



EU GREEN DEAL

**MAKE IT  
REAL**

**PARTNER EVENT**  
**#EUGREENWEEK**  
**30 MAY – 5 JUNE 2022**

**DISTAL**



ALMA MATER STUDIORUM  
UNIVERSITÀ DI BOLOGNA  
DIPARTIMENTO DI SCIENZE E TECNOLOGIE  
AGRO-ALIMENTARI

**STAAA PhD OPEN DAY**

Dipartimenti di Eccellenza 2018-2022  
DISTAL The Nexus Approach for Sustainability in Agriculture,  
Food, Energy & Water

*June 1<sup>st</sup>, 2022*

# Biotechnological valorization of residues and by-products from agro-food industries

PhD candidate: **Beatrice Cellini**

Cycle: **XXXVI**

(supervisor: *Prof. Lucia Vannini*;  
co-supervisors: Dott. Giorgia Gozzi)

**NEXT  
GEN  
EU**

# EU waste production

Processing and production of food, beverages and tobacco generated around **22.4 million** tons of waste in the EU-27 in 2018

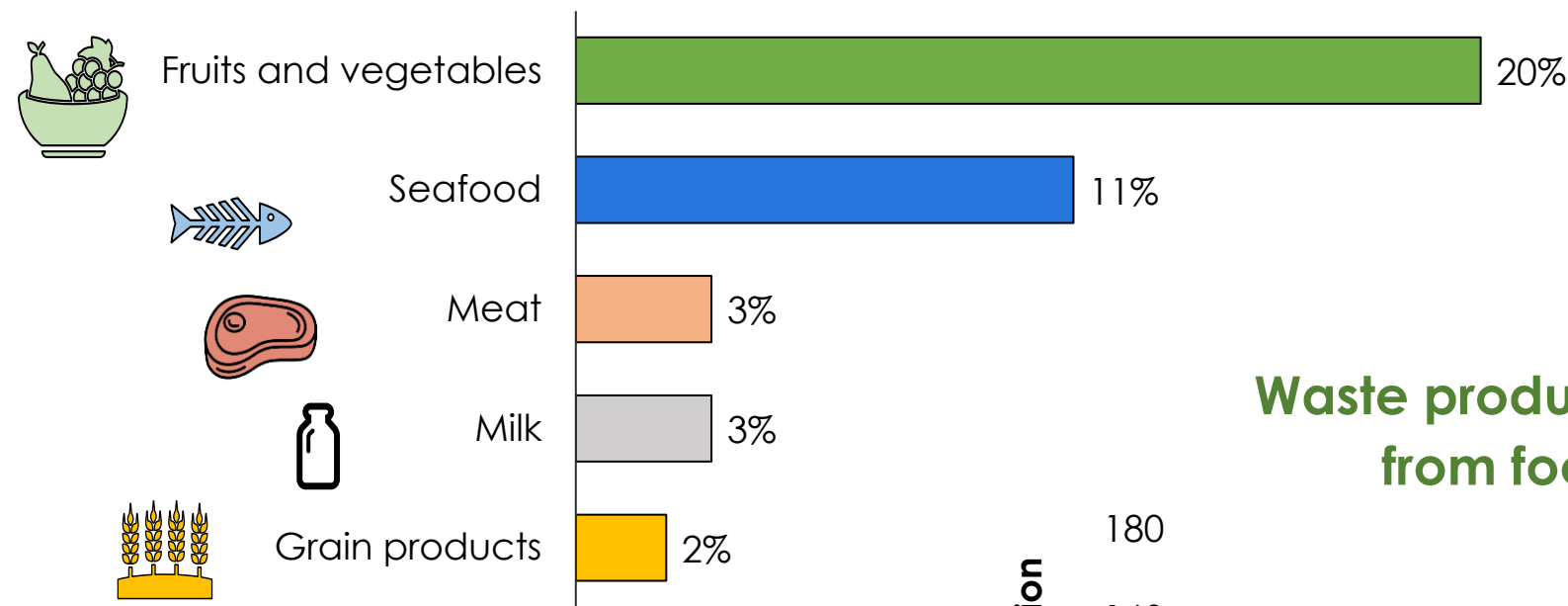
## Principal waste categories:

