

PROMINENT

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## The pathway for novel protein ingredients from cereal side streams

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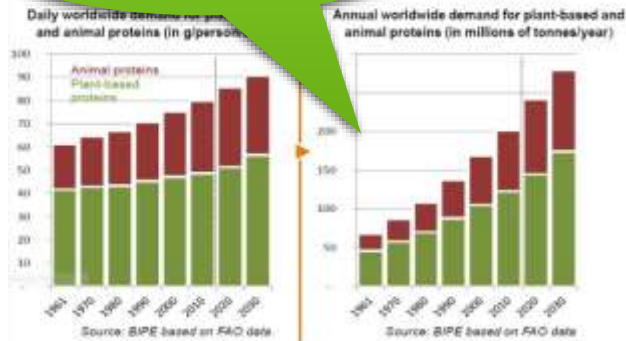
Funded by the Horizon 2020  
Framework Programme of the  
European Union

This project has received funding from the Bio-Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 668953.



# What was once a niche... is now a global trend!

Growing demand...



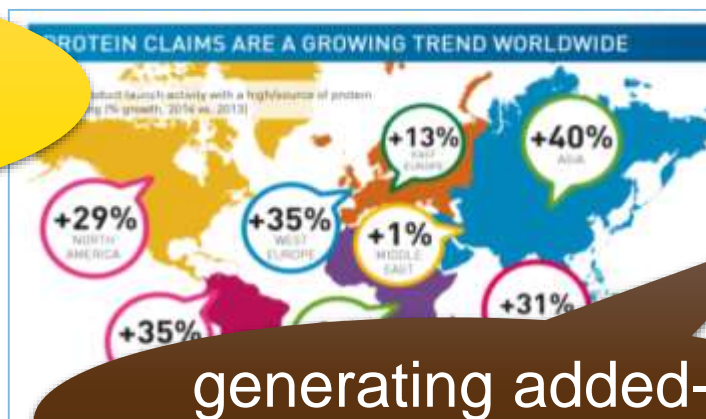
for sustainable...



healthy food proteins...



applicable in food production...

