shared repository where only people with access (PIs) can enter using the link (https://drive.google.com/drive/folders/1zz194wTVswDVWx_5hF9mk-TJ01hxYBJx?usp=sharing). The shared folder is organized in subfolders named WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8 (Fig. 2) where the files approved by each PIs are stored and accessible only for reading and downloading.

- A stakeholder platform, composed of at least 3 members per participating country, was established to represent the interests of the target- and user -groups. The Consortium Partners identified the key stakeholders for each participating country, ensuring gender and group balance and promoting inclusion of crop producers, food industries operators etc. (for details on Stakeholder platform see D2.5 Establishment of a stakeholder platform for knowledge exchange network)
- 4 Newsletters sent to selected stakeholders with updated information/news about the project and its progresses and main outcomes
- A data management plan was drafted and completed by Month 6, to manage the SEAFENNEL4MED data overall collected from stakeholders as well as qualitative and quantitative analyses foreseen in WP3, 4, 5, 6, 7 and 8. The data management plan was drafted according to the H2020 Guidelines on Data management, including issues such as: "What types of data will the project generate/collect? What standards will be used? How will this data be exploited and/or shared/made accessible for verification and re-use? How will this data be curated and preserved?" This plan will be annually discussed and updated (see for detailed D2.6 SEAFENNEL4MED Data Management Plan).
- 1 Press release released at project launch for wide public:

PRESS RELEASES	D2.4	Press release ANSA - Agenzia Nazionale Stampa Associata – 23rd July 2022 Title: "Studio internazionale coordinato da Univpm su finocchio marino [International study coordinated by Univpm about sea fennel]" https://www.ansa.it/marche/notizie/terraegusto/2022/07/23/studio-internazionale-coordinato-da-univpm-su-finocchio-marino_4cff91c0-3cca-432d-851b-ea288036a46f.html	Press release to ANSA - Agenzia Nazionale Stampa Associata – 23.07.2022
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- 7 Articles published in magazines/journal for wide public

PUBLICATION IN DIVULGATION JOURNAL/MAGAZINE	D2.10	Article published in the Italian National Newspaper "Il Resto del Carlino" - 24 th July 2022 Title: "Politecnica, studio sui benefici del finocchio marino" https://www.ilrestodelcarlino.it/ancona/cronaca/politecnica-studio-sui-benefici-del-finocchio-marino-1.7916229	Italian newspaper "Il Resto del Carlino"
PUBLICATION IN DIVULGATION JOURNAL/MAGAZINE	D2.10	Article published in the local on-line magazine "Cronacheancona.it" - 22 nd July 2022 Title: "Finocchio marino: UNIVPM coordina studio internazionale sulla coltivazione biologica" https://www.cronacheancona.it/2022/07/22/finocchio-marino-univpm-coordina-studio-internazionale-sulla-coltivazione-biologica/378538/	Local on-line magazine "Cronacheancona.it"
PUBLICATION IN DIVULGATION JOURNAL/MAGAZINE	D2.10	Article published in the local on-line magazine "Adriaeco" – 22 nd July 2022 Title: "Studio internazionale coordinato da Univpm sul finocchio marino" https://www.adriaeco.eu/2022/07/23/studio-internazionale-coordinato-da-univpm-sul-finocchio-marino/	Local on-line magazine "Adriaeco"
PUBLICATION IN DIVULGATION JOURNAL/MAGAZINE	D2.10	Article published in the local on-line magazine "VivereAncona.it" – 23 rd July 2022 Title: "I Paccasassi al centro di uno studio internaziale di agroecologia targato UNIVPM" https://www.adriaeco.eu/2022/07/23/studio-internazionale-coordinato-da-univpm-sul-finocchio-marino/	Local on-line magazine "VivereAncona.it"
PUBLICATION IN DIVULGATION JOURNAL/MAGAZINE	D2.10	Article published in the local on-line magazine "VivereMarche.it" - 22 nd July 2022 Title: "Ancona: I Paccasassi al centro di uno studio internaziale di agroecologia targato UNIVPM" https://www.viveremarche.it/2022/07/23/ancona-i-paccasassi-al-centro-di-uno-studio-internazionale-di-agroecologia-targato-univpm/2100223019	Local on-line magazine "VivereMarche.it"
PUBLICATION IN DIVULGATION JOURNAL/MAGAZINE	D2.10	Article published in the local on-line magazine "AnconaNews" - 22 nd July 2022 Title: "Finocchio marino, Univpm coordina studio internazionale sulla coltivazione biologica" https://www.anconanews.it/2022/07/22/finocchio-marino-univpm-coordina-studio-internazionale-sulla-coltivazione-biologica/	Local on-line magazine "AnconaNews"
PUBLICATION IN DIVULGATION JOURNAL/MAGAZINE	D2.10	Interview to the project Coordinator, Prof. Lucia Aquilanti (UNIVPM), published in the online magazine "Agrifoglio" – 4 th January 2023 Title: "E' ora di conoscere il Paccasasso, ce lo presenta la professoressa Lucia Aquilanti" https://agrifoglio.ilfoglio.it/lezioni-private/e-ora-di-conoscere-il-paccasasso-ce-lo-presenta-la-professoressa-lucia-aquilanti/	On-line magazine "Agrifoglio"

- 4 open access papers published in peer reviewed journals (indexed in WoS/Scopus)

