Feed

From Edible sprouts to hEalthy fooD

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PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION
IN THE MEDITERRANEAN AREA

FAO | WORLD FOOD FORUM

The PRIMA programme is an Art. 185 initiative supported and founded under Horizon 2020, the European Union's Framework Programme for Research and Innovation

Plant Sprouts

What are edible sprouts?

Definition of sprouts from EU: «The products obtained from seed germination, harvested before the development of the first leaf and fully consumed including the seed»

Why Sprouts?

1. **Sprouts** are attracting attention as healthy ready-to-eat foods
1. **better** than their seeds counterpart and mature plant

the **germination** process activates the endogenous enzymes and storage nutritional compounds are converted to **bioactive components**

the **germination** reduces the amount of antinutritional factors

Germination Process

Effect

Higher nutritional composition including amino acid, protein, fatty acid, vitamin, sugar, macro- and micro-elements and phytochemicals: **phenolics**, **flavonoids**, with antioxidant activity.

The nutrient levels and bioavailability of sprouted seeds are improved.

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Sprouts production from different plant species

Objectives

- To select specific wild and cultivated species for sprouting
- To set-up the best growing condition and light treatments
- To transfer the sprout growing technology to a specialized factory for a pilot-scale sprout production

Sprout species Tested:

Species	Variety
Alfalfa	Demetra
Red Basil	Pompei
Red Beet	Agata
Broccoli	Calabrese Sibari
Carrot	Peline
Black Kale	Salus
Chia	Helmet
Onion	Pinga
Fenugreek	Perseo
Fennel	Napo
Wheat	Incas
Red Lentil	Maranello
Black Lentil	Colfiorito
Lentil	Colfiorito
Purple radish	Tango
Spicy Rocket	Chantico
Red Mustard	Kiss
Green Mustard	Snack
Black Sesame	Ardesia

Red Basil Var. Pompei

Broccoli Var. Calabrese Sibari

Black Kale from Tuscany

Purple Radish Var. Tango

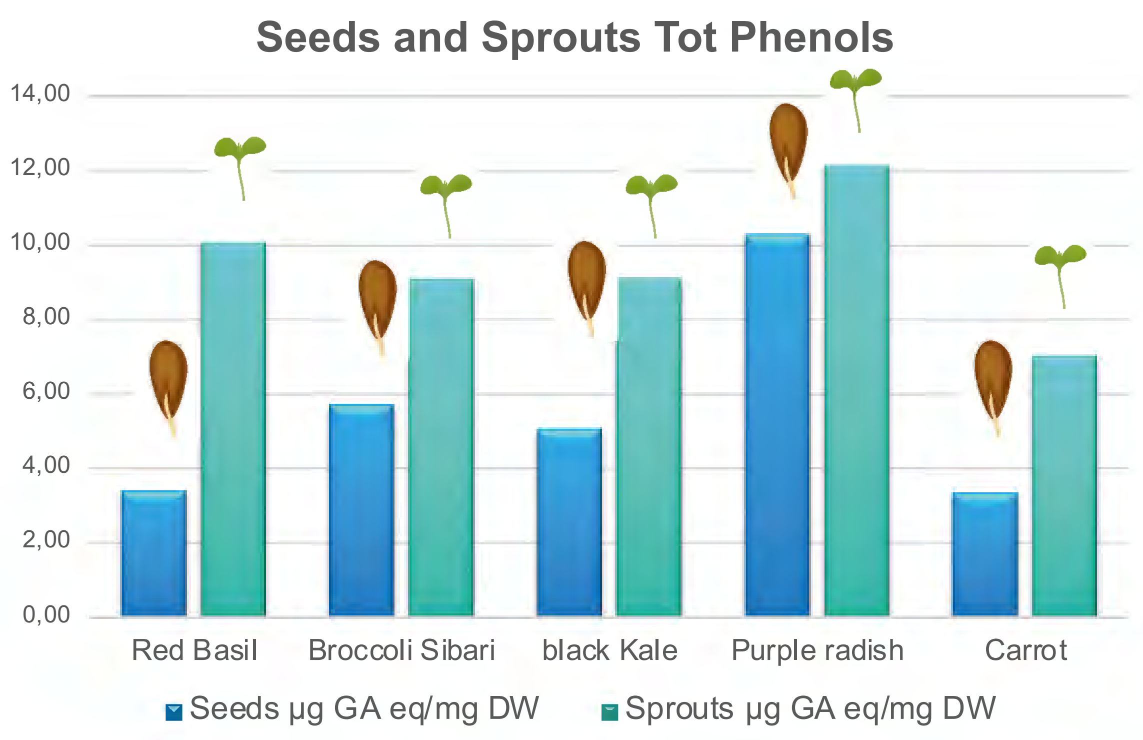
Biochemical and sensory characterization of fresh sprouts

