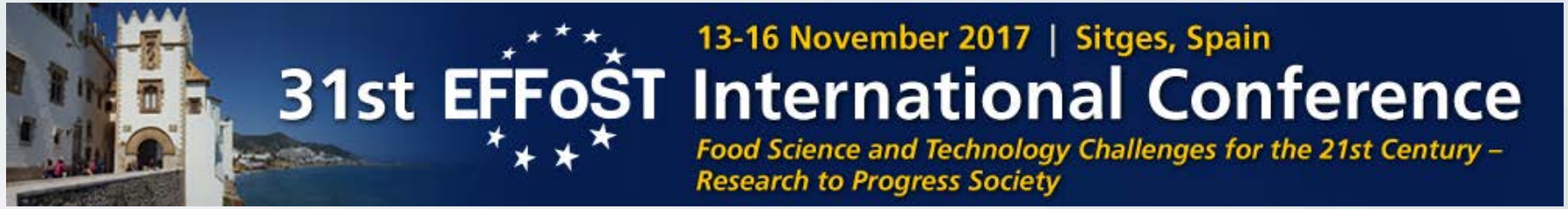


Sustainability in the vegetable food supply chain
- overview of the results of the project SUNNIVA

Trond Løvdal, Ferruh Erdogdu, Bart van Droogenbroeck, Ingunn Vågen, Agnieszka Bartoszek, Christine Vos, Inge Hanssen, Giovanni Agati, Stanislaw Kaniszewski, Dagbjørn Skipnes, Mustafa Tutar, Romain Larbat, Christophe Robin

Sunniva

Sustainable food production through quality optimized raw material production and processing technologies for premium quality vegetable products and generated by-products

SUNNIVA project consortium

- Nofima
- NIBIO
- Fjordland AS
- Fjordkjøkken AS

- Gdansk University of Technology
- InHort Research institute of Horticulture
- Meat Company Nowak
- Enbio Technology

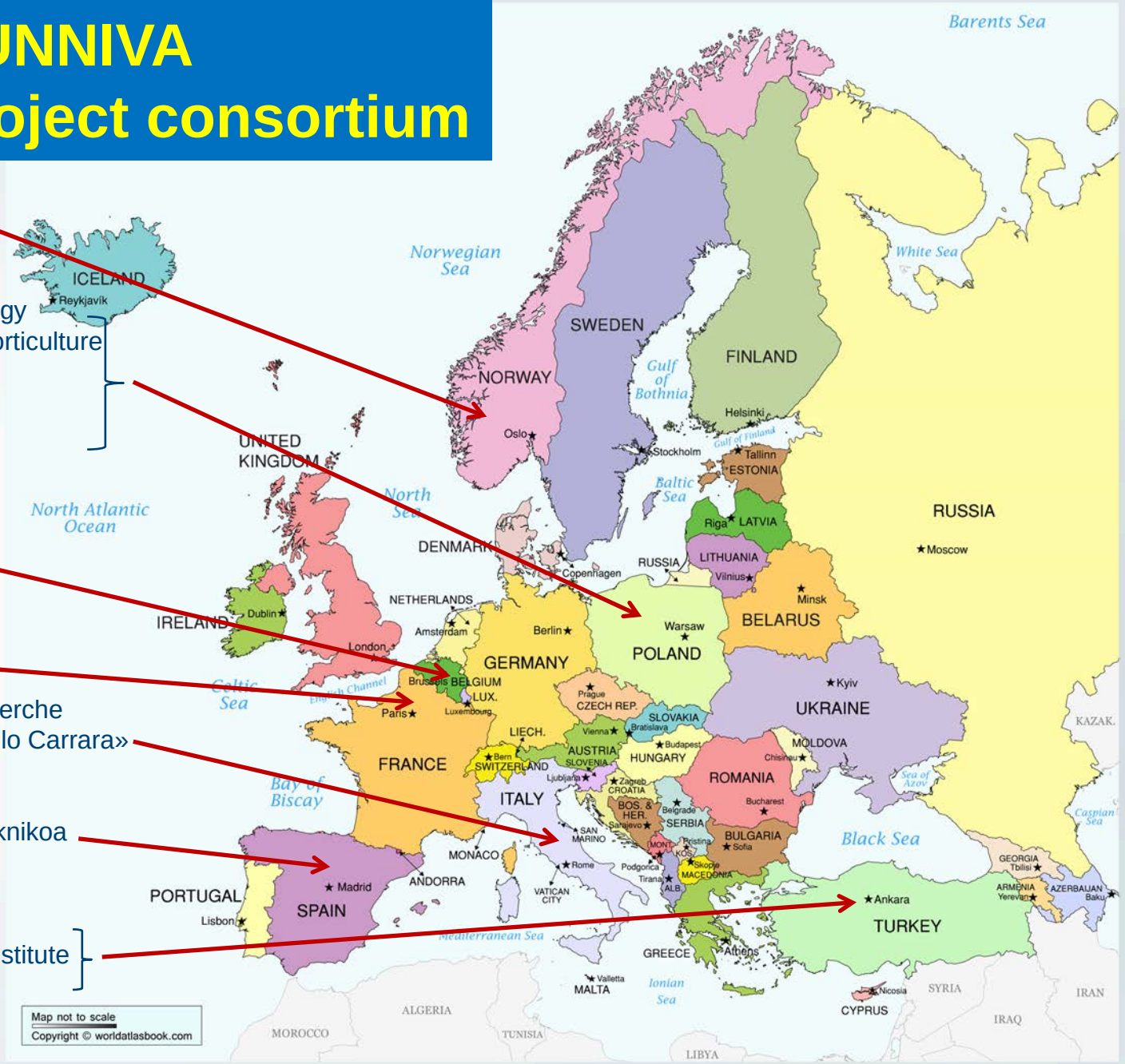
- ILVO
- Greenyard Prepared
- KU Leuven
- De Ceuster Meststoffen

