

PROVIDE: project overview

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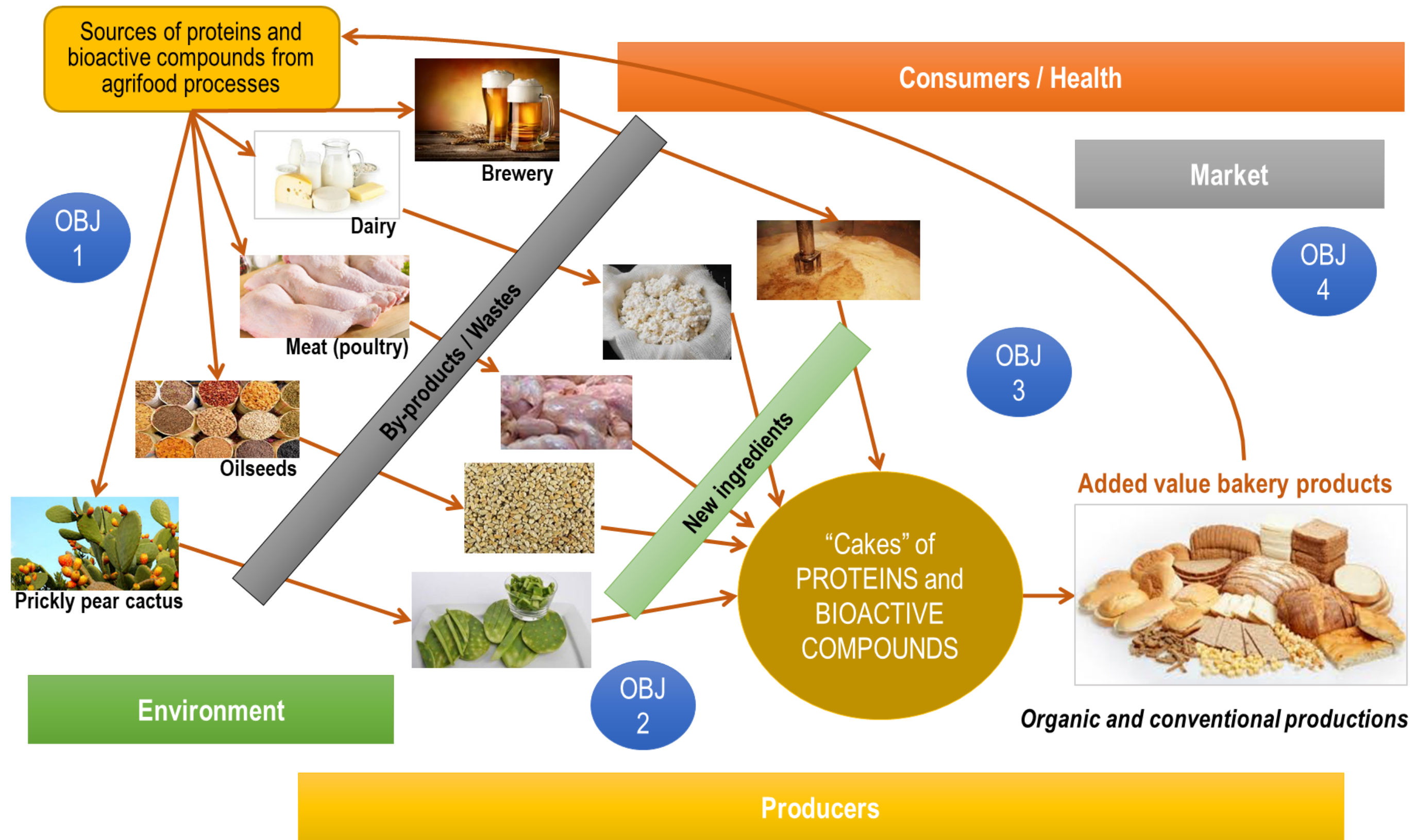