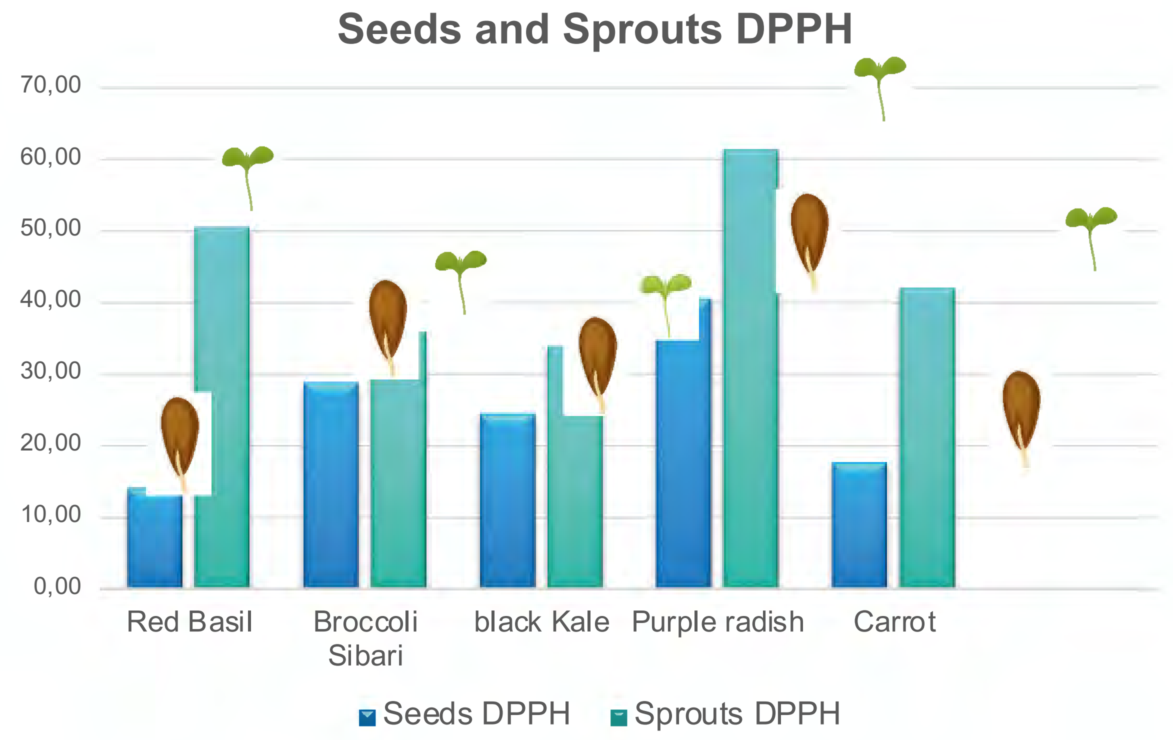
Consiglio Nazionale delle Ricerche

Objectives

- To determine the health benefits activity (antioxidant metabolites), *in vitro* immuno-modulation and *in vitro* prebiotic effects of the sprouts
- To select the sprouts with most health-promoting compounds.
- To conduct a sensorial characterization of fresh sprouts
- To conduct a metabolite profiling analysis for the bioactive compounds in the produced sprouts

Comparison between seeds and sprouts phenols and antioxidant activity:





- sprouts performed better than seeds
- the rate of improvement depends on the species

Harvest and grounding

Extraction

Phenolic separation

Analyses

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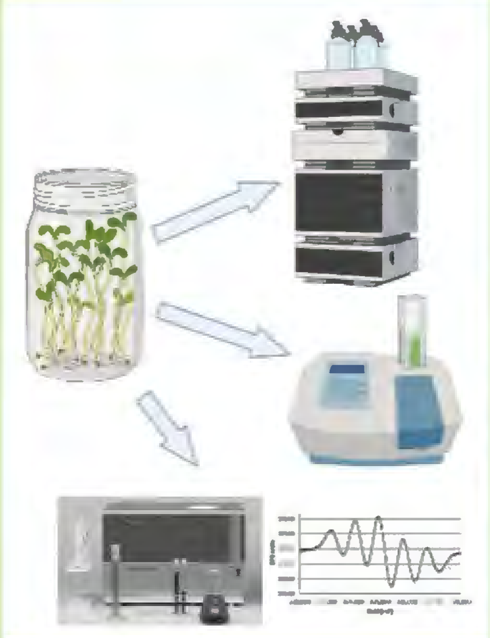
Biochemical and sensory characterization of fresh sprouts