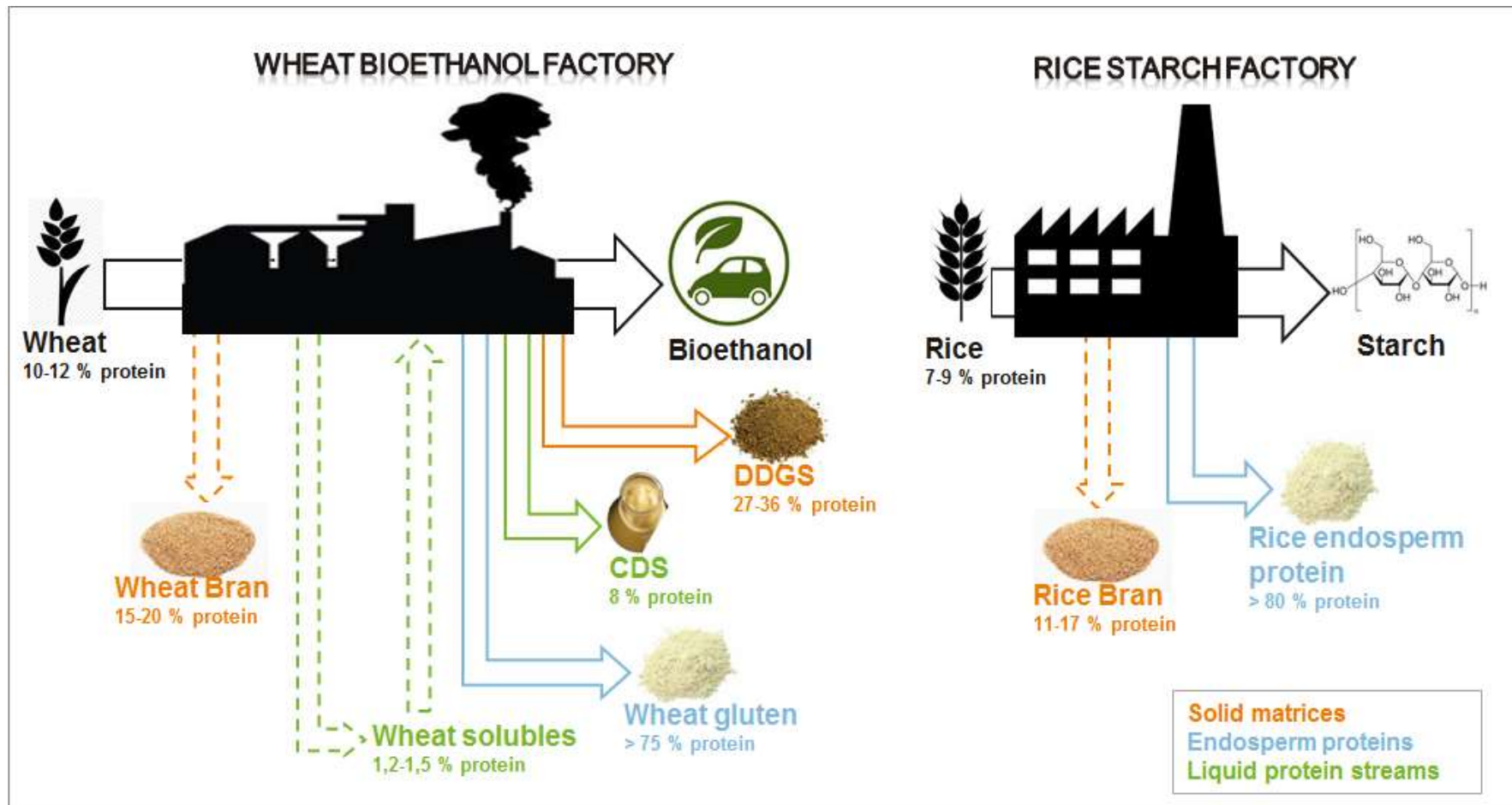


generating added-value products!



# The Approach:

## Valorize and upgrade protein sources from cereal side-streams



# Quality Criteria for Food Protein Ingredients

- Composition, protein content / **purity**
- **Nutritional quality** and labelling
  - amino acid spectrum and protein digestibility
  - Contaminants, allergens, anti-nutritional compounds
  - GMO issues (e. g. soy)
- Cost effectiveness, image, etc.
- Applicability → **taste** and **protein functionality**