- INRA

- Consiglio Nazionale delle Richerche
  – Istituto di Fisica Applicata «Nello Carrara»

- Mondragon GOI Eskola Politeknikoa

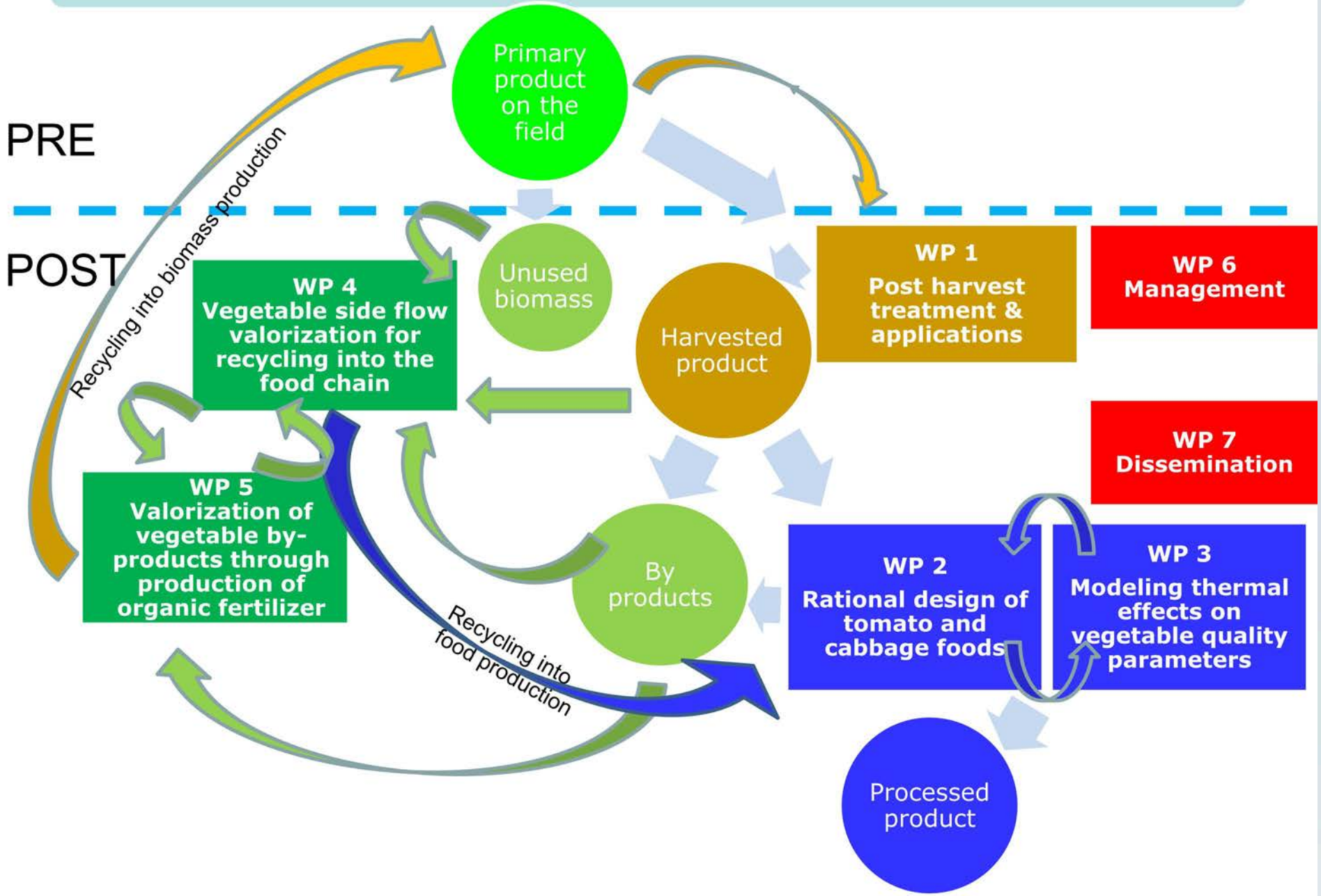
- Ankara University
- Alata Horticultural Research Institute