OPEN ACCESS PUBLICATION IN INTERNATIONAL PEER- REVIEWED JOURNALS	D2.11	LITERATURE REVIEW describing the available reports about physico-chemical and nutritional traits of <i>Crithmum maritimum</i> L. and its application in food production Title: Sea fennel (<i>Crithmum maritimum</i> L.) for the food and nutraceutical industries Authors: Maryem Kraouia, Ancuta Nartea, Antonietta Maoloni, Andrea Osimani, Cristiana Garofalo, Benedetta Fanesi, Lama Ismaiel, Lucia Aquilanti, Deborah Pacetti Molecules (MDPI), Accepted for publication	International peer-reviewed Journal: Molecules, MDPI Special Issue "Halophytes: Nutrients, Bioactive Compounds, Chemical Characterisation and Potential Applications"
OPEN-ACCESS PUBLICATION IN INTERNATIONAL PEER- REVIEWED JOURNALS	D2.11	ORIGINAL RESEARCH ARTICLE describing a study aimed to investigate the most potent sea fennel extract obtained by different extraction methods (conventional and green techniques) for the application in food and nutraceuticals. Title: Comparison of Conventional and Green Extraction Techniques for the Isolation of Phenolic Antioxidants from Sea Fennel Author: Veršić Bratinčević, M.; Kovačić, R.; Popović, M.; Radman, S.; Generalić Mekinić, I. Journal: Processes 2023, 11, 2172. https://doi.org/10.3390/pr11072172	International peer-reviewed Journal: Processes, MDPI
OPEN-ACCESS PUBLICATION IN INTERNATIONAL PEER- REVIEWED JOURNALS	D2.11	ORIGINAL RESEARCH ARTICLE describing a study aimed to investigate sea fennel essential oils (EOs) from different parts of the plant (flowers, leaves and stems) and the corresponding hydrodistillation by-products (residual water) to validate their potential use and application in different industries. Title: Chemical Profiling of Sea Fennel (<i>Crithmum maritimum</i> L., Apiaceae) Essential Oils and Their Isolation Residual Waste-Waters Author: Politeo O., Popović M., Veršić Bratinčević M., Kovačević K., Urlić B., Generalić Mekinić I. Journal: Plants 2023, 12(1), 214 https://doi.org/10.3390/plants12010214	International peer-reviewed Journal: Plants, MDPI
OPEN-ACCESS PUBLICATION IN INTERNATIONAL PEER- REVIEWED JOURNALS	D2.11	ORIGINAL RESEARCH ARTICLE describing Title: Conventional vs. Microwave-Assisted Hydrodistillation: Influence on the Chemistry of Sea Fennel Essential Oil and Its By-Products Author: Politeo O., Popović M., Veršić Bratinčević M., Koceić P., Ninčević Runjić T., Generalić Mekinić I. Journal: Plants 2023, 12(7), 1466 https://doi.org/10.3390/plants12071466	International peer-reviewed Journal: Plants, MDPI

- 6 Abstracts in proceedings of International/national Conferences

CONTRIBUTION AT NATIONAL/INTERNATIONAL CONFERENCES	D2.12	A flash presentation focusing on the by-product of a new crop of sea fennel will be presented at the EuroFoodChem Congress, an important international gathering in the field of food chemistry and it will take place June 14 – 16, 2023 in the capitol of Serbia, Belgrade. Title: Profiling of carotenoids and tocopherols of a new food ingredient based on sea fennel industrial by-product Authors: Nartea A., Fanesi B., Lucci P., Casavecchia S., Aquilanti L., Pacetti D.	International Conference: XXII EuroFoodChem, 14-16 June 2023, Belgrade, Serbia Session "Food composition, quality and safety"
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		Flash presentation accepted by the Scientific Committee of XXII EuroFoodChem https://xxiieurofoodchem.com/	
CONTRIBUTION AT NATIONAL/INTERNATIONAL CONFERENCES	D2.12	Title: Characterization of the aroma of essential oils from sea fennel (<i>Crithmum maritimum</i> L.) leaves and crop by-products. Author: Raffo A., Baiamonte I., Nardo N., Melini V., Nartea A., Pacetti D., Aquilanti L. Oral presentation under submission https://www.wartburg-symposium.de/, accepted by the Scientific Committee	International Conference: 13th Wartburg Symposium on Flavor Chemistry & Biology, 3-6 October 2023 Eisenach, Germany
CONTRIBUTION AT NATIONAL/INTERNATIONAL CONFERENCES	D2.12	Title: Halophytes- Crops of the future Authors: Slišković L., Ninčević Runjić T., Dumičić G., Runjić M., Politeo O., Urlić, B., Generalić Mekinić I. Poster presentation on the most widespread halophyte species (among which special attention was paid to <i>Crithmum maritimum</i>) growing along the Adriatic coast, their main characteristics, their potential for use in different sectors and their importance for the environment (professional paper planned). Accepted by the Scientific Committee	International Conference: 4th International ZORH conference of scientists, professionals and students, 20-21 April 2023, Split, Croatia

- Attendance at 2 events/exhibitions

ATTENDED EVENT/EXHIBITION	D2.16	Participation at 2022 European Researchers Night by Urlic B., Runjić M., Ninčević Runjić T., Generalić Mekinić – I. - Project promotion (Pictures and flyer in ANNEX)	2022 European Researchers' Night , September 30, 2022, Split, Croatia
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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 IN THE REPORTING PERIOD