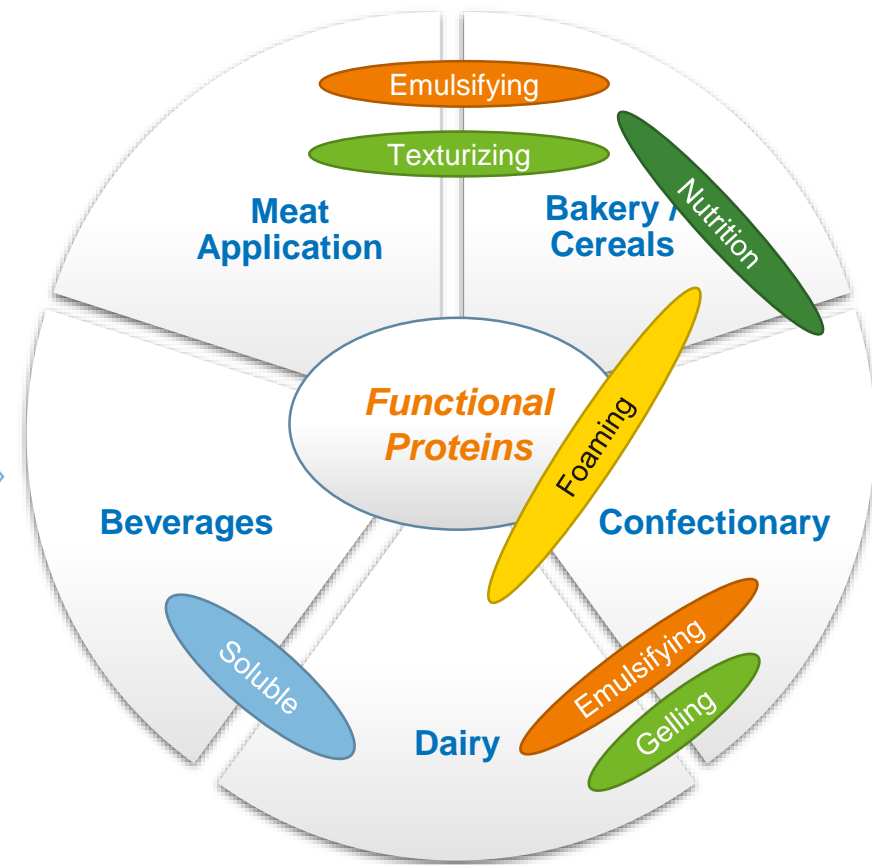
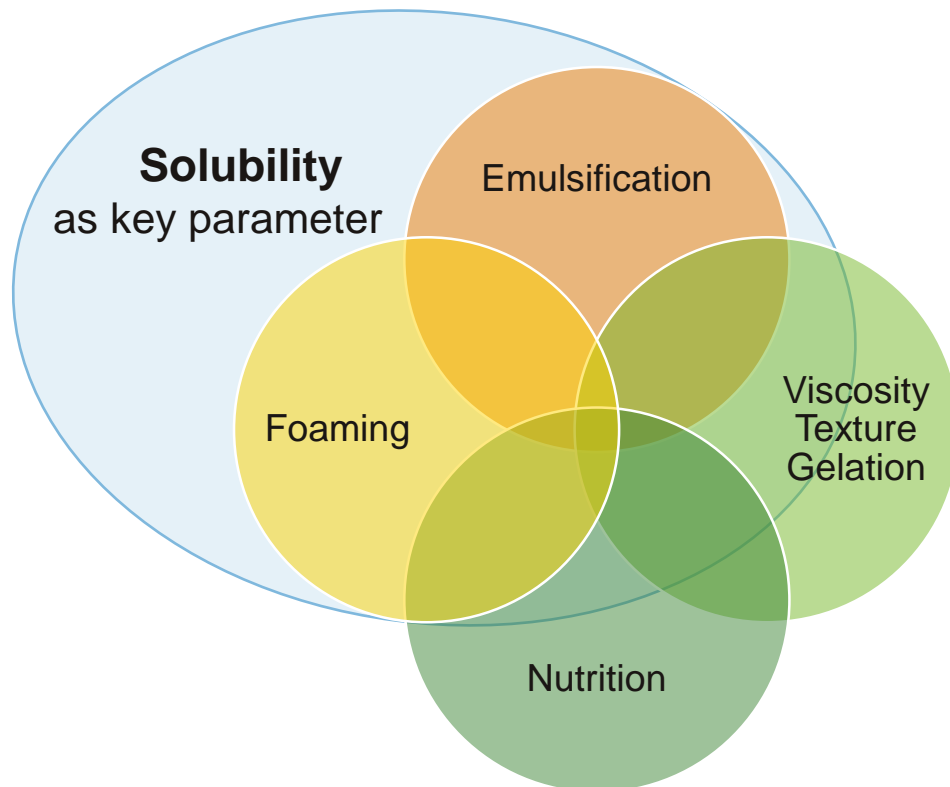
The collage displays four overlapping 'beneo remy' Specification & Information Sheets for Remypro N80+ protein powder. Each sheet includes:

- Product Information:** Product name (Remypro N80+), description (rice protein), and suggested applications (e.g., bakery, sports nutrition).
- Amino Acid Profile:** A table listing amino acids and their content in g/100g.
 