- **17 partners from 7 countries**

“We aim at the development of a sustainable food system from production to consumption, addressing the entire food supply chain for the vegetables tomato and *Brassica* and their derived products. The project will increase consumers’ access to safe, healthy and convenient food through novel processing techniques and improve utilization of raw material, by-products and waste, for which valorization strategies will be developed”

Work package interactions – flow diagram



Objectives WP 1
Post-harvest treatments and applications

- O1: Generate added health value of vegetables for food products and by-products by means of optimized post-harvest conditions and use of elicitors

- O2: Determine critical control points from harvest to processing to maintain raw material quality and preserve health-beneficial phytochemicals (HBPC)

- O3: Optimize non-destructive optical tools to estimate in situ flavonols and chlorophyll of *Brassica* and lycopene content of tomato to facilitate more frequent and inexpensive monitoring of PC content of vegetable raw material. This tool will be used in Objectives 1 and 2.

WP1 Post-harvest treatments and applications (NIBIO, InHort, CNR-IFAC)

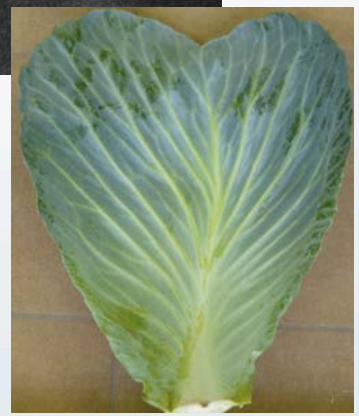
Field trials

Jæren, Norway

Skierniewice, Poland

Non-destructive optical tools for monitoring of lycopene in tomato and flavonols and chlorophyll in Brassica were developed and validated, and practically applied in WP1 research activities.

Dualex



Multiplex

Example of elicitor treatment:
Waste fraction of tomatoes treated with ethylene

cv. Calista F1

Before storage

After storage with ethylene

cv. Volna F1

Before storage

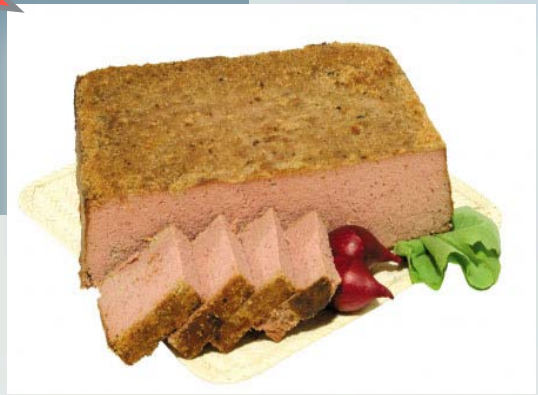
After storage with ethylene

Objectives WP 2
WP2 Rational design of cabbage and tomato foods

- O1: Design food products with high health quality by exploiting relevant PC in Brassica and tomato
- O2: Design technology for production of proposed products at moderate cost and low energy expenditure