Task 3.1 (RES). Sampling and morphological characterization of spontaneously growing sea fennel populations **ON-GOING**

Task 3.2 (RES) Chemical analysis of dried sea fennel aerial parts/seeds **ON-GOING**

Task 3.3 (RES). Molecular analysis of sea fennel aerial parts **ON-GOING**

Task 3.4 (RES) Elaboration of morphological, chemical, and genetic data for potential identification of different ecotypes **NOT STARTED**

DELIVERABLES DELIVERED IN THE REPORTING PERIOD

D3.1 Dried sea fennel biomass (leaves, stems, flowers) from at least 5 Mediterranean spontaneous sea fennel populations (month 6) **DELIVERED ON 30TH NOVEMBER 2022**

D3.2 Catalogued and stored seeds (≥ 2500) from at least 5 Mediterranean sea fennel populations (month 8) **DELIVERED ON 30TH JANUARY 2023**

D3.3 Selected Mediterranean sea fennel germplasm (at least 1 ecotype) for cultivation (month 10) **DELIVERED ON 30TH MARCH 2023**

D3.4 Report with elaborated data overall collected within WP3 (month 10) **DELAYED**

BRIEF DESCRIPTION OF WORK DONE IN THE REPORTING PERIOD

Morphological characterization is the first step in the description and classification of germplasm. Accordingly, the genetic diversity in spontaneous sea fennel populations occurring in different Mediterranean areas (coastal areas in Italy, Croatia, France, Türkiye, and

Tunisia) were morphologically characterized based on qualitative and quantitative traits, thus leading to the identification of different geographical populations and even ecotypes. Samples and seeds from these populations were collected, catalogued, and stored.

The WP3 activities carried out in the reporting period are briefly summarized as follows.

Samples from sea fennel populations spontaneously occurring in various Mediterranean coastal areas (PARTY 1: Italian coastal areas; PARTY 4: Dalmatian coastal areas; PARTY 6: Atlantic coastal areas; PARTY 7: North African coastal areas; PARTY 8: Turkish coastal areas) have been collected, classified, and characterized through the evaluation of morphological (qualitative and quantitative) traits. Sampling has been carried out using the simple random method and a specimen of each population has been catalogued and stored with notes of collecting areas. More details about sampling are reported in D3.1.

Sampled sea fennel individuals have been dried according to a standard procedure detailed in D3.1. The dried material has been crushed and the resulting powder has been kept in sealed bags at room temperature for storing.

Seeds have been catalogued according to international protocols (ISTA, 2018), and further stored in rooms at controlled temperature (15°C) and relative humidity (15%) and in freezer cabinets at -20°C; all details about seeds cataloguing and storage are reported in D 3.2.

During the reporting period, morphometric data have been collected to further identify different ecotypes. In parallel, both DNA extraction and purification protocols have been optimized for further genetic analyses (Next generation sequencing)

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 IN THE REPORTING PERIOD

Task 4.1 (R). Sustainable production of sea fennel crop in demo field (month 6 – 24). **ON-GOING**

Task 4.2 (D). Sustainable production of sea fennel crop in open field (month 12 – 35). **ON-GOING**

Task 4.3. (D) Analysis of the new sea fennel crops (month 6 – 35). **ON-GOING**

Task 4.4. (D) Statistical analysis (month 18 – 35). **ON-GOING**

DELIVERABLES DELIVERED IN THE REPORTING PERIOD

D4.1 Experimental plan design of cultivation trials (month 6); **DELIVERED ON 30.11.2022.**

BRIEF DESCRIPTION OF WORK DONE IN THE REPORTING PERIOD

Field experiments have been planned in 4 experimental sites, each modelling a Mediterranean scenario with different landscapes and climatic conditions, namely:

- **Central Italy (P1)**: 1 test site located at a coastal area with a **warm and rainy temperate climate** (classified as **Csa** = hot-summer Mediterranean climate, according to Köppen and Geiger) → Farm “Paccasassi del Conero” (Ancona)
- **Croatia (P5)**: 1 test site with a **warm and rainy temperate climate** (classified as **Csa** = hot-summer Mediterranean climate, according to Köppen and Geiger) → Institute for Adriatic Crops, Split (Croatia)
- **Tunisia (P7)**: 1 test site in Northern Tunisia with a **warm and rainy temperate climate** (classified as **Csa** = hot-summer Mediterranean climate, according to Köppen and Geiger) → Site: INRGREF site-Ariana-Tunisia (36.845610, 10.193484); 1 test site in Southern Tunisia with a **hot desert climate** (classified as **BWh** = hot semi-arid climate according to Köppen and Geiger) (P7) (not identified, yet).
- **Turkey (P8)**: 1 test site in the western coastal area **with an arid climate** (classified as **BSh** = hot semi-arid climate, according to Köppen and Geiger) → Izmir, Bornova, TURKEY (Western coastal area) – University experimental fields

The WP4 activities carried out in the reporting period are briefly summarized as follows:

As agreed by all Partners involved in this WP, at least two sea fennel ecotypes (one local and one consisting of a wild population sampled on the Atlantic coast) are compared in a randomized block experimental design with three replications, at all the experimental sites. Design of the experimental plan at the selected sites is detailed in D4.1.