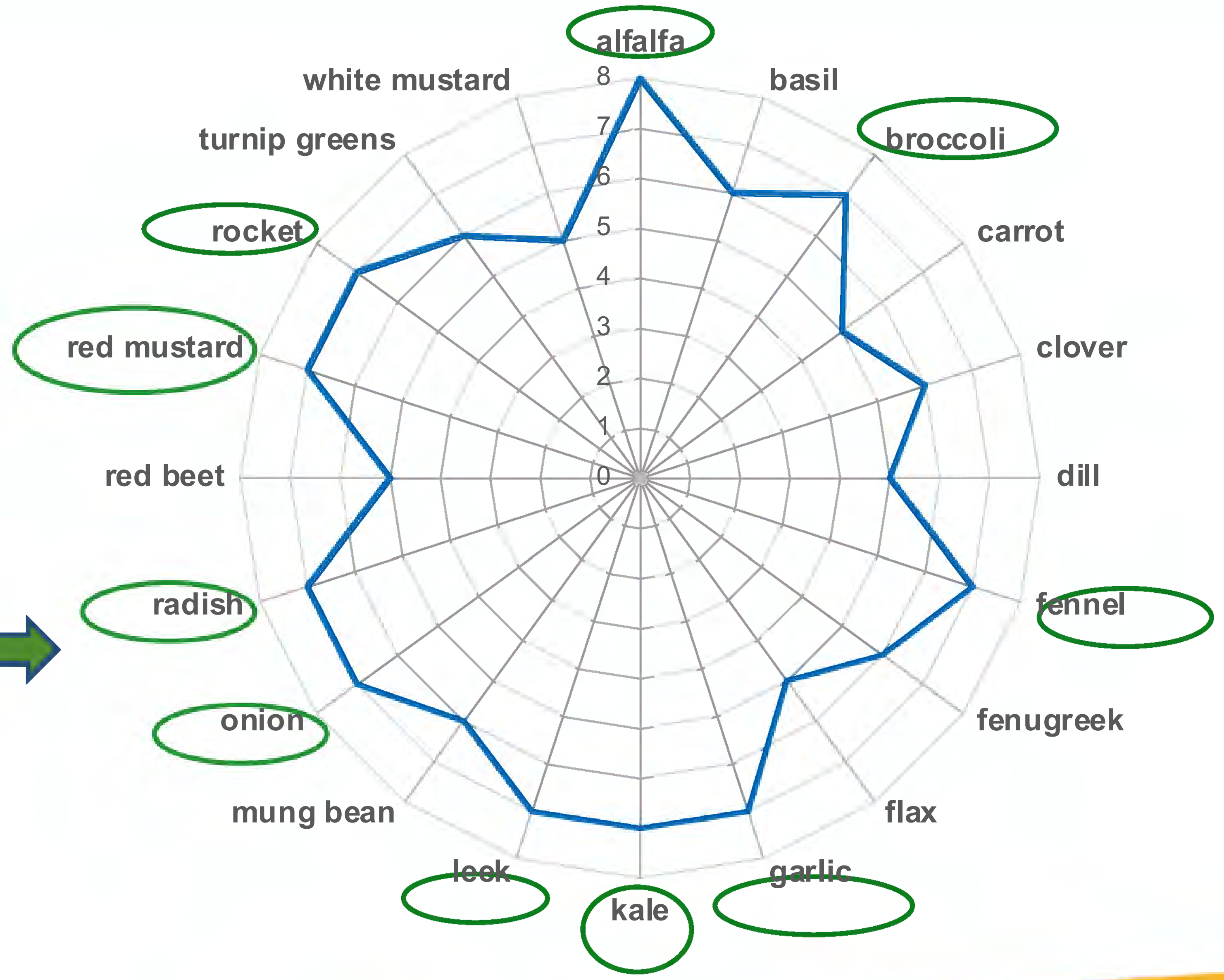
Sensory analyses



Colour, texture, sensorial characteristics (panel of trained testers)

Sprouts for fresh consumption or for processing

- Aspect pleasantness
- Bitterness intensity
- Spicy intensity
- Vegetal intensity
- Aroma pleasantness
- Consistency pleasantness
- Overall pleasantness
- Willingness to buy



Among the most preferred by panelists, the sprouts with the **highest antioxidant** content will be selected for shelf-life studies.

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Experimental Models: advanced *in vitro* and *in vivo* benefits validation of sprouts

Objectives

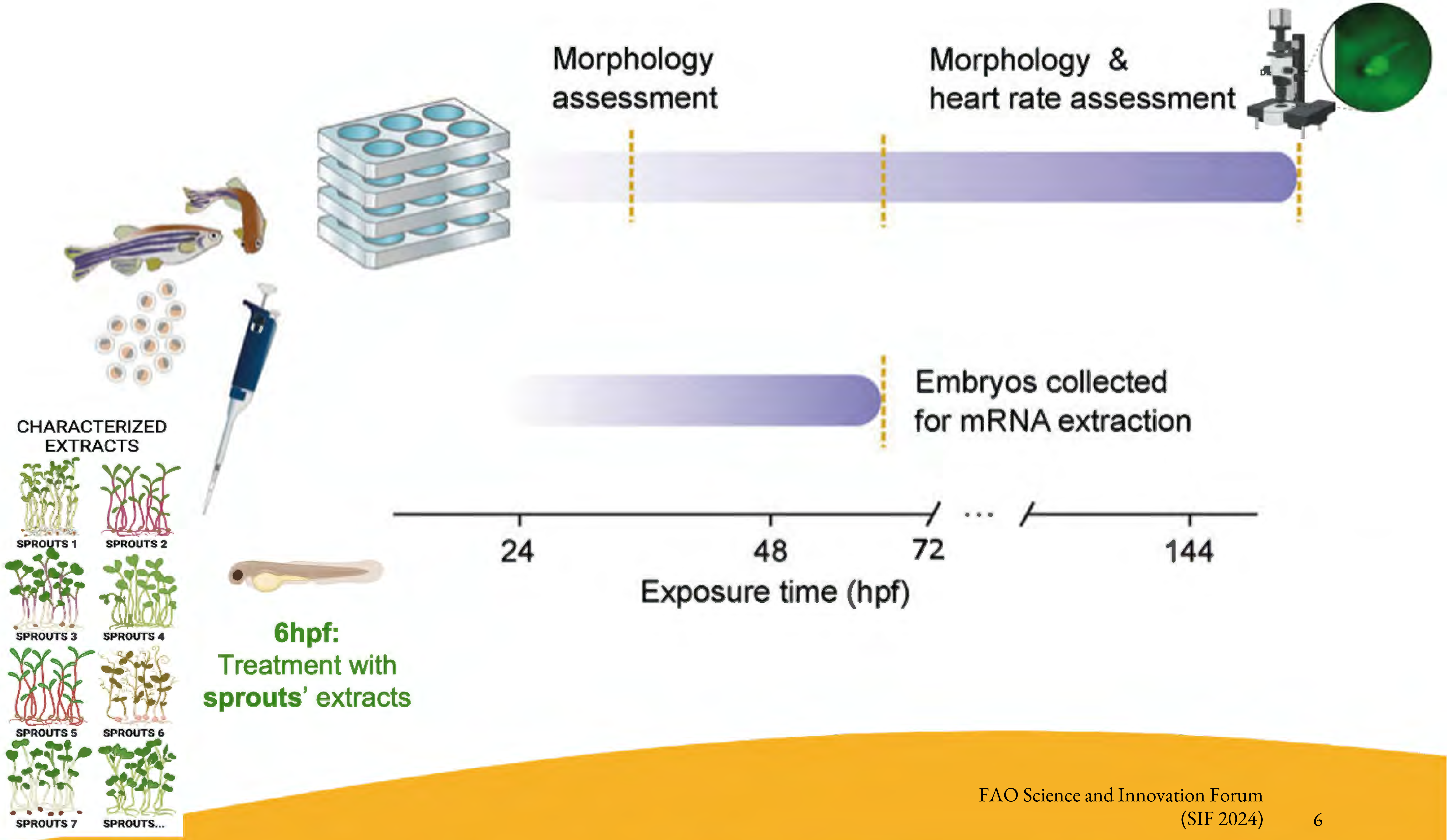
- **Characterization of Edible Sprouts:** Analyze 20 edible sprout species for antioxidants, polyphenols, and secondary metabolites, assessing in vitro antioxidant activity, immuno-modulation, prebiotic effects, and antinutritional compounds in collaboration with IBBA-CNR (Italy) and CSIC (Spain).