WP2 Rational design of cabbage and tomato foods

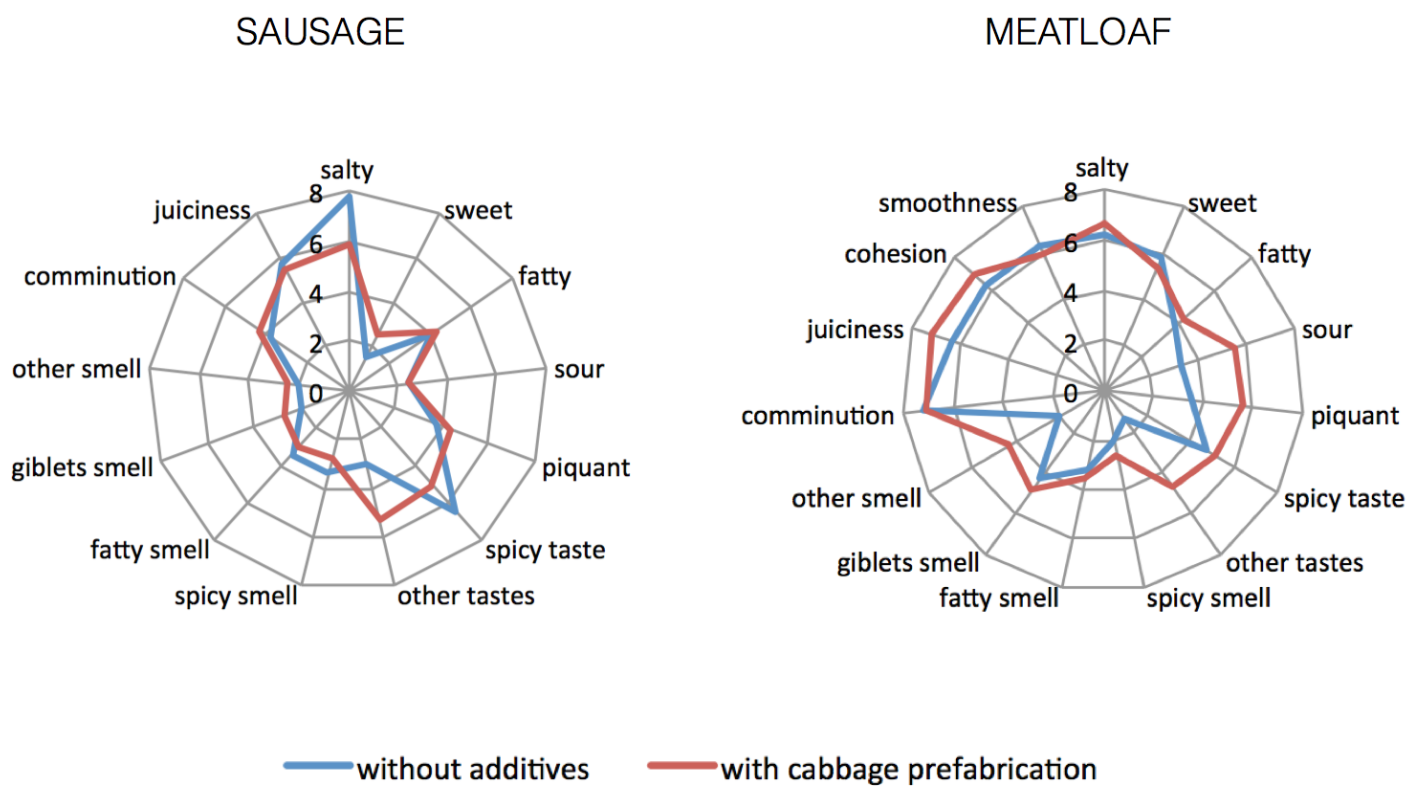
GDANSK UNIVERSITY OF TECHNOLOGY
FACULTY OF CHEMISTRY



- Sausage and Meatloaf with 18% prefabricated cabbage

Brassica vegetables contain powerful anticarcinogens. Could this be exploited in meat industry?