- Animal
- Fruits
- Vegetables
- Fats and oils

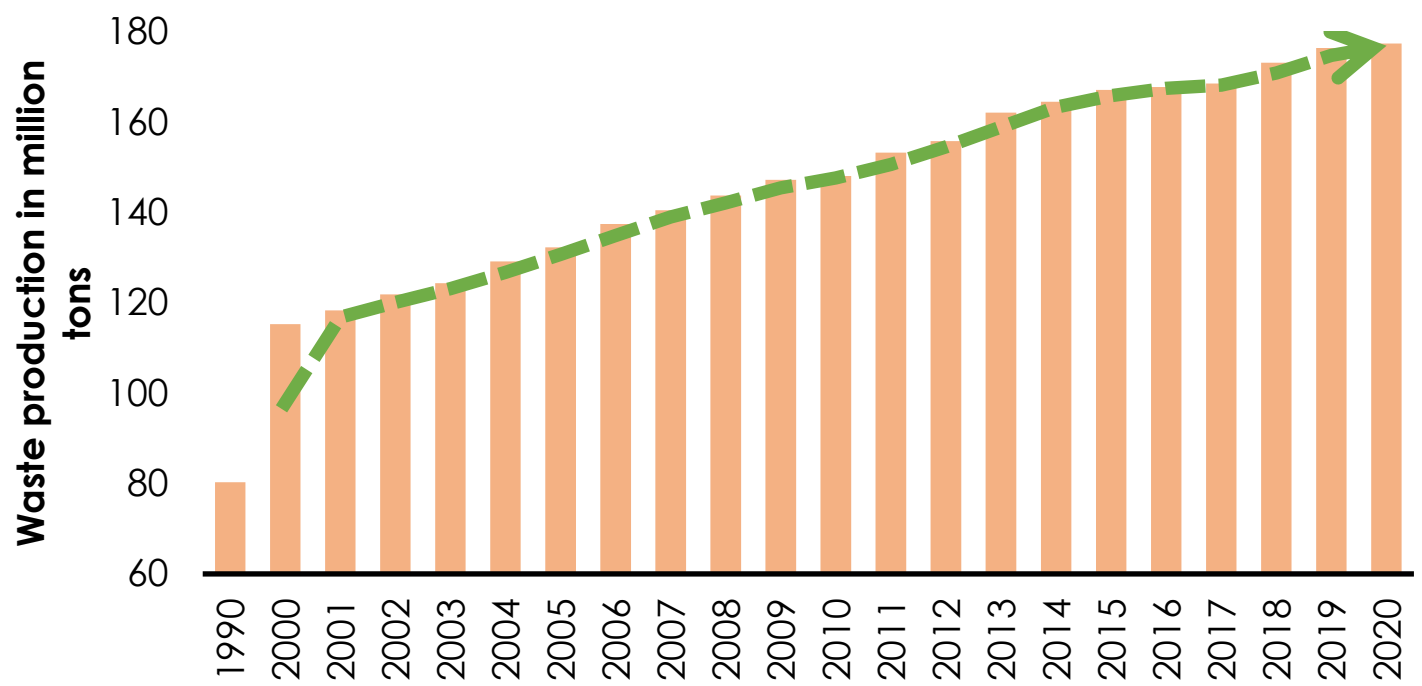
Mainly used as feedstock, biofuels and energy production