- **Validation of Cardioprotective Effects:** Test sprout extracts on **zebrafish embryos** to evaluate their cardioprotective effects against Doxorubicin-induced cardiotoxicity, analyzing gene expression, oxidative damage, and cardiac morphology using fluorescence microscopy

- **Expected Outcomes:** Identify 4-5 top-performing sprout species based on phytochemical profiles, bioactivity, and toxicity levels for further testing.

Validation of sprouts Health benefits:

Heart disease protection in Zebrafish Model !



Experimental Models: advanced *in vivo* benefits validation of sprouts

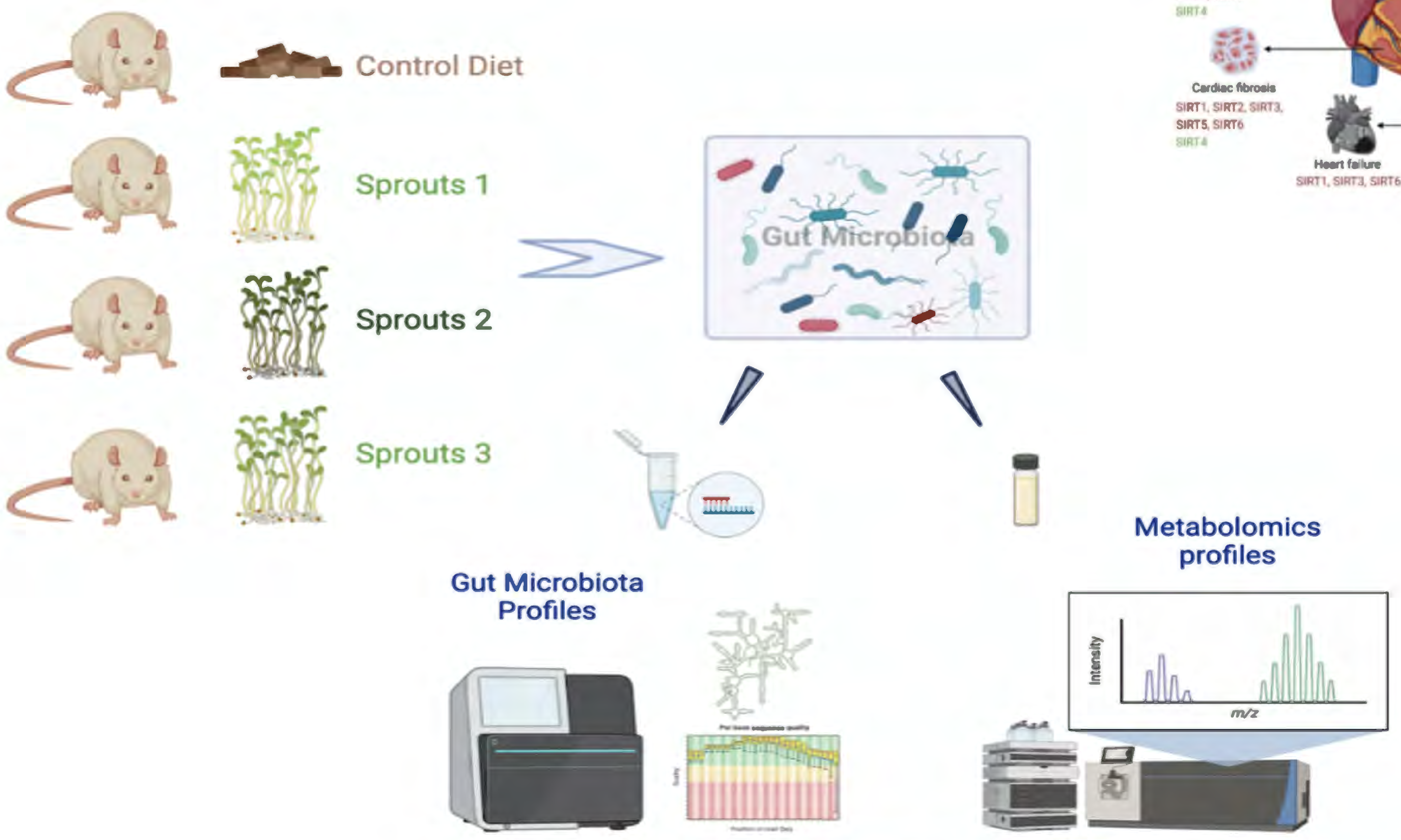
Objectives

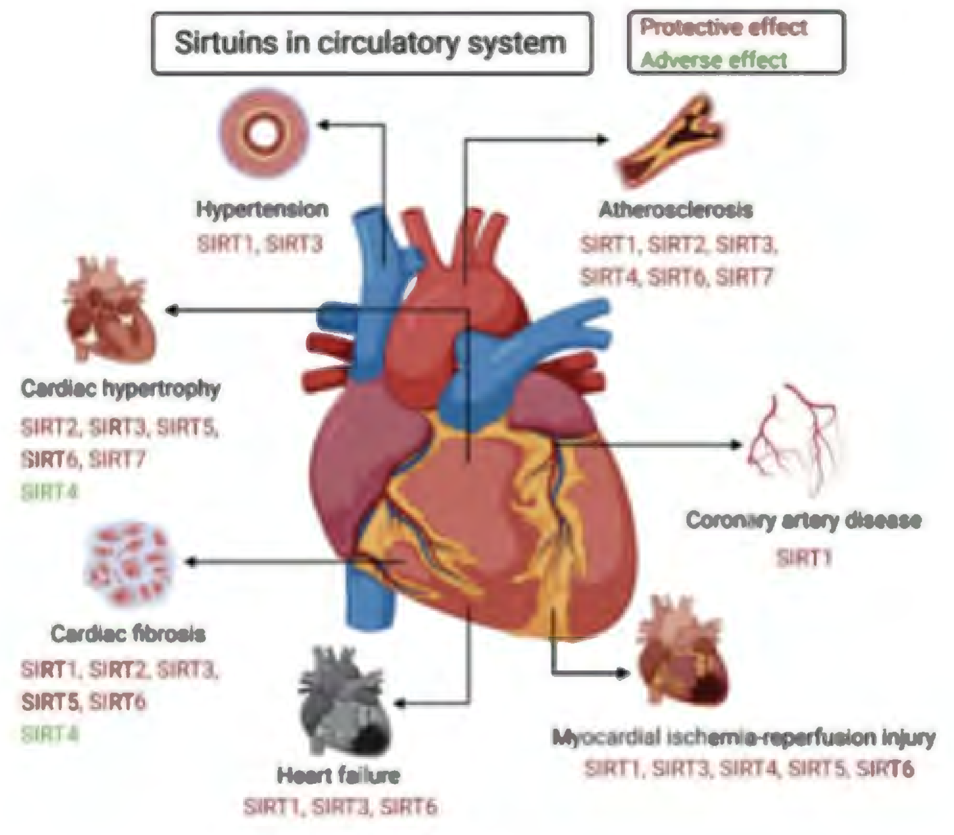
- **Selection of Sprout species for animal study:** Identify 4-5 top-performing sprout species based on phytochemical profiles and bioactivity from the zebrafish model.