SENSORY ANALYSIS - Marine Academy, Gdynia



- > 10% less fat in products with cabbage prefabrication

Objectives WP3
WP3 Modelling thermal effects on vegetable quality parameters

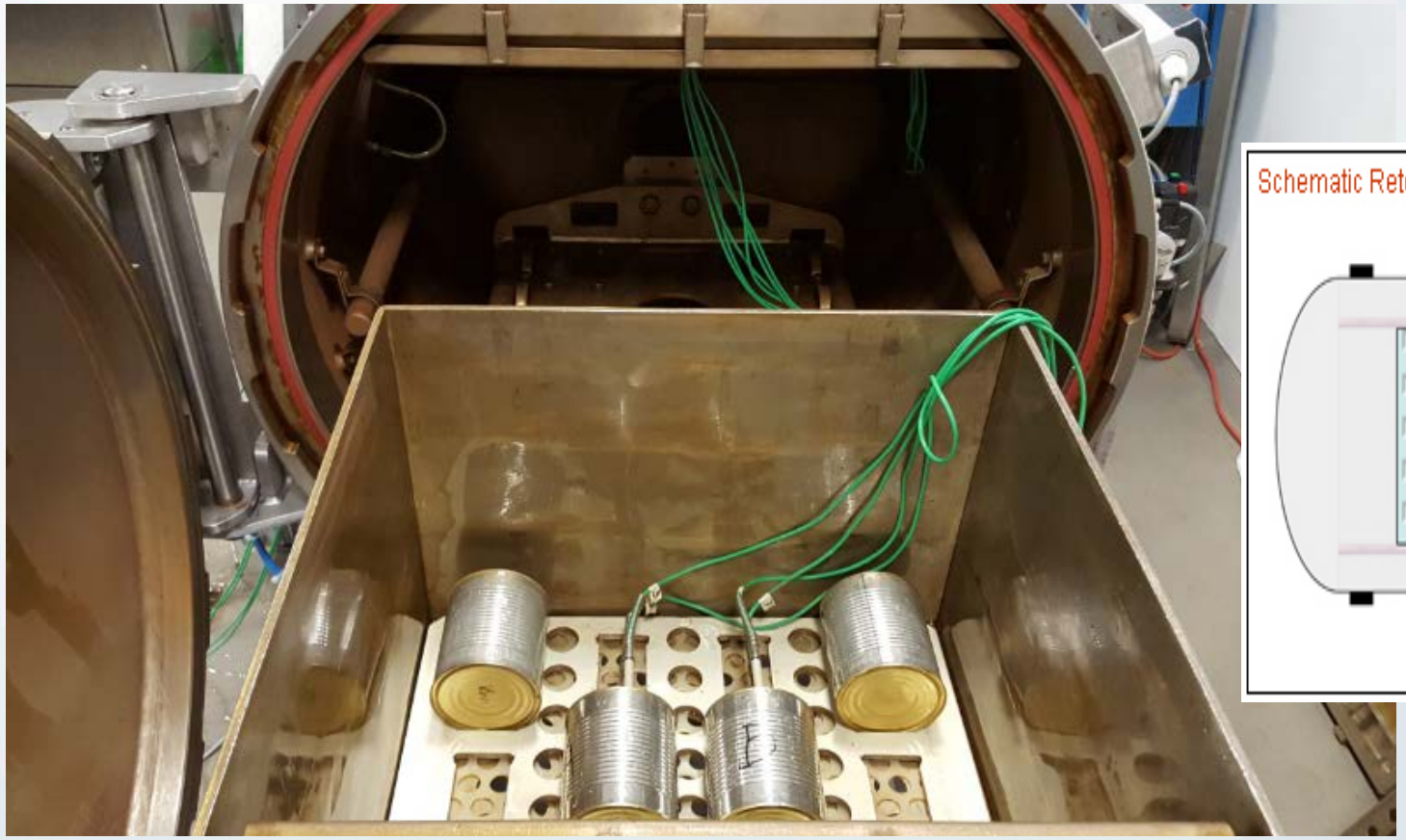
- Optimize the process for shaking retort systems (reduced thermal processing time will also improve nutritional and sensory quality)