# Percentage of food wasted Worldwide



Waste production of fruit and vegetables from food industries Worldwide



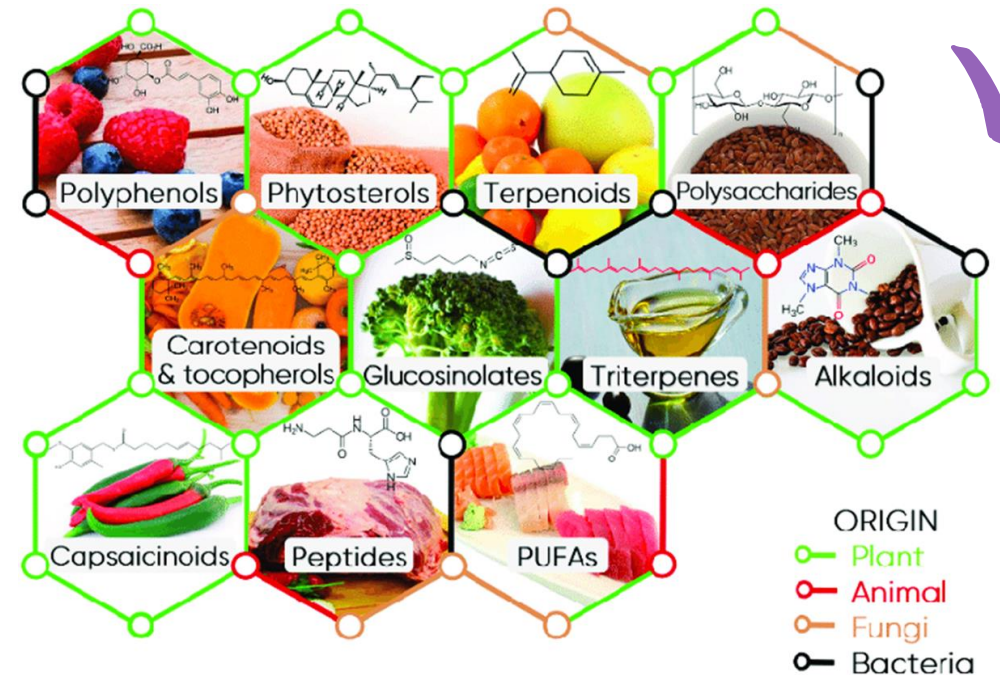
**Note(s):** Worldwide; 2011  
**Source(s):** Natural Resources Defense Council; FAO; [ID 239813](#)