In March - May 2023, sea fennel seeds collected in Summer- Autumn 2022 from the selected ecotypes (~2'000 per ecotype) preliminarily underwent germination tests (under growth chamber and/or greenhouse conditions) to identify the most suitable conditions for germination, being temperature, light, pre-treatments, etc. As a rule, a germination rate of **≥ 50%** was achieved for all the assayed

ecotypes. The mean germination rate observed was lower than that expected (90%), based on previous assays carried out at UNIVPM onto sea fennel seeds harvested from sea fennel crop produced at RINCI (Party 3). Hence, a significantly lower numbers of seedlings was available in Spring 2023 for transplanting, thus leading to a downscaling of cultivation trials at all the experimental sites. In parallel to germination tests, key soil parameters (e.g., pH, organic matter content, electrical conductivity, total N, exchangeable K₂O, available P₂O₅, exchangeable Ca, Na and Mg, etc.) were also evaluated at all the experimental sites, according to standardised procedures already in use at the laboratories of the Consortium Partners.

UNIVPM (P1)



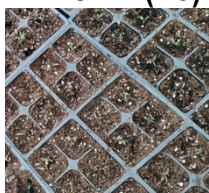
Regarding the Italian site (Farm "Paccasassi del Conero" located in Camerano – Ancona – Italy. (43.530 N, 13.550 E), seeds from the two selected ecotype (Marche and Atlantic coast) were planted in standard seed trays prior to treatment with a bio-fertilizer corresponding to a blend of 4 strains of the following bacterial species at a 2:1:1 (v/v/v) ratio (Abdallah et al., 2021):

- o *Azospirillum brasilense* DSMZ 1690 and *Azotobacter chroococcum* DSM 2286 used for atmospheric nitrogen fixation;
- o *Priestia megatherium* var. *phosphaticum* DSMZ 339, used as phosphorus-dissolving bacteria;
- o *Niallia circulans* DSMZ 30598 as potassium-solubilizing bacteria.

Details about the bacterization of seeds are detailed in D4.5.

The impact of this biostimulant on the rhizosphere microbiota and growth parameters of sea fennel root was investigated. In parallel the same biostimulant was applied to the 3-y-demo field at PARTY3 to evaluate the effect of the biostimulation on crop yield (harvest 2023).

IACKR (P5)



Regarding the Croatian site (Institute for Adriatic Crops, Split ()), seeds from the two selected ecotypes (Korčula and Atlantic coast) were sowed in January 2023 in polystyrene plug filled with commercial peat; in February 2023, seedlings were further transplanted into PE trays. In May 2023, seedlings with 4-5 true leaves were transplanted at the demo site. No fertilizers/bio-stimulants were used at this stage.

INRGREF (P7)



Regarding the Tunisian site (INRGREF site-Ariana-Tunisia (36.845610, 10.193484), in February 2023 2'000 seeds from 2 selected ecotypes (Haouaria and Atlantic coast) were sowed in plastic seedbed trays filled with sterilized organic pits (March 2023); the vials were irrigated with a sprinkler every day at 9:00-10:00 AM. In May 2023, seedlings with three-four true leaves were transplanted in the INRGREF demo field. Fertilization with NPK fertilizer (20-20-20) has been assayed at this stage.

UNIEGE (P8)



Regarding the Turkish site (Ege University, Faculty of Agriculture, Department of Field Crops, Bornova-Izmir/Turkey (38°27'06.0"N 27°13'31.9"E), in March 2023 seeds (2'000) from 4 Turkish ecotypes and the ecotype ATL (Atlantic Coast) were sowed in plastic seedbed trays filled with sterilized organic pits, under greenhouse conditions, at the rate of two-three seeds per well. A bio-stimulant was applied to the seedlings at the beginning of the seeding process in the greenhouse. In May 2023 seedlings from 2 Turkish ecotypes being ecotype AC-1 (Aegean Coast 1) and ecotype AC-2 (Aegean Coast 2) plus the French ecotype (ATL) with 3-4 true leaves were transplanted at the demo field.

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). **ON-GOING**

Task 5.2 (R) Laboratory-scale manufacturing of unfermented shelf-stable preserves (month 1 – 20). **ON-GOING**

Task 5.3 Pilot-scale manufacturing of fermented and unfermented shelf-stable sea-fennel preserves (D) (month 20 – 35). **NOT STARTED**

DELIVERABLES DELIVERED IN THE REPORTING PERIOD

None

BRIEF DESCRIPTION OF WORK DONE IN THE REPORTING PERIOD

The planned and on-going activities carried out by each Partner or cluster of Partners involved in this WP are summarized as follows.

UNIVPM (P1), CREA-AN (P2), RINCI (P3)

During the reporting period, the three Italian partners listed above have planned their activities as follows.