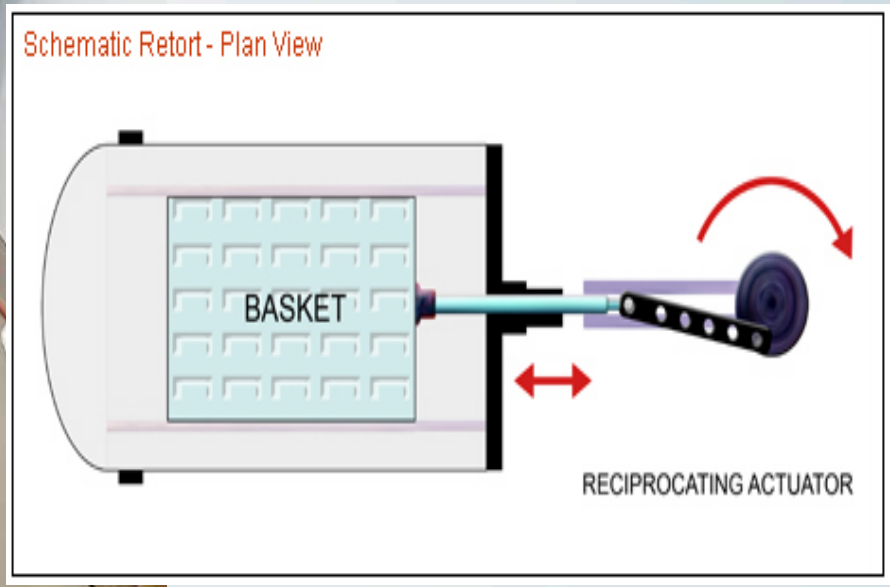
- Develop a model for thermal effects on health beneficial phytochemicals (PCs - lycopene in tomato and glucosinolates in Brassica based products)

WP3 Modelling thermal effects on vegetable quality parameters

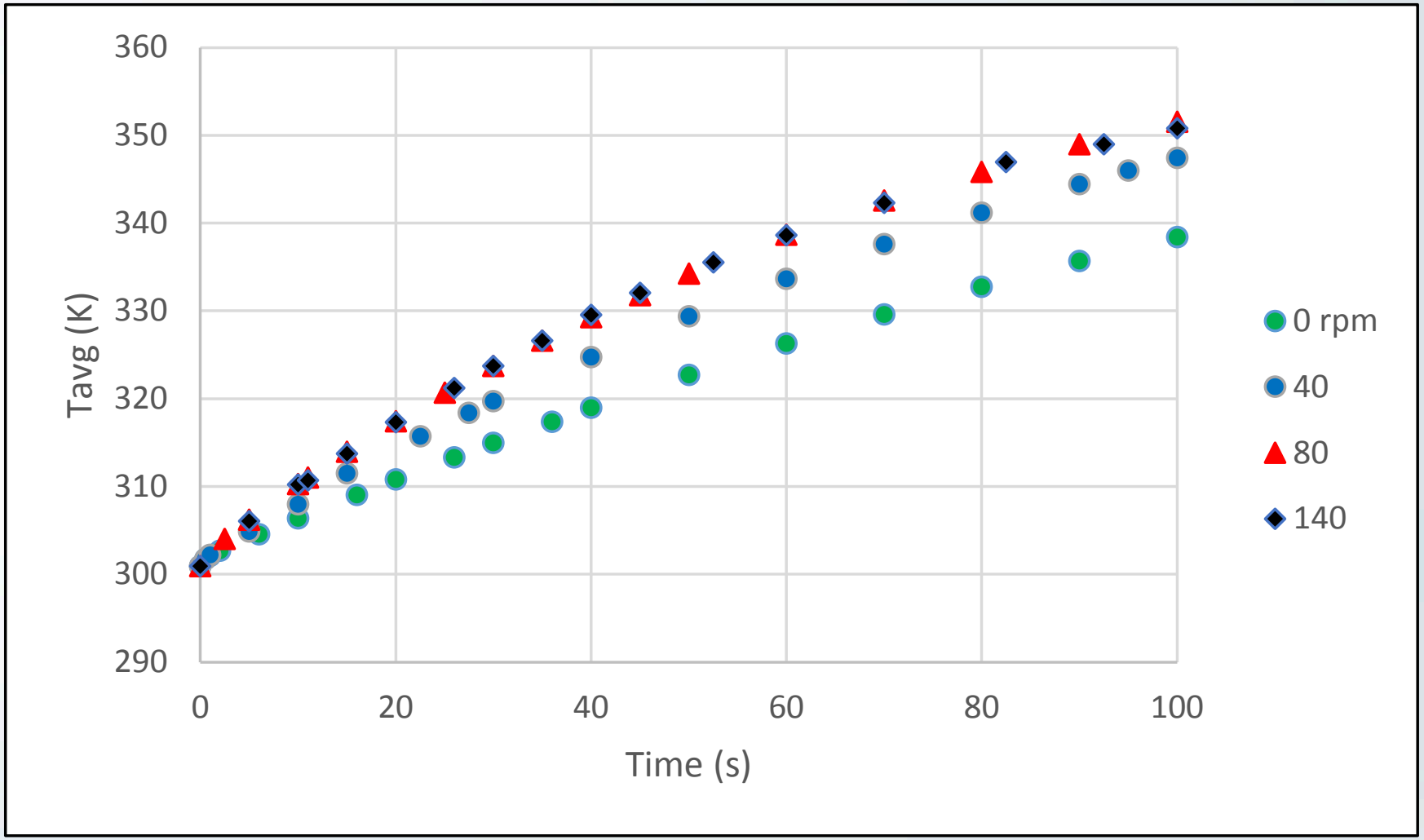
(Ankara University, Nofima, Mondragon GEP)