Amino Acid	g/100g
Alanine	11.50
Arginine	5.50
Asparagine	6.00
Aspartic acid	1.75
Glutamic acid	17.25
Glutamine	4.25
Proline	2.25
Valine	4.25
Leucine	9.50
Isoleucine	5.50
Phenylalanine	5.50
Threonine	5.50
Serine	5.50
Protein	75.00
Crude protein	75.00
Protein (N x 6.25)	75.00
Protein (N x 5.71)	75.00
Protein (N x 5.4)	75.00
Protein (N x 5.2)	75.00
Protein (N x 5.0)	75.00
Protein (N x 4.8)	75.00
Protein (N x 4.6)	75.00
Protein (N x 4.4)	75.00
Protein (N x 4.2)	75.00
Protein (N x 4.0)	75.00
Protein (N x 3.8)	75.00
Protein (N x 3.6)	75.00
Protein (N x 3.4)	75.00
Protein (N x 3.2)	75.00
Protein (N x 3.0)	75.00
Protein (N x 2.8)	75.00
Protein (N x 2.6)	75.00
Protein (N x 2.4)	75.00
Protein (N x 2.2)	75.00
Protein (N x 2.0)	75.00
Protein (N x 1.8)	75.00
Protein (N x 1.6)	75.00
Protein (N x 1.4)	75.00
Protein (N x 1.2)	75.00
Protein (N x 1.0)	75.00
Protein (N x 0.8)	75.00
Protein (N x 0.6)	75.00
Protein (N x 0.4)	75.00
Protein (N x 0.2)	75.00
Protein (N x 0.0)	75.00
- Physical and Chemical Measurements:** Tables showing moisture content, ash, and other parameters.
- Legal Classification:** Information regarding allergens and GMO status.
- Additional Information:** Storage conditions, shelf life, and contact details.

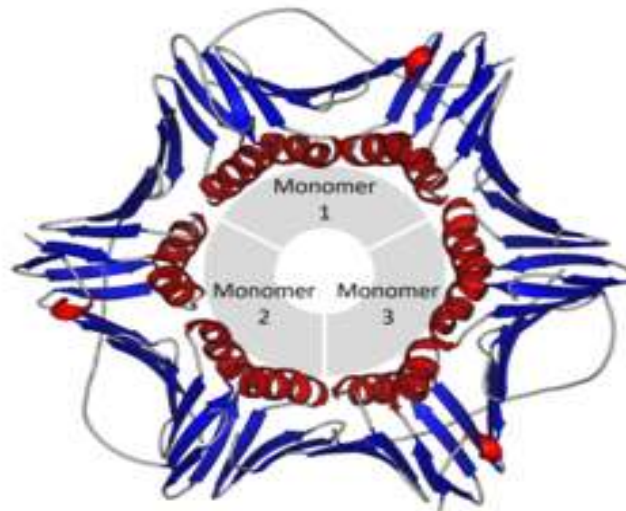
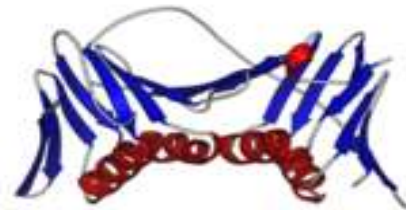
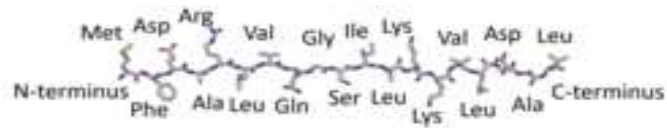
# How protein functionality determines application...!

- ... characterize proteins in small scale lab model systems
- ... compare and
- ... identify potentials for food application



# Why behave protein ingredient so differently?

## 1) Functionality depends on intrinsic protein properties



### Primary protein structure

Sequence and types of amino acids

### Secondary protein structure

Folding due to hydrogen bonding

### Tertiary protein structure