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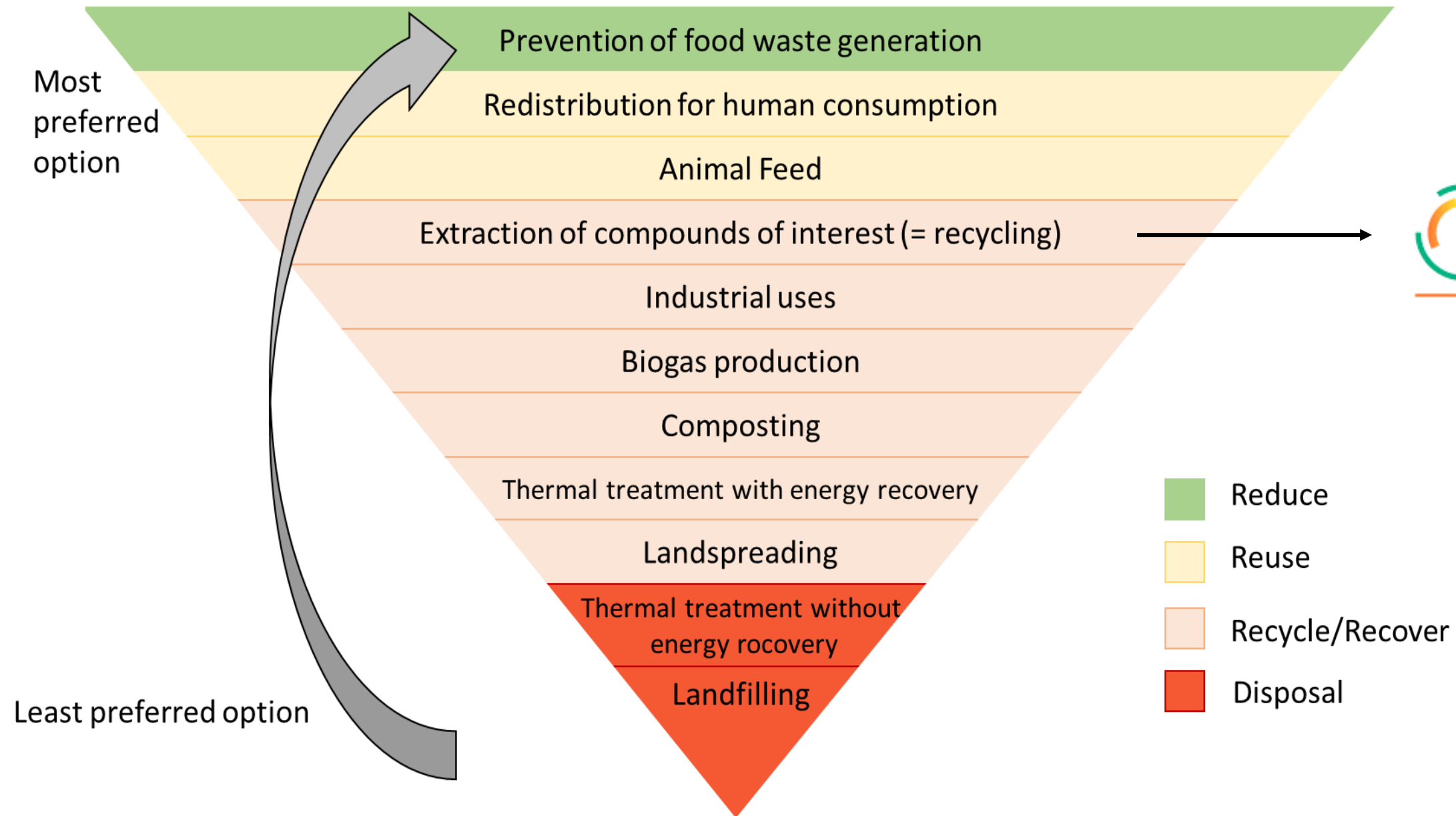


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Waste hierarchy for surplus food and food waste



Food industry by-products

- ❖ produced during the various steps of production, in which the desired components are extracted from the raw materials (product-specific waste)
- ❖ other **potentially useful components** present in the remaining materials
- ❖ large proportions of **industrial food waste are unavoidable**, which are commonly known as food by-products
 - amount and kind of waste produced **can scarcely be altered** if the quality of the finished product is to remain consistent
 - implying **food-waste management is necessary** rather than preventive measures in some cases



Objectives of the PROVIDE project



- ① Identifying by-products rich in nutrients and bioactives, and investigating their nutritional profile
- ② Valorizing wastes and by-products and increasing the efficiency and sustainability of conventional technological processes usable during bakery production
- ③ Promoting circular Food Systems and models for Responsible Research and Innovation
- ④ Defining strategies to put the newly developed products into the market, facilitating technology transfer and promoting consumer acceptance



What have we achieved so far?