Sea fennel edible tender leaves and sprouts provided by RINCI SrL (P3) are exploited for development, production, and validation of:

- **LABORATORY-SCALE PROTOTYPES OF FERMENTED FOODS** (Task 5.1)
 - BEER (addition of extracts produced in WP6 or of fresh sea fennel leaves/flowers during boiling) (TEAM PROF PACETTI & PROF AQUILANTI, UNIVPM)
 - KIMCHII-LIKE PRESERVE (natural and started fermentation of mixtures of vegetables including sea fennel sprouts) (TEAM PROF AQUILANTI & PROF MOZZON, UNIVPM)
 - FERMENTED SEA FENNEL IN VINEGARD (TEAM PROF AQUILANTI, UNIVPM)
- **LABORATORY-SCALE PROTOTYPES OF UNFERMENTED FOODS** (Task 5.2)
 - SHELF-STABLE PESTO-LIKE (optimization of the pasteurization process and evaluation of microbiological stability by accelerated growth tests and challenge tests) (TEAM PROF AQUILANTI & PROF MOZZON, UNIVPM)

According to Task 5.3, ALL the laboratory-scale prototypes (except BEER) obtained from T5.1 and T5.2 will be produced at P3 (RINCI) at pilot-scale and, hence, validated. For pilot-scale manufacturing of beer, a pilot plant available at UNIVPM (P1) will be used.

The pilot-scale prototypes will further be validated through the following analyses: colour, appearance, texture, odour, and content of bioactive compounds by UNIVPM (P1) and CREA-AN (P2).



Regarding the manufacture of a KIMCHI-LIKE PRESERVE, the prototype has been successfully obtained using a multiple strain starter formulated with lactic acid bacteria strains previously selected based on their technological traits (Maoloni et al., 2021; Marcelli et al., 2020); the prototype was validated through preliminary microbiological, chemical, and sensory analysis (UNIVPM, P1); further analysis (colour, texture, analysis of bioactive compounds) will be carried out by CREA-AN (P2) and UNIVPM (P1).



Regarding the manufacture of FERMENTED SEA FENNEL IN VINEGAR, the same multiple strain starter was used for the preliminary fermentation of blanched sea fennel tender leaves and stems. Even for this prototype, preliminary analyses were carried out by UNIVPM in the reporting period (microbiological, chemical, and sensory). Further analyses will be carried out by CREA-AN (P2).

For BEER and a PESTO-LIKE SAUCE no activities have been carried out, in the reporting period.

CITED REFERENCES

- Maoloni A, Milanović V, Osimani A, Cardinali F, Garofalo C, Foligni R, Mozzon M, Cirlini M, Spaggiari M, Reale A, Boscaino F, Di Renzo T, Haouet M. N., Staccini B, Di Bella S, Aquilanti L. (2021). Exploitation of sea fennel (*Crithmum maritimum* L.) for manufacturing of novel high-value fermented preserves. *Food and Bioproducts processing* 127, 174-197.
- Marcelli V., Maoloni* A., Cardinali F., Milanovic V., Garofalo C., Osimani A., Clementi F., Aquilanti L. (2020). Selection of starter cultures for manufacturing of new fermented preserves with sea fennel (*Crithmum maritimum* L.) [Selezione di starter per la produzione di nuove conserve fermentate a base di finocchio marino (*Crithmum maritimum* L.)]. *Industrie Alimentari*, LIX, 614, pp 4-10.

UNIST (P4)

During the reporting period, this Croatian partner has planned its activities as follows.

Sea fennel edible tender leaves and sprouts purchased from commercial sea fennel crop are exploited for development, production, and validation of:

- **LABORATORY-SCALE PROTOTYPES OF UNFERMENTED FOODS** (Task 5.2)
 - DRIED SPICES FORMULATED WITH BLENDS OF SEA FENNEL AND OTHER MEDITERRANEAN AROMATIC HERBS
 - FORMULATION AND ANALYSIS OF A TYPICAL DALMATIAN PATÈ WITH SEA FENNEL AND ONIONS
 - PICKLED SEA FENNEL FORMULATION using different vinegars (apple, grape, etc)

Regarding DRIED SPICES, a preparatory study for the formulation of a laboratory-scale prototype were carried out, and the following Mediterranean herbs were selected to be used in association with sea fennel based on their use in traditional dishes, chemical, composition, antioxidant and organoleptic, properties: rosemary, bay laurel, fennel.

For the DALMATIAN PATE' a preparatory study was again carried out to identify the list of ingredients to be exploited for the formulation of the laboratory-scale prototype, being olives or native/domestic Dalmatian variety of onion and various spices. Finally, for PICKLED SEA FENNEL, a further preparatory study was also carried out to evaluate the use of different vinegars (apple, grape, etc.) and their proportions, with/without blanching, etc. with respect to the chemical composition of the pickled sea fennel and its organoleptic properties.

INRGREF (P7)

During the reporting period, the Tunisian partner has planned its activities as follows.

Sea fennel edible tender leaves and sprouts purchased from commercial sea fennel crop are exploited for development, production, and validation of:

FERMENTED PROTOTYPES (Task 5.1)

- CHILI PUREE (HARISSA)
- ORANGE JAM
- SNACK.



Regarding CHILI PUREE HARISSA, a laboratory scale prototype was produced in the reporting period, following a popular traditional recipe, which include as main ingredients: dried pepper (50%), garlic (35%), mix (salt, coriander, caraway) (15%). Different doses of sea fennel powder were added to HARISSA in order to determine the best concentration to be used. Analyses aimed at evaluating the chemical and microbiological stability of this prototype were carried out in the reporting period.

Regarding ORANGE JAM, a first laboratory-scale prototype has been produced to evaluate the effect of sea fennel addition on stability and taste of orange jam. Sea fennel was incorporated as a powder at different doses. Analyses of stability, expiry date and microbiological analyzes were carried out. A sensory analysis is in progress with experienced and ordinary taster



For SNACKS, no prototypes have been produced in the reporting period, yet.