- **Health and Microbiota evaluation:** Assess cardiovascular health and gut microbial communities through physiological measurements and fecal sampling.
- **Immune response monitoring:** Monitor immune responses throughout the treatment period.
- **Histological and Biomarker analysis:** Collect heart tissue samples for histological evaluation and measure oxidative stress biomarkers using sequencing and qPCR.

Analyze data to evaluate the cardioprotective effects of the bioactive compounds highlighting potential applications for reducing hypertension in high-risk cardiovascular disease patients.

Validation of sprouts Health benefits:

Hypertension protection in a rodent model Dahl Salt-Sensitive Rats





Wu et al., 2022

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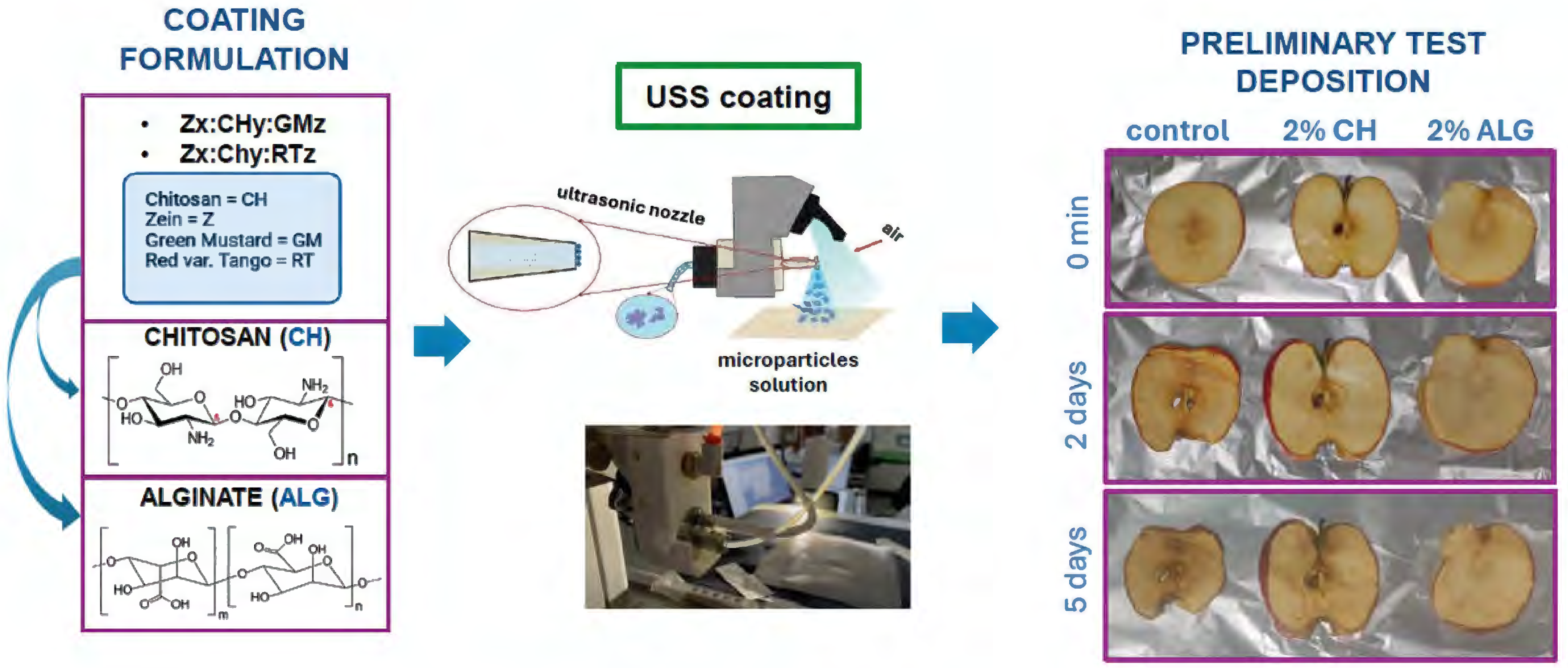
Development of edible coatings and biodegradable active packaging