# The value of reuse



**REDUCE  
REUSE  
RECYCLE**



## Valorization of some agro-food by-products and residues



Evaluate and exploit  
their functional  
properties

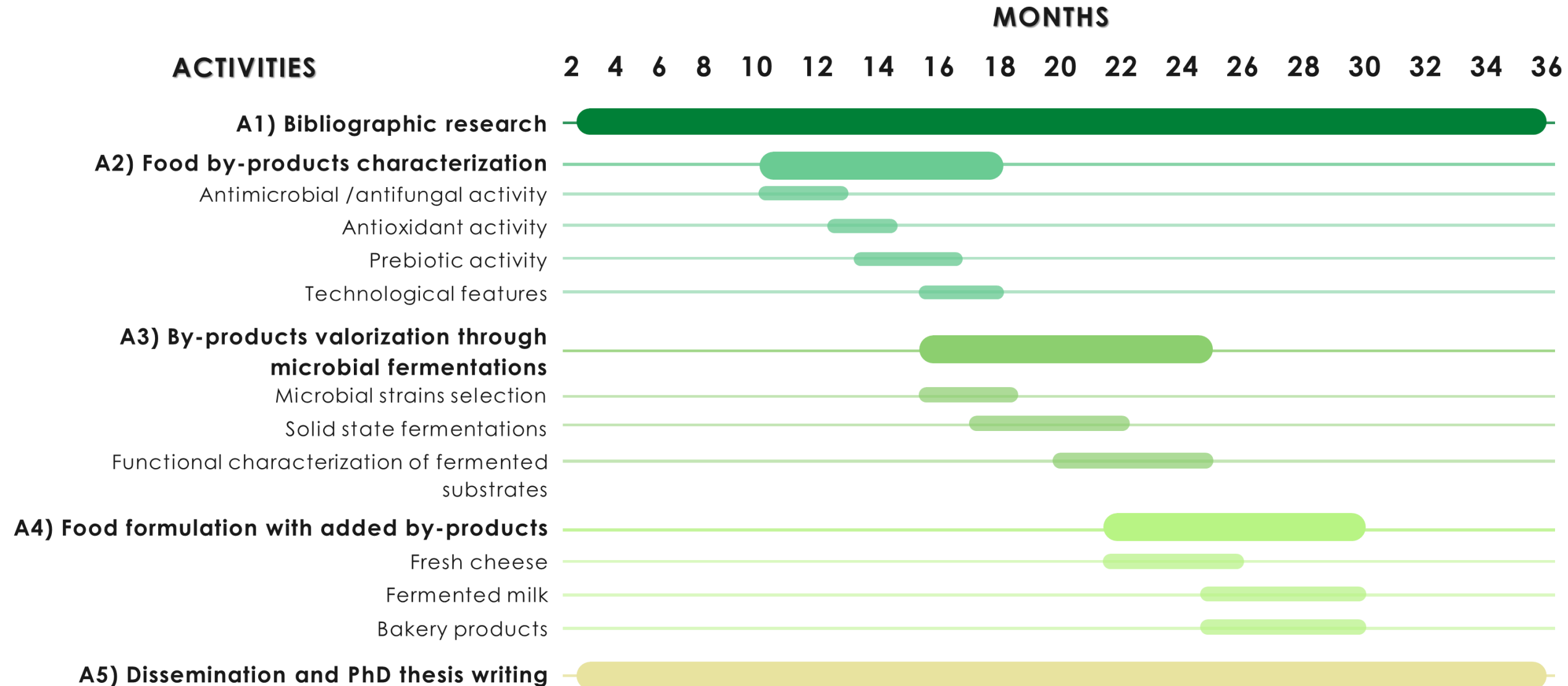


Develop  
biotechnological  
processes based on  
microbial fermentations  
to increase their  
bioactivities



Use of the by-products  
as functional  
ingredients directly  
added to foods

# Gantt diagram



# Citrus pomace



Worldwide production:  
Over **14.50 million tons**  
Italian production:  
**3 million tons/year**

**Inedible part → 60-70%**

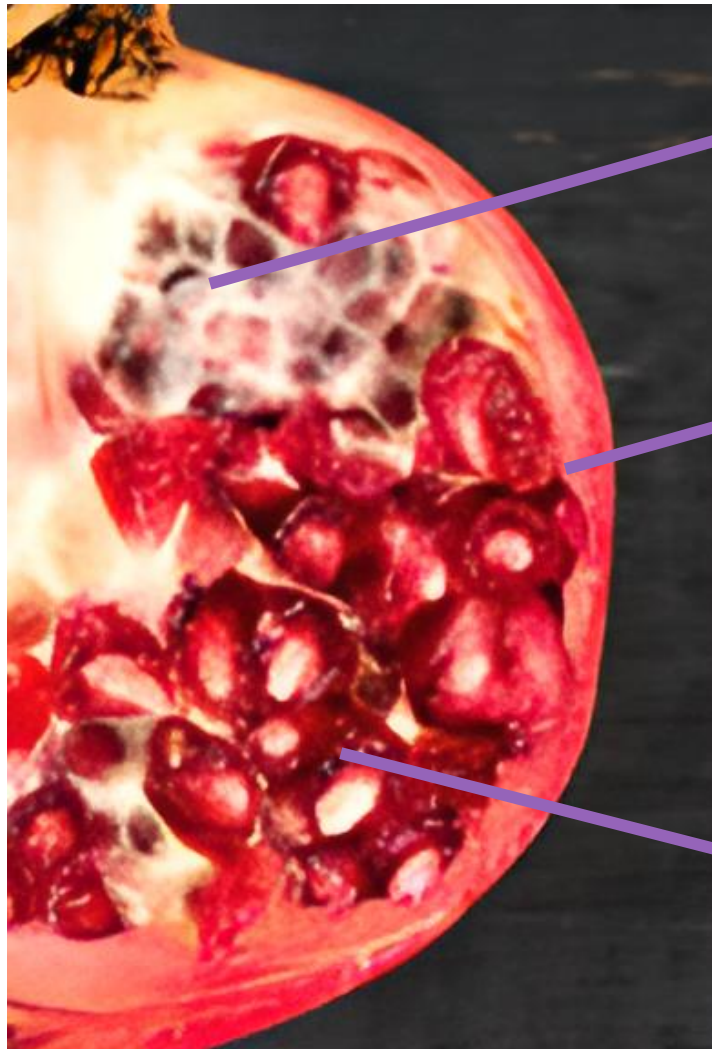
Edible part → 30-40%

## Composition:

Water 85%  
Fibres 6%  
Sugar 2-4%

Proteins 1%  
Minerals 0.5-0.6%  
Oil 0.1%

# Pomegranate peels and seeds



**Pulp membrane**

**Peels**

**Arils**

49-55%

Juice → 26-30%

Seeds → 18-20%

**FOOD  
WASTE**

## **Phenolic compounds**

(18-510 mg/g dry matter)

- flavonoids (anthocyanins and flavonols)
- tannins (ellagitannins and gallotannins)