UNIEGE (P8)

UNFERMENTED PROTOTYPE (Task 5.2)

- SNACKS OBTAINED BY EXTRUSION STARTING FROM (A) DOUGHS MADE WITH SEA FENNEL AND OTHER INGREDIENTS AND (B) STUFFED WITH SEA FENNEL CREAM
- SPICED NOODLES WITH SEA FENNEL

Regarding NOODLES, a laboratory-scale prototype was prepared with durum semolina added with 5 and 10 % (w/w) of sea fennel powder (dried at 45 °C for 48 h). The prototype was analyzed for: color parameters, cooking properties (optimum cooking time, water absorption, cooking loss, swelling index), and texture parameters.
Regarding EXTRUDED SNACKS, no activities were carried out in the reporting period.

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 sea fennel crop by-products (month 12 – 18). **ON-GOING**

Task 6.2 (R&D) Exploitation of the extracts as functional food ingredients and nutraceuticals (month 18 – 24). **NOT STARTED**

Task 6.3 (R&D) Composting of residual sea fennel biomass (month 24 – 35).

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) **ON-GOING**

DELIVERABLES DELIVERED IN THE REPORTING PERIOD

None

BRIEF DESCRIPTION OF WORK DONE IN THE REPORTING PERIOD (detailed for each Task and Partner)

- **Task 6.1: PREPARATION AND ANALYSIS OF EXTRACTS FROM SEA FENNEL CROP BY-PRODUCTS**

UNIVPM (P1)

For this task, in the reporting period it has been planned that residue of organic sea fennel crop (e.g., nonedible woody leaves – stems, autumn mowing) provided by RINCI Srl (P3) will be exploited in the following activities:

- PRODUCTION OF EXTRACTS WITH POLAR BIOACTIVE COMPOUNDS and analysis of their chemical, antioxidant, and antimicrobial activities (the latter towards key foodborne pathogens: *Escherichia coli*, *Staphylococcus aureus*, *Listeria monocytogenes*).

For this activity, by-product of organic sea fennel crop produced at open field by Rinci (PARTY3), manually harvested from the field in Summer 2022, was air-dried (T<40°C till reaching RH%<15). An aliquot of powder was further extracted with deionized water at room temperature in dark conditions, under ultrasound for 15 min, centrifuged, stabilized at -18°C for 2 hours and filtered on regenerated cellulose filter. The extract was analyzed for the total phenolic content and latter freeze-dried, and the yield of extraction was calculated; the freeze-dried extract was stored at -18°C prior to further analysis.

UNIST (P4)

The following activities have been planned for T6.1 at UNIST:

- EXTRACTION AND ANALYSIS OF ESSENTIAL OILS (EOs).
- ANALYSIS OF RESIDUAL-WATER EXTRACTS

For these activities, flowering aerial parts of wild-grown sea fennel were collected in Central Dalmatia (43°39'44" N 15°56'40" E, Croatia) in September 2022 at the plant full-flowering stage. Prior to the isolation of essential oils, the material was air-dried (15 days at room temperature), and after drying, was divided into plant parts, namely, flowers, leaves, and stems. Sea fennel EOs from the different plant sections (flowers, stem, and leaves) were isolated from the dry plant material by hydro distillation. The isolated EOs were dried over anhydrous sodium sulfate, and the oil yield was calculated based on the dry plant material. The

wastewater that remained after oil extraction was cooled, filtered, and freeze-dried, and the crude extracts obtained were dissolved in water (at a concentration of 10 mg/mL) and used for further analysis.

Sea fennel EOs underwent Gas Chromatography-Mass Spectrometry (GC-MS).

The obtained residual-water extracts were analyzed spectrophotometrically for total phenolics (TPC), flavonoids (TFC) and tannins (TTC) using optimized protocols in use at UNIST laboratories. The results of these analyses are freely available at <https://doi.org/10.3390/plants12010214>.

In addition, the effects of the applied methods for EO isolation, being conventional hydro-distillation (HD), and microwave-assisted hydro-distillation (MHD) on the chemical profile of sea fennel (*Crithmum maritimum* L.) EO were also investigated. Even methods and results of this further research activity are freely available at <https://doi.org/10.3390/plants12071466>.

UNIBRE (P6)

The following activities have been planned for T6.1 at UNIBRE:

- NMR ANALYSIS OF AQUEOUS EXTRACTS FROM SEA FENNEL LEAVES

In the reporting period, sea fennel leaf powder produced by Partner P1, P4, P6, P7, P8 was extracted three times with 30% ethanol at a ratio of 10 mL per gDW. Supernatants were pooled and evaporated under vacuum at 35°C, and the residue was resuspended in deuterated water (D2O) for NMR analyses. 1D 1H NMR spectra were obtained using a Brüker DRX-400 spectrometer (400 MHz), equipped with a 5 mm Dual 1H probe head. A typical 1D 1H-NMR spectrum consisted of 32 scans. Determination of major solutes present in sea fennel extract or fractions was made on NMR spectra in comparison with external standards.

INRGREF (P7)

The following activities have been planned for T6.1 at INRGREF:

- EXTRACTION AND ANALYSIS OF ESSENTIAL OIL (EO).
- ANALYSIS OF RESIDUAL AQUEOUS EXTRACTS

Regarding these activities, EO and AQUEOUS EXTRACTS were obtained from fennel by-product collected from wild plants. The antioxidant activity of both EO and aqueous extract was determined, together with the antifungal activity was carried out against phytopathogenic strains. For both antidiabetic and insecticidal effects, no activities have been carried out, yet at INRGREF.