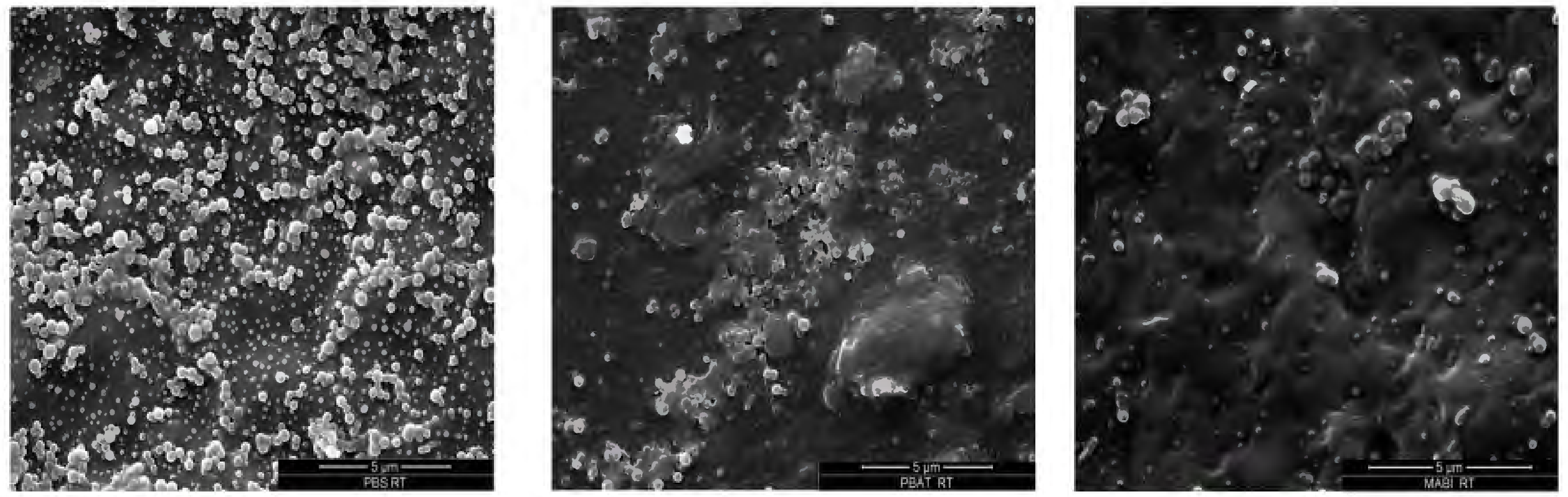
Objectives

- **Select Sprout extracts:** Identify sprout extracts with high antioxidant activity for formulation.
- **Develop Microparticles:** Embed selected extracts in natural polymer microparticles (polysaccharides and proteins).
- **Create edible Coatings:** Formulate and evaluate edible coatings using the microparticles on sprouts.
- **Incorporate into Films:** Integrate antioxidant-rich extracts into thermoplastic films to enhance shelf life and test the effectiveness of coatings made from red radish and green mustard extracts on cherry tomatoes.
- **Formulate active Coatings, manufacture and characterize films:** Develop polyester, polysaccharide, and protein-based coatings for sprouts and produce and assess active biodegradable films for sprout packaging.
- **Create Biobased Microcapsules:** Develop biodegradable microcapsules for active coatings in packaging films.
- **Evaluate Environmental Impact**: Assess the sustainability of developed coatings and packaging solutions.

New edible coatings from sprouts with antioxidant activity!

Preparation of edible coatings





Two innovative edible coatings formulated with Red Radish or Green Mustard were found effective in enhancing the shelf-life of cherry tomatoes.

Sample Name	Day 1	Day 5	Day 8	Day 12	Day 14	Day 16	Day 20	Day 23	Day 27	Day 30
Control										
RT formulated edible films*										
SV formulated edible films*										

*Radish var. tango (RT), Senape Verde (SV)

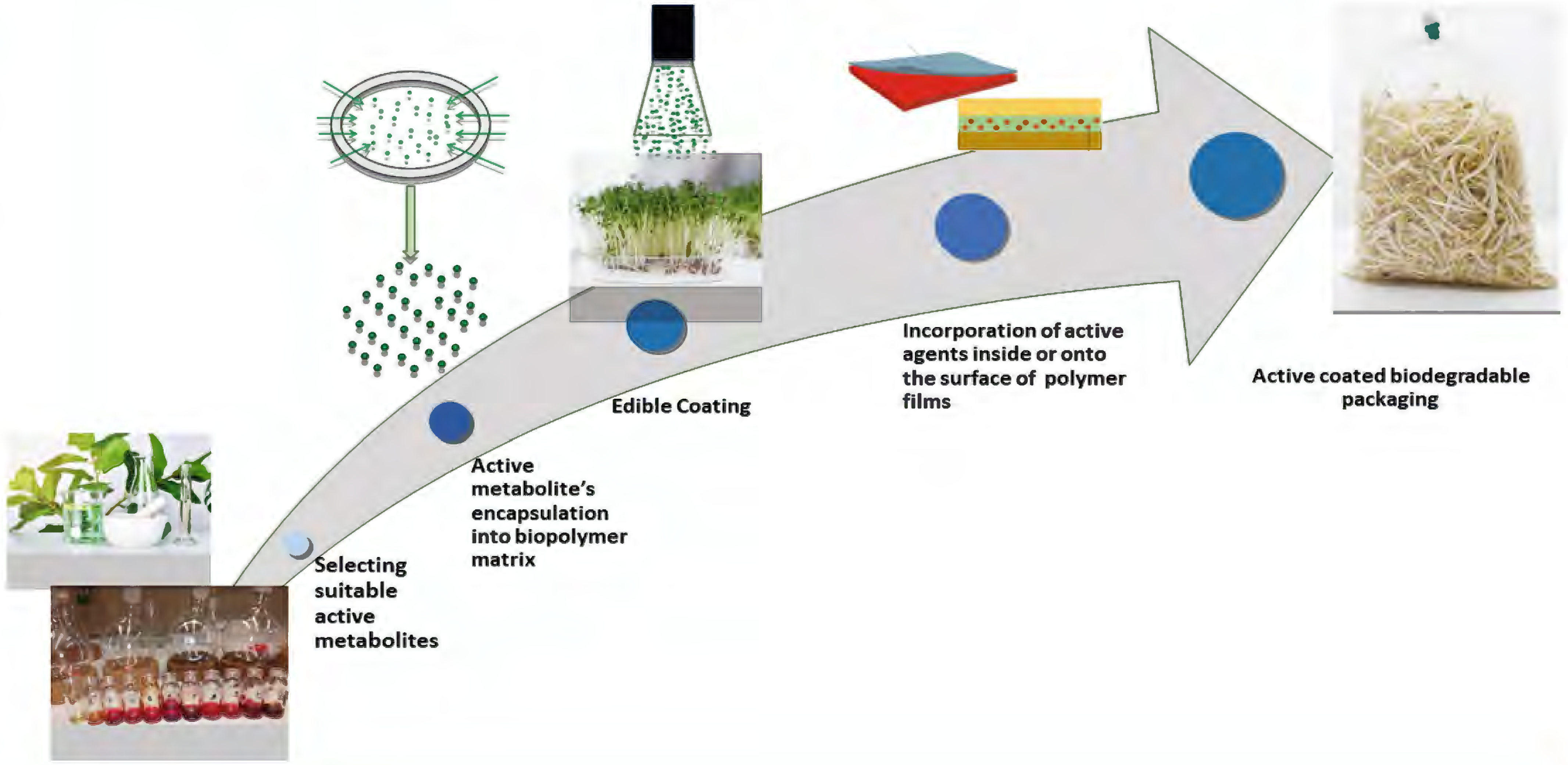
Quality characteristics and shelf-life of packaged products

