Interreg Co-funded by the European Union

IPA ADRION

BFC

BioFarms Cluster – BFC

Interreg VI-B IPA Adriatic Ionian

Priority 1 - Supporting a smarter Adriatic - Ionian region

SO 1.1 - Strengthening innovation capacities in the Adriatic - Ionian region

Activity 1.2 - Knowledge transfer among partners

Assessment of the process, protocols and know-how

GOEL

Contents

Introduction

This document collects and describes the main extraction technologies used within the BioFarms Cluster project, with a particular focus on innovative solutions for the valorization of plant matrices.

The operating principles, advantages, application limitations, and environmental impact of each technique are analyzed from supercritical CO_2 extraction to ultrasound-assisted extraction to vacuum distillation.

An overview of the company's equipment for pre-treatment of raw materials and the operational steps required to develop the pilot-scale process is also provided. The aim is to offer an integrated view of the expertise and technologies available to support the development of sustainable, high-value supply chains.

1.Project context

- **Programme:** Interreg VI-B IPA Adriatic Ionian
- **Specific objective:** Strengthening innovation capacities in the Adriatic-Ionian region
- **Activity 1.2:** Knowledge transfer between partners, with evaluation of processes, protocols and know-how
- **Deliverable 1.2.2:** Assessment of the process, protocols and know-how

2.Technologies presented

Advanced techniques for the extraction of bioactive compounds from plant matrices are:

1. **Supercritical CO_2 Extraction (SC-CO_2)**
2. **Ultrasound-assisted extraction (UAE)**
3. **Vacuum distillation (for essential oils and hydrolates)**

2.1. Supercritical CO_2 Extraction

Principle: CO_2 brought above the critical point (31.1°C, 73.8 bar) assumes properties intermediate between liquid and gas, becoming an excellent solvent for non-polar compounds.

Advantages:

- Clean process, without toxic residues;
- High selectivity by regulating pressure/temperature;
- Suitable for thermolabile compounds

Disadvantages:

- High installation and maintenance costs
- Effectiveness limited to non-polar or slightly polar compounds (unless co-solvents are used);

Environmental impact: Low, thanks to the reuse of CO_2;

Applications: Food, cosmetic and pharmaceutical sectors.

2.2. Ultrasound-Assisted Extraction (UAE)

Principle: Ultrasonic waves generate cavitation in a liquid, which breaks the cell walls of plants and promotes the release of active compounds (e.g. polyphenols, flavonoids).

Advantages:

- Reduction in extraction times;
- Use of more eco-friendly solvents (e.g., water or ethanol);
- Relatively low operational costs.

Disadvantages:

- Possible degradation of sensitive compounds;
- Limitations in industrial scale-up for certain applications.

Environmental Impact: Moderate, depending on the solvent used.

Applications: Preparation of extracts for dietary supplements and cosmetic products.

2.3. Vacuum Distillation

Principle: Reduction of pressure to evaporate volatile compounds at low temperatures.

Advantages:

- Reduced thermal degradation of volatile compounds.
- Higher purity of essential oils and hydrosols.
- Energy savings due to low-temperature evaporation.

Disadvantages:

- Requires specialized and costly equipment.
- Demands technical expertise for vacuum and process control.

Environmental Impact:

- Lower impact due to energy savings and the possibility of recycling water and materials.
- Sustainable process when combined with renewable energy sources.

Applications:

- Production of essential oils and hydrosols for cosmetics, aromatherapy, and food industries.
- Extraction of thermolabile compounds from plant matrices.

3.Matrix pre-treatment

The company has dedicated equipment for washing, drying, milling, and sifting raw materials: essential operations to ensure the effectiveness and quality of the subsequent extraction phases.

Data from some preliminary operations conducted during the pilot phase were analyzed with the aim of reconstructing the plant's actual production capacity in detail, integrating all process elements.

4. Conclusions

The deliverable aimed to share the know-how on the main extraction technologies currently usable on a pilot and semi-industrial scale for the design of piloting activities that range from supercritical CO_2 to ultrasound-assisted extraction to vacuum distillation, highlighting their advantages, limitations, and potential applications.

To support these processes, it was also illustrated the comprehensive plant matrix pre-treatment system, equipped with washing, drying, milling, and sieving equipment, which are essential for ensuring the quality and efficiency of subsequent processing.

Data collected during preliminary analysis was also analyzed to more accurately estimate the plant's actual production capacity. This phase allowed us to integrate all process elements into a robust operational framework, paving the way for protocol optimization and the development of a sustainable and scalable extraction chain.

BFC

www.interreg-ipa-adrion.eu

PARTNERS

UMG

GRUPPO COOPERATIVO

PORA
Regionalna razvojna agencija Koprivničko-križevačke županije

VUK
Veleučilište u Križevcima

Gospodarska zbornica Slovenije
Chamber of Commerce and Industry of Slovenia
Association of Chemical Industries of Slovenia

REGIONAL ECONOMIC DEVELOPMENT AGENCY for Sumadija and Pomoravlje

AGJENCIA PËR ZHVILLIM TË QËNDRUESHEM
AGENCY FOR SUSTAINABLE DEVELOPMENT

INNOVATION PARK JOIST

fab sarajevo