Research on by-products generated in five different food value chains (both organic and conventional production processes)



Oilseeds



Brewery



Dairy



Prickly pear cactus



Meat (Poultry)

Main criteria for the use in the PROVIDE project:

- Promising nutritional value/ health promoting compounds
- Amounts of generated by-products per year
- Potential contaminants or compounds relevant for food safety
- Opinion of stakeholders for suitability in bakery production and estimated consumer acceptance

Oilseed, brewery and dairy sidestreams were chosen as main by-products for the PROVIDE project, while experiments with the prickly pear cactus will be conducted as side project



What have we achieved so far?

Research on by-products generated in five different food value chains (both organic and conventional production processes)



Oilseed by-products

- e.g. groats/flours from sunflower, rapeseed, grape seed, hemp, ...
- *Valuable ingredients*: rich in proteins (27-63 %), polyphenols (2-5 %), main polyphenol: chlorogenic acid



Spent grains

- Account for 85 % of brewery by-products
- BSG production is over 40 million tons/year
- *Valuable ingredients*: up to 30 % proteins (high quantities of lysine, beta-glucans, arabinoxylans)



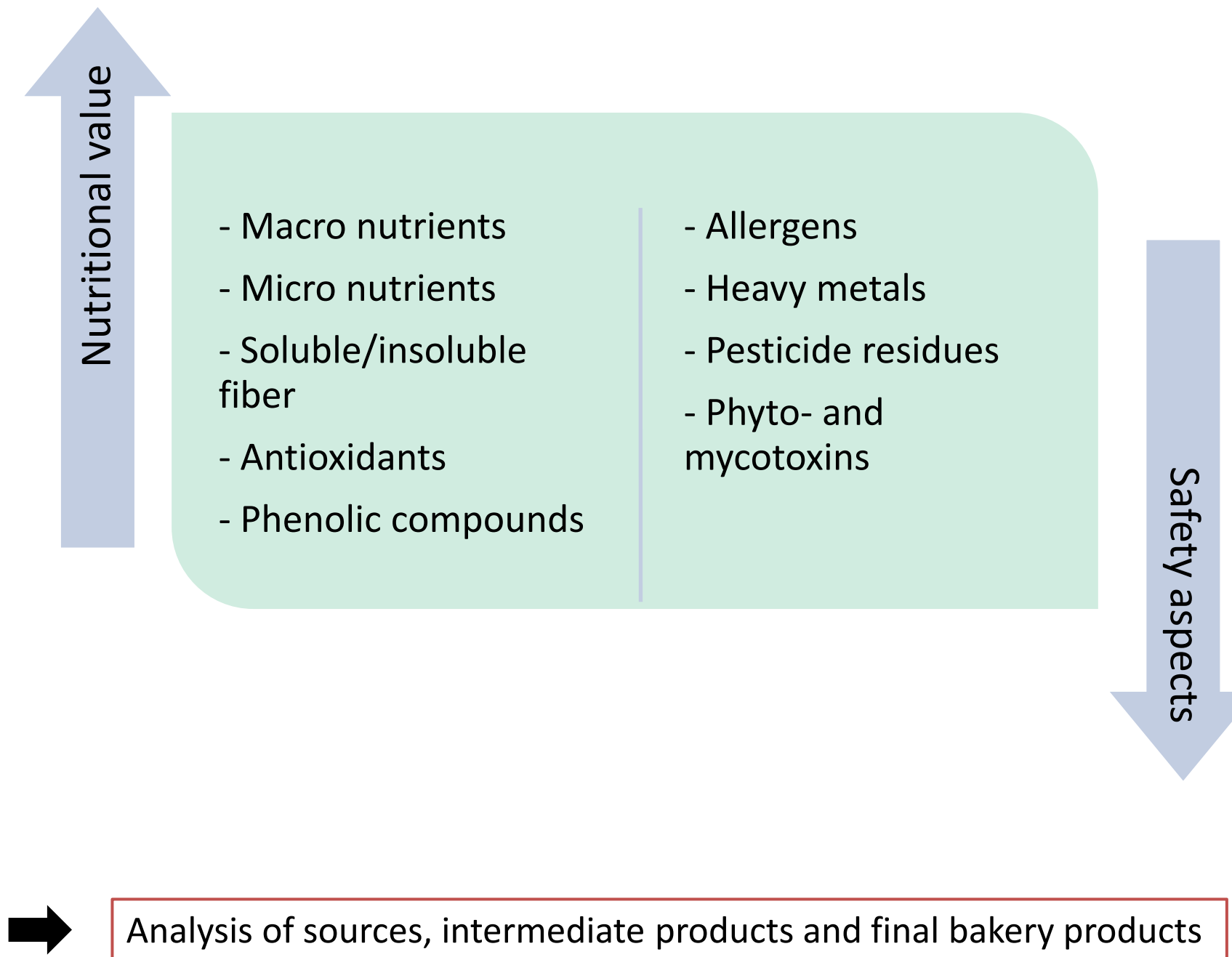
Whey

- Major by-product of cheese and casein production
- Whey generation is estimated at 180-190 million ton/year
- *Valuable ingredients*: whey proteins, lactose, vitamin B2



What have we achieved so far?

Quality and Safety of sources



What have we achieved so far?

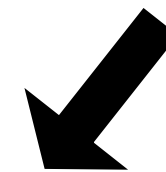
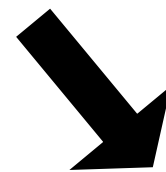
Example: oilseed by-products (14 different by-products)

Nutritional value:

- High in polyphenols
- High in flavonoid content
- High antioxidant capacity
- Contents are influenced by variety (e.g. sunflower, rape seed, sesame...) and by-product type (e.g. flour, groats, meals)

Safety evaluation:

- Spoilage microorganisms were below limit of quantitation imposed for similar matrices
- No foodborne pathogens
- Mycotoxins varied between the different varieties
- No aflatoxin could be detected over the limit of quantitation (1.75 $\mu\text{g}/\text{kg}$)
- Only one sample exceeded the limit for lead, and two the limit for cadmium