Objectives

- To optimize modified atmosphere packaging parameters for sprout quality preservation.
- To select the most effective innovative packaging for extending sprouts' shelf-life.
- To test the efficacy of edible coatings on sprouts' shelf-life

Shelf-life testing of sprouts packaged with the new <u>active packaging</u> and/or treated with the innovative <u>edible coatings</u>

Colour, texture, bioactive metabolites, in vitro antioxidant activity, membrane integrity (TBARS), PAL enzyme, off-flavour development, microbiol analyses, sensory properties



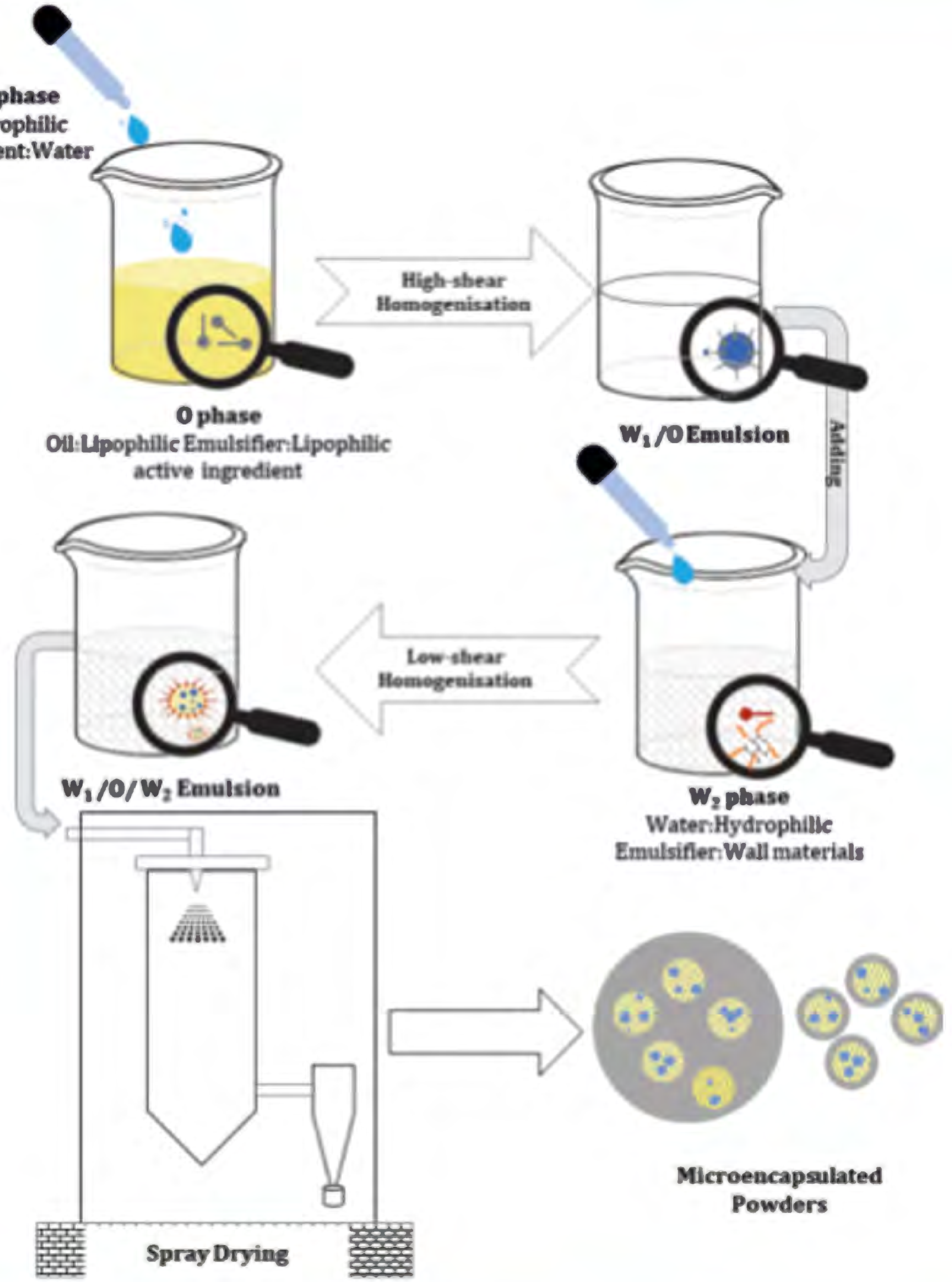
Microencapsulation of bioactive compounds for food ingredients.