UNIEGE (P8)

The following activities have been planned for T6.1 at UNIEGE:

- PRODUCTION AND ANALYSIS OF crude extracts with polar bioactive compounds from SEA FENNEL BY-PRODUCTS.

Regarding this activity, no experiments have been carried out, yet at UNIEGE.

• Task: 6.2 EXPLOITATION OF EXTRACTS AS FUNCTIONAL FOOD INGREDIENTS

UNIVPM (P1)

The following activities have been planned for T6.2 at UNIVPM:

- PRODUCTION AND VALIDATION OF SEASONIG EDIBLE CAPSULES FROM AQUEOUS EXTRACTS or EOs PRODUCED (IN KIND) AT AN EXTERNAL COMPANY (La Distilleria Appo Marche, <https://www.ladistilleriaappo.it/>) → example balsamic Modena vinegar (→ spherification process using sodium alginate).
- APPLICATION OF EOs PRODUCED (IN KIND) AT AN EXTERNAL COMPANY (La Distilleria Appo Marche, <https://www.ladistilleriaappo.it/>) for the manufacturing of FERMENTED SALAMI (es. ciauscolo) to improve sensory traits/safety/functional properties.
- APPLICATION OF ESSENTIAL OILS PRODUCED (IN KIND) AT AN EXTERNAL COMPANY (La Distilleria Appo Marche, <https://www.ladistilleriaappo.it/>) for the manufacturing of HAMBURGER to improve sensory traits/safety/functional properties (example 3).

For these activities, no progresses are recordable for UNIVPM in the monitoring period.

UNIST (P4)

The following activities have been planned for T6.2 at UNIST:

- ADDITION OF EO'S TO DIFFERENT VEGETABLE OILS to prevent their degradation (oxidation) and as flavor components.

Regarding the planned activity, no experiments have been carried out, in the reporting period, yet at UNIST.

INRGREF (P7)

The following activities have been planned for T6.2 at INRGREF:

- APPLICATION OF EO'S AS FOOD INGREDIENTS TO IMPROVE QUALITY/SHELF-LIFE OF JELLY CANDIES.

Regarding this activity, the formulation of jelly candies has been defined, different doses of sea fennel EO were added to the candies. Preliminary physical and physicochemical characterization of candies was conducted.

• Task 6.2: EXPLOITATION OF EXTRACTS AS NUTRACEUTICALS

UNIVPM (P1)

The following activities have been planned for T6.2 at UNIVPM.

It has been planned that residue of sea fennel crop (e.g., nonedible woody leaves – stems, autumn mowing) provided by RINCI Srl (P3) will be exploited in the following activities:

- APPLICATION OF THE EXTRACTS WITH POLAR BIOACTIVE COMPOUNDS FOR PRODUCTION OF EDIBLE CAPSULES (in gelatine) (as those pictured below)



Regarding this planned activity, no experiments were carried out in the reporting period, yet at UNIVPM.

INRGREF (P7)

The following activities have been planned for T6.2 at INRGREF.

- USE OF SEA FENNEL BY-PRODUCTS IN ANIMAL FEED FORMULAS (concentrates or vegetable flours) based on sea fennel or mixed with other products. We propose to test their effectiveness on average daily gain (for the ruminants).
- USE OF SEA FENNEL AQUEOUS EXTRACTS FOR ANIMAL NUTRITION and evaluation of its effect on meat quality.

Regarding the first and second planned activity, no experiments have been carried out, yet at INRGREF.

Regarding the third activity, the antioxidant activity of essential oil and aqueous extract was determined. The antifungal activity was carried out against phytopathogenic strains. For both antidiabetic and insecticidal effects, no activities have been carried out, yet.

UNIEGE (P8)

The following activities have been planned for T6.2 at UNIEGE:

- encapsulation of standardized crude extract with polar bioactive compounds (one extract obtained at optimum extraction conditions) in micro- and nano-carriers and evaluation of stability (UV, heat)
- evaluation of health-beneficial traits of a standardized crude extract with polar bioactive compounds (one extract obtained at optimum extraction conditions): anti-diabetic effects using enzyme (alfa-glucosidase) inhibition assays
- preparation of mucoadhesive oral films (oral strips) at lab scale for the buccal delivery of polar bioactive compounds in standardized crude extract (only for one extract obtained at optimum extraction conditions)
- evaluation of the synergistic effects of a standardized crude extract with polar bioactive compounds (one extract obtained at optimum extraction conditions) with selected bio-enhancers.
- analysis of alfa glucosidase enzyme inhibition assays, and test for the determination of blood glucose decreasing properties of the standardized extracts for antidiabetic activity evaluation

Regarding these activities, no experiments have been carried out, yet, at UNIEGE.

• Task 6.3: EXPLOITATION OF SEA FENNEL RESIDUES AS SOIL AMENDMENTS

IACKR (P5)

The following activities have been planned for T6.3 at UNIEGE:

- LABORATORY-SCALE COMPOSTING TRIALS with the residues of sea fennel biomass after extraction of polar/apolar bioactive compounds have been planned.