Shaking Retorts

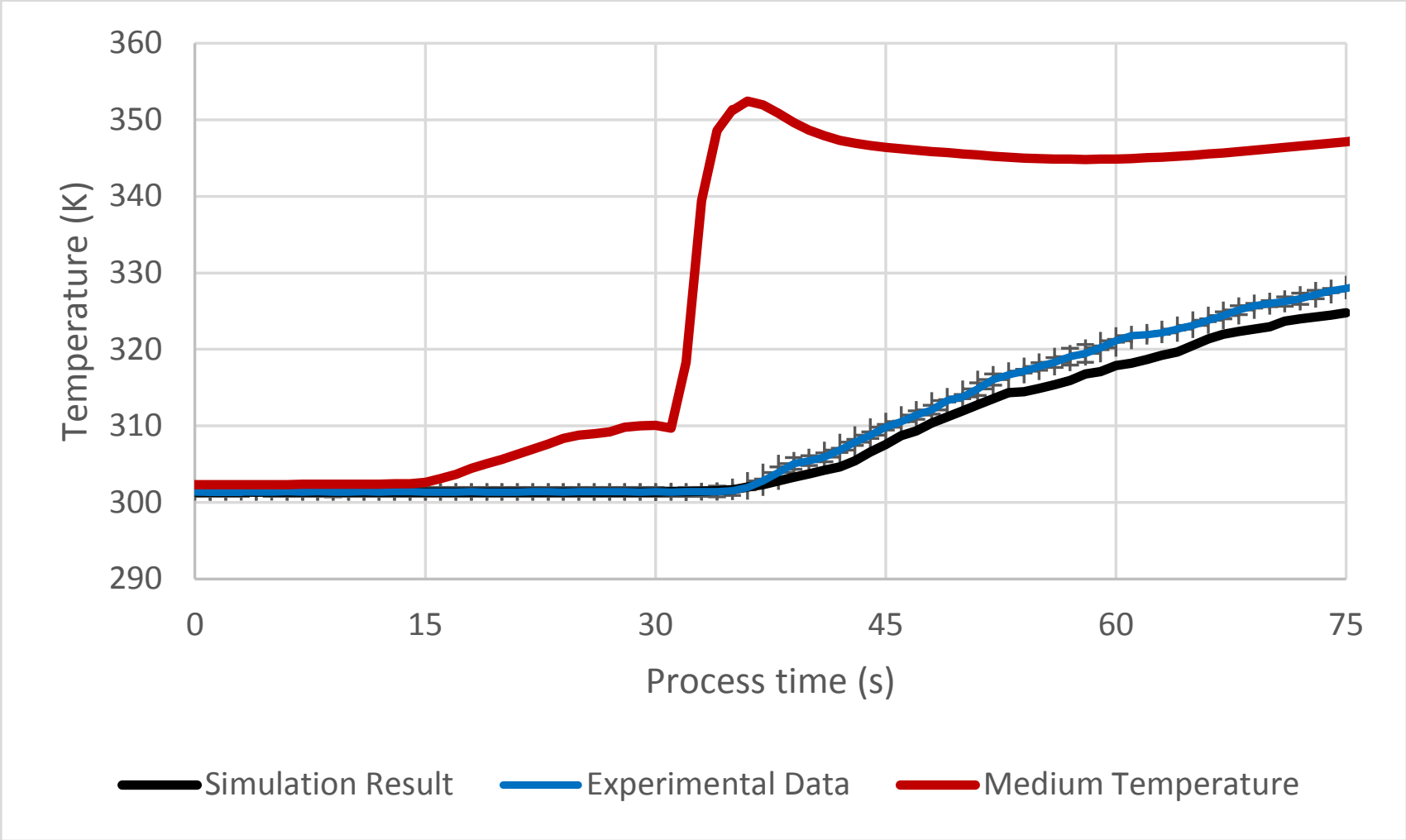




Comparison of the container average temperature at different oscillation rates



Comparison of experimental and numerical simulation results



Objectives WP4

WP4 Vegetable by-product valorization

- Characterization of the most relevant PC in underutilized vegetable biomass and investigating the impact of processing technologies on the presence of PC
- Evaluate innovative **cost-efficient** stabilization/processing techniques, that maximally preserve initial **quality**
- Develop versatile/flexible technologies/processes, suitable for different types of biomass
- Strive for **combined valorization** routes, starting as high as possible in the value chain - recycling into food production & biomass production

WP4 Vegetable by-product valorization (Greenyard Prepared, ILVO)

Characterization

Vegetable by-products:
Salsify, carrot, bean, flageolet, peas, red beet, celery…

Processing & Stabilization

Technologies:
Oxygen-free milling and pressing (Vaculiq) – innovative drying technologies – UHT/Pasteurisation

Valorisation

End products:
Juice, dietary fiber, colorant, bioactives …

Analysis

pH, Brix, moisture content, protein, sugar, fibre, bioactives, microbiology, heavy metals, pesticides & mycotoxins shelf-life, phyisco-chemical stability ….