# *Equisetum arvense*

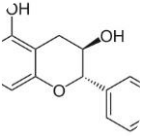


- Dietary fibres
- Vitamins A, E and C
- Minerals: potassium (3-5%), calcium (1-2%), manganese, magnesium (0.1-0.3%), phosphorus (0.4%)
- Tannins
- Phenolic esters
- Flavonoids
- Phytosterols
- Alkaloids
- Caffeic acid

In horticulture and agriculture, an aqueous extract of *E. arvense* has been approved for its use as a fungicide in the European Union

# Food by-products characterization

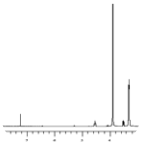
## Chemical characterization



Total phenols (Folin-Ciocalteu)



Antioxidant activity (DPPH assay)

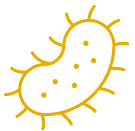


Volatile compounds (SPME-GC/MS)

ingredient

REAL SYSTEM  
'PRIMO SALE'  
CHEESE

## Functional characterization



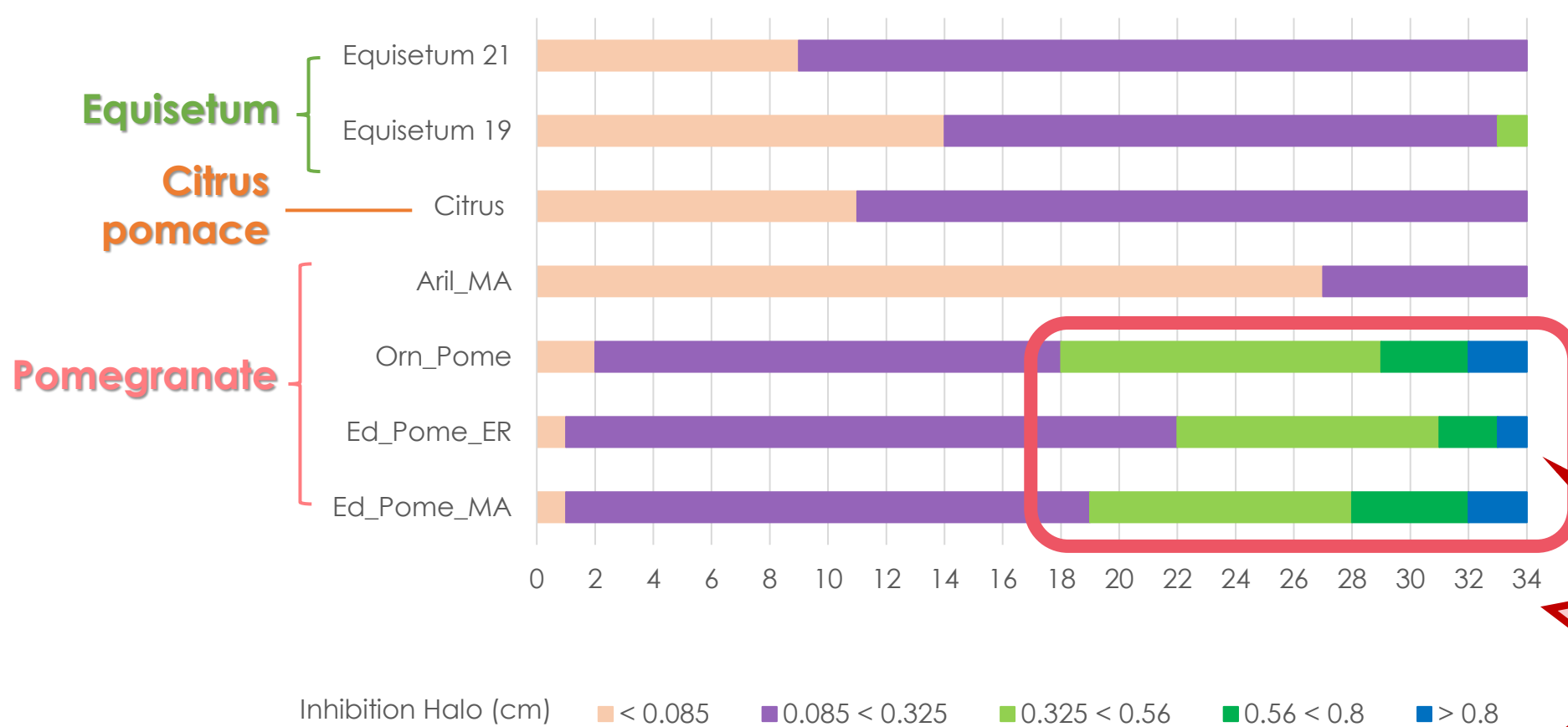
Antimicrobial activity against foodborne pathogens  
and spoilage microorganisms