Regarding this activity, in the reporting period, no experiments have been carried out at IACKR, yet.

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). **ON-GOING**

Task 7.2 (D) Assessment of consumer attitudes and acceptance of sea fennel products (month 13–30). **NOT STARTED**

Task 7.3 (D) Business model evaluation (month 24 – 35). **NOT STARTED**

DELIVERABLES DELIVERED IN THE REPORTING PERIOD

D7.1 Lock-ins and drivers for the development of sea-fennel products (month 12); **DELAYED**

BRIEF DESCRIPTION OF WORK DONE IN THE REPORTING PERIOD

During the reporting period, two meetings were held within the scope of WP7: one with the general participation of the Consortium partners (20th December 2022), and the other with the project partners who will be involved in WP7 (13rd February 2023).

Following the first meeting, the implementation protocol of WP7 was prepared and made available to the project partners on the project information sharing platform (SEAFENNEL4MED_Sharing_Platform on Google Drive).

After the second meeting, the minutes including the action plan and dates related to Task 7.1 were shared with the partners through the platform.

Accordingly, the questionnaire to be used in the first round of the Delphi survey within the framework of the action plan was finalised with the cooperation of UNIVPM and the questionnaire was uploaded to Qualtrics, a data collection and analysis software, for implementation. Currently, the translations of the first round of the survey questionnaire into local languages for implementation in different countries were checked and the partners are trying the survey on Qualtrics. The participant lists per country were determined. The survey is about to start.

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). **ON-GOING**

Task 8.2 (D) Sustainability assessment of new sea fennel-based foods/food ingredients (month 1-35). **ON-GOING**

Task 8.3 (D) Sustainability assessment of functional extracts for food ingredients/nutraceuticals (month 1- 35). **ON-GOING**

DELIVERABLES DELIVERED IN THE REPORTING PERIOD

None

BRIEF DESCRIPTION OF WORK DONE IN THE REPORTING PERIOD

The technical documents needed to correctly apply LCA methodology on (i) sea fennel crop; (ii) sea fennel-based food; (iii) sea fennel-based nutraceuticals were checked and used as reference for the analysis (ISO 14040, ISO 14044, EPD PCR 2020:07). A specific meeting has been held in April 2023 with RINCI (P3) to plan the data collection needed to calculate the environmental indicators by means of LCA. The data collection file is under construction in interaction between P1 and P3 and will be filled by P3 during the open field trials and pilot-scale production of sea fennel-based foods. Data will also be taken from LCA databases (Ecoinvent, Agrifootprint, Agribalyse, World Food LCA database, etc.) and scientific literature.

In the monitoring period, key aspects for LCA were identified as follows for each type of output.

Sea fennel crop:

- production of inputs used for sea fennel cultivation (fertilizers, plant protection products, seeds, seedlings);
- production of materials used for greenhouses, mulching, trays, and substrates (peat or others). a particular attention will be paid to mulching material;
- production of electricity and fuels used;
- production of auxiliary products used, if any;
- manufacturing of primary and secondary packaging, if applicable;
- transportation of inputs and material to the cultivation field;
- amounts of inputs of energy and materials used for cultivation;
- direct emissions from sea fennel cultivation;
- preparation of the final product (before transportation);
- waste treatment of waste generated during manufacturing (e.g., mulching materials);
- production of agricultural machinery.

Sea fennel-based food:

- sea fennel cultivation from task 8.1
- transportation from field to the processing site;
- manufacturing of primary and secondary packaging, if applicable;
- transportation of inputs and materials (especially primary packaging) to the processing site;
- production of ingredients, preservatives, emulsifiers and additives used in the product;
- production of auxiliary products used such as detergents for cleaning, refrigerating etc;
- production of primary, secondary and tertiary packaging materials;
- amounts of inputs of energy (fuels, electricity) and materials (ingredients, preservatives, emulsifiers, additives) used for sea fennel preserves;
- cold chain operations;
- direct emissions from sea fennel processing;
- waste treatment of waste generated during processing and end of life of packaging.

Sea fennel-based nutraceuticals

- Transportation of residues to the processing site;
- Transportation of inputs and materials (if needed) to the processing site;

- Amounts of inputs of energy (fuels, electricity) and materials used for extraction;
- Direct emissions from processing;
- Waste treatment of waste generated during processing.

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)

A new Data Management Plan (DMP) was drafted (Deliverable 2.6). The aim of the SEAFENNEL4MED DMP is to identify the project's research data and to describe how to make them findable, accessible, interoperable, and re-usable (FAIR). Following the H2020 Data Management Plan Template, all partners involved in research's activities were asked to provide detailed information about the data generated during the entire project. In more detail, in the Deliverable, an initial analysis on how the SEAFENNEL4MED Consortium intends to manage the amount of data produced in the SEAFENNEL4MED project is reported. The first checkpoint of the whole architecture of the DMP is the release of the first scientific publication that will be published within the SEAFENNEL4MED project: indeed, the data reported in this paper will be made available and interoperable to the larger typologies of stakeholders. To avoid issues related to Principal Investigators (PI) rights and their access, as a first step in the strategy of development of DMP, only data related to publications available to the public will be released. In the SEAFENNEL4MED Project DMP is intended to be a living document in which information can be made available on a finer level of accuracy and details through updates as the implementation of the project progresses and when significant changes occur.

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 field, 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 sea 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.

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