- Oilseed byproducts can improve the nutritional properties and antioxidant quality of bakery products
- No critical contaminants could be detected in most by-products
- Main challenge:
 - No regulations for contaminants/safety levels are available for by-products -> update necessary



What have we achieved so far?

Green Technologies



Membrane Filtration



- Fraction 1: skimmed whey
- **Fraction 2: Protein concentrate (to be used for baking)**
- **Fraction 3: concentrate from nanofiltration (sugary, suitable for drinking products)**
- Fraction 4: Permeate from nanofiltration



Supercritical CO₂ Extraction + Membrane Filtration



- Fraction 1: Aqueous extract
- Fraction 2: Concentrate from ultrafiltration
- Fraction 3: Concentrate from nanofiltration
- Fraction 4: Permeate from nanofiltration



Supercritical CO₂ Extraction



- Fraction 1: Oils
- **Fraction 2: De-oiled panel as protein matrix (to be used for baking)**



What have we achieved so far?

Bread Prototypes with sunflower meal



Bread fortified with sunflower meal
obtained from whole seeds
(Control, 10%, 15%, 20%)



Bread fortified with sunflower meal
obtained from partially dehulled seeds
(Control, 10%, 15%, 20%)



Bread fortified with sunflower meal
obtained from fully dehulled seeds
(Control, 10%, 15%, 20%)



- ❖ Protein content increased from 8.66% (control) to 9.58 – 11.04%, which is directly proportional to the percentage of meal added
- ❖ Crude fiber content increased from 0.28% (control) to 0.79 – 2.61% (depending on type and substitution)
- ❖ Increased phenolic content in samples with sunflower meal
- ❖ 20% meal addition led to a lower bread volume compared to 15% addition
- ❖ Elasticity decreased with the increase of the percentage of meal added



Quality and Safety

- Analysis of nutritional composition and health benefits
- Evaluation of safety aspects
- Conducted in analytical chemistry and microbiological laboratories

New bakery products

- Three food prototypes
- In pilot plants for bakery production
- Analysis in sensory labs
- Evaluation of consumers acceptance

Transfer & Sustainability

- Demonstration and technological transfer to industry
- Life cycle analysis
- Development of traceability systems



Thank you!



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 ProvideProject_6

 ProvideSusfood2

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