Prebiotic activity

# By-products potential

Antimicrobial activity- 34 strains tested:  
foodborne pathogens & spoilage microorganisms



**HIGH  
Antioxidant  
And antimicrobial  
power**

# Prebiotic activity

---

## Reference probiotics

*L. plantarum*  
*E. faecalis*  
*P. pentosaceus*  
*L. acidophilus*  
*L. casei* SHIROTA

FOS & Inulin

Equisetum &  
citrus

Pomegranate

Promoted the growth of  
**all** the probiotics

Limited the growth of 3  
out of 12 strains



# Real System: 'Primo sale' cheese

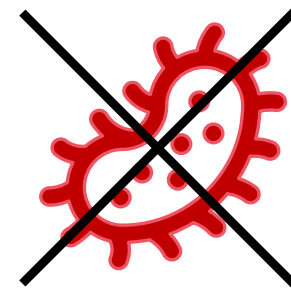
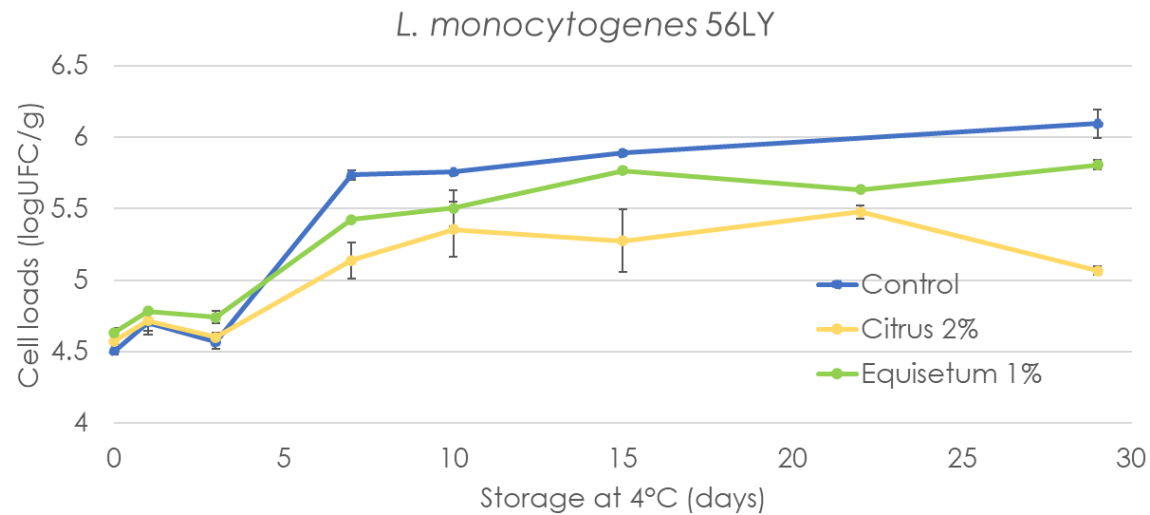
Control