Objectives WP5

WP5 Vegetable waste flow valorisation through incorporation into organic fertilizer/soil amendment

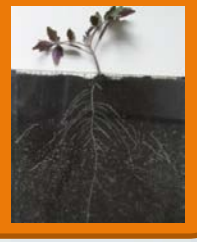
- Conversion of food processing waste/side-flows into raw materials for production of organic fertilizer and soil amendments

- Enhancement of the raw material by addition of beneficial microorganisms to increase vegetable Health-Beneficial PC content, in a sustainable commercial production context

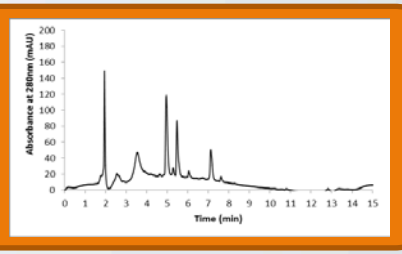
WP5 Vegetable waste flow valorisation through incorporation into organic fertilizer/soil amendment (DCM, KUL)

1. Inventory & analysis of vegetable side flows:
-Nutrient content
-Organic matter

2a. Effect on plants:
-Plant growth
-Disease resistance



2b. Analysis of bio-active compounds



3. Innovative drying & stabilization of promising side flows

4. Effect on plants

5. Production of soil amendment or fertiliser test batch

6. Test product in greenhouse and field scale trials

Other partners involved: NIBIO, CNR-IFAC, ILVO, Inhort, INRA

Acknowledgements

The Research Council of Norway

SUSFOOD

fondation daniel & nina carasso
sous l'égide de la fondation de france

The National Centre for Research and Development

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VEGETABLE OPTIMIZATION PROJECT