ADANA ALPARSLAN TÜRKEŞ
BİLİM VE TEKNOLOJİ ÜNİVERSİTESİ

Objectives

- To determine optimum microencapsulation formulation.
- To determine optimum spray drying process conditions during the production of microencapsulated powders.
- To identify the storage stability of the microencapsulated powders.
- To investigate the potential of microencapsulated bioactive compounds as a food ingredient: production of drinkable yogurt and Turkish noodles using microencapsulated bioactive compounds.

Bioactive compounds microencapsulation:



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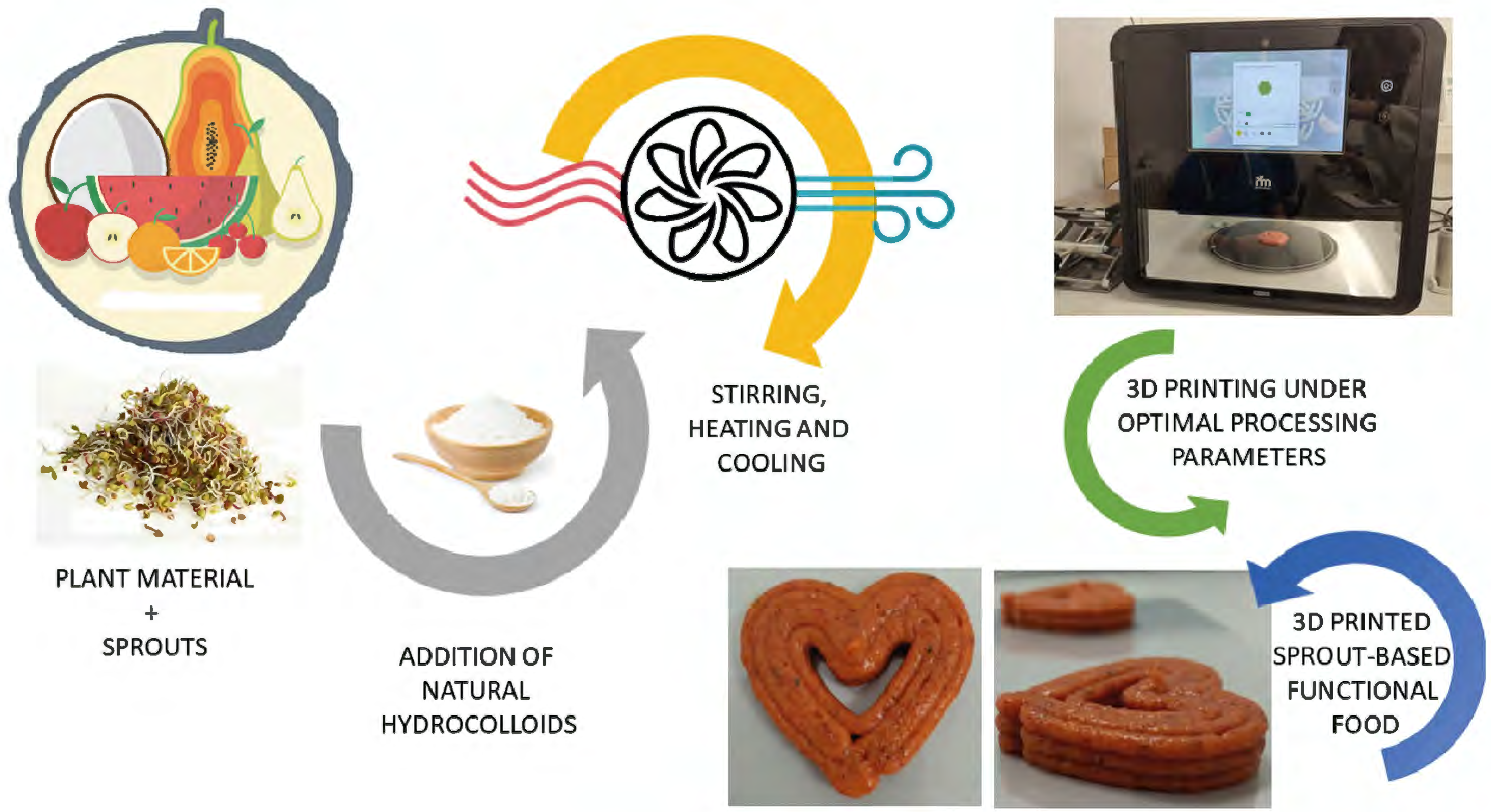
Production of snacks and jelly food containing the selected healthy sprouts

faculty of food technology and biotechnology
University of Zagreb

Objectives

- To select plant material eligible for 3D printing and cooking.
- Sprouts functional food production based on 3D-printing technology
- Application of sustainable non-thermal technologies in sprouts functional food production
- Sprouts functional food production based on cooking with gelling-agents

Novel sprout-based functional foods:



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Consumer acceptance, social awareness, and carbon footprint

Objectives

- To define the requirements of different consumer profiles using personas technique related with the project approach.
- To reach a better knowledge about the most effective communication strategies to provoke a **change in the consumers' diet behavior** according to their lifestyle
- To develop a consumer perception evaluation about the initial concept of the prototypes
- To develop **MED-based educational games and e-manuals** based on scientific evidence in order to increase social awareness about MED benefits.
- To assess the carbon footprint of a few selected FEED products.

Living labs and Sustainability: Promoting the mediterranean diet!

MEDITERRANEAN DIET

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TUM

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