Citrus

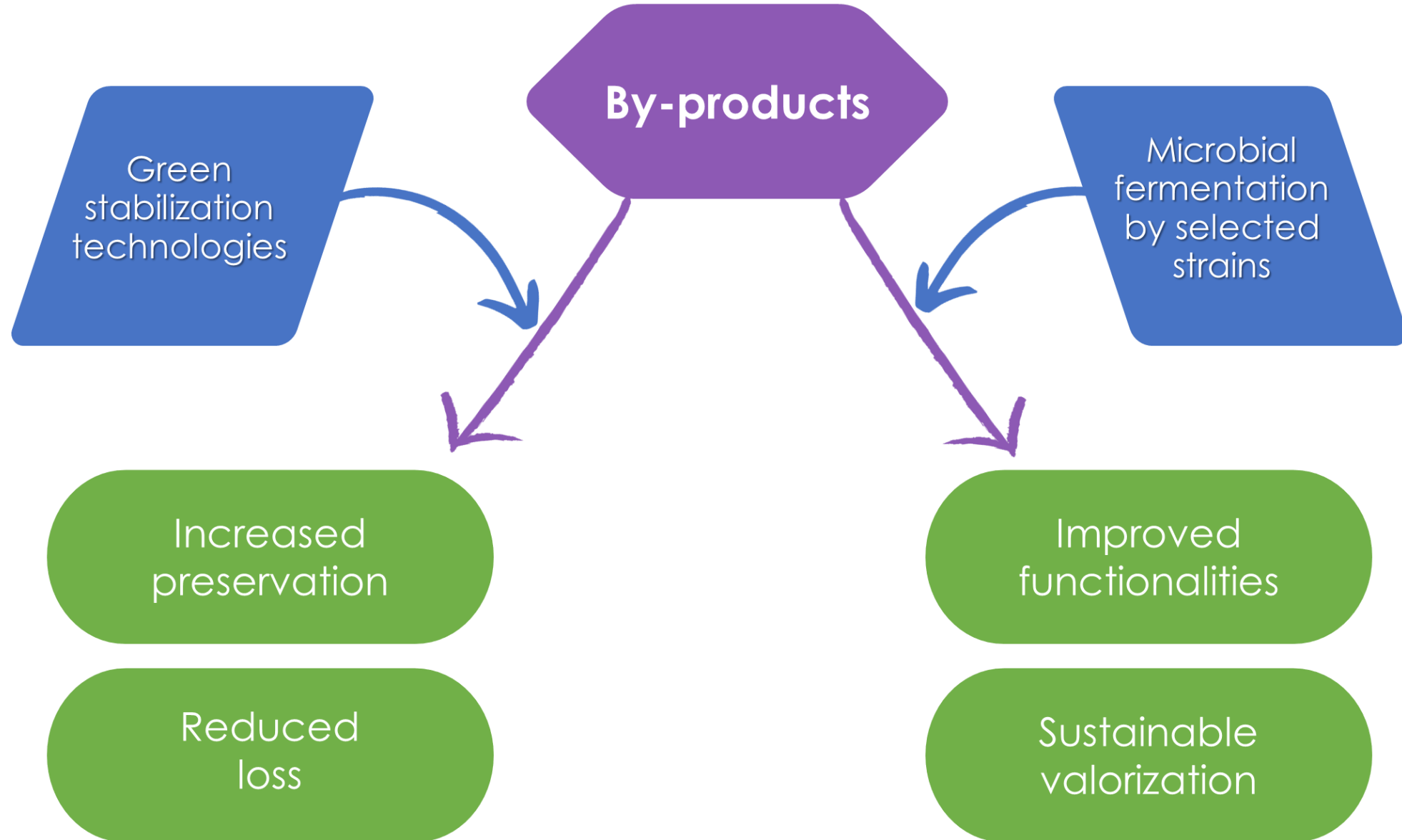


*Equisetum arvense*

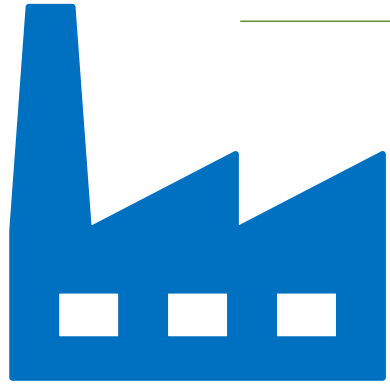


# Future activities

---



# What for??

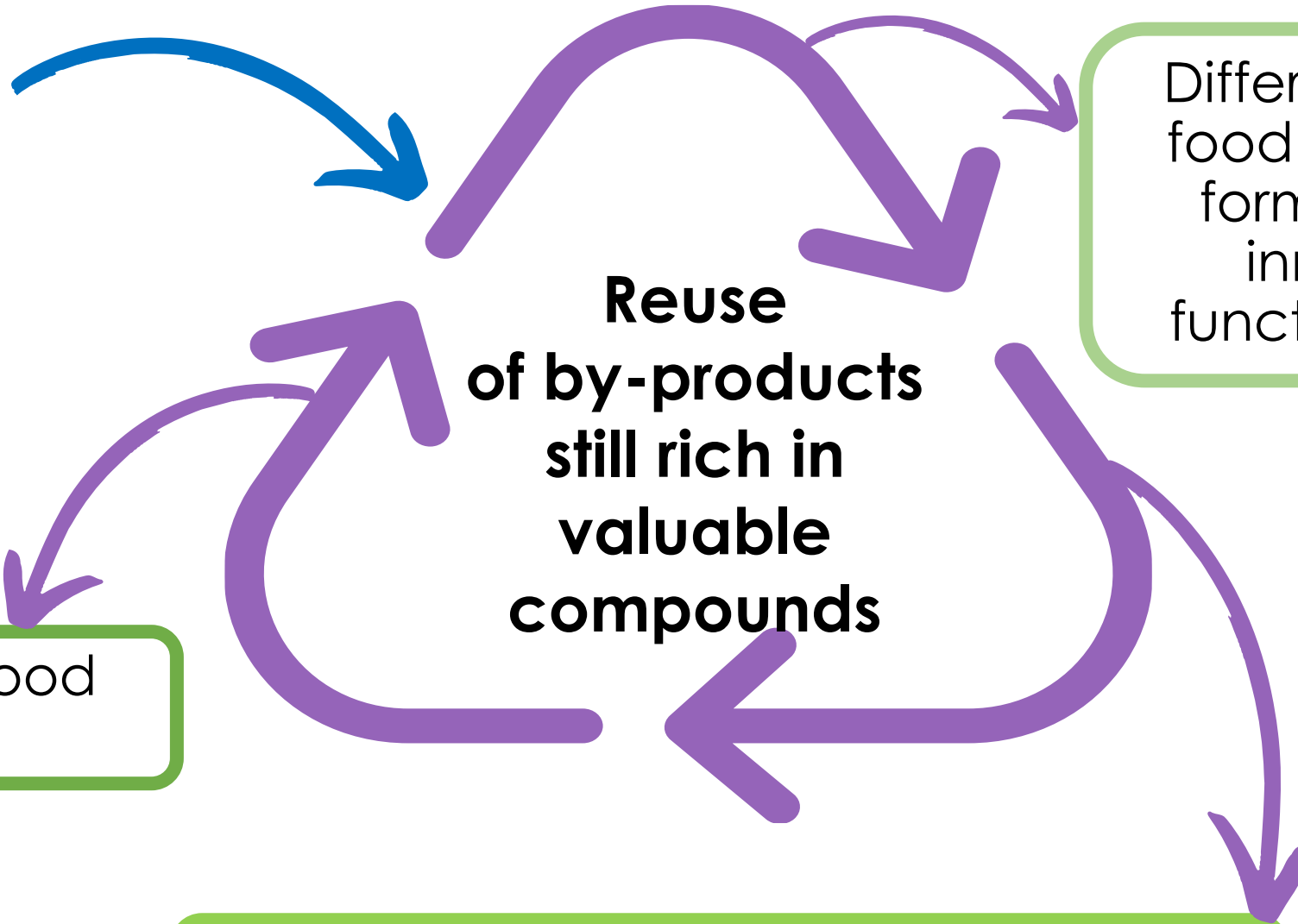


**Reuse  
of by-products  
still rich in  
valuable  
compounds**

Differentiation of  
food products &  
formulation of  
innovative  
functional foods

Reduction of food  
waste

Extension of the shelf life & ensured  
safety of traditional foods





**EU GREEN DEAL**

**MAKE IT  
REAL**

**PARTNER EVENT**

**#EUGREENWEEK**

**30 MAY – 5 JUNE 2022**

**DISTAL**



ALMA MATER STUDIORUM  
UNIVERSITÀ DI BOLOGNA  
DIPARTIMENTO DI SCIENZE E TECNOLOGIE  
AGRO-ALIMENTARI

**STAAA PhD OPEN DAY**

Dipartimenti di Eccellenza 2018-2022  
DISTAL The Nexus Approach for Sustainability in Agriculture,  
Food, Energy & Water

*June 1<sup>st</sup>, 2022*

Thank you for your attention!

Beatrice Cellini

[beatrice.cellini2@unibo.it](mailto:beatrice.cellini2@unibo.it)

**Next  
GEN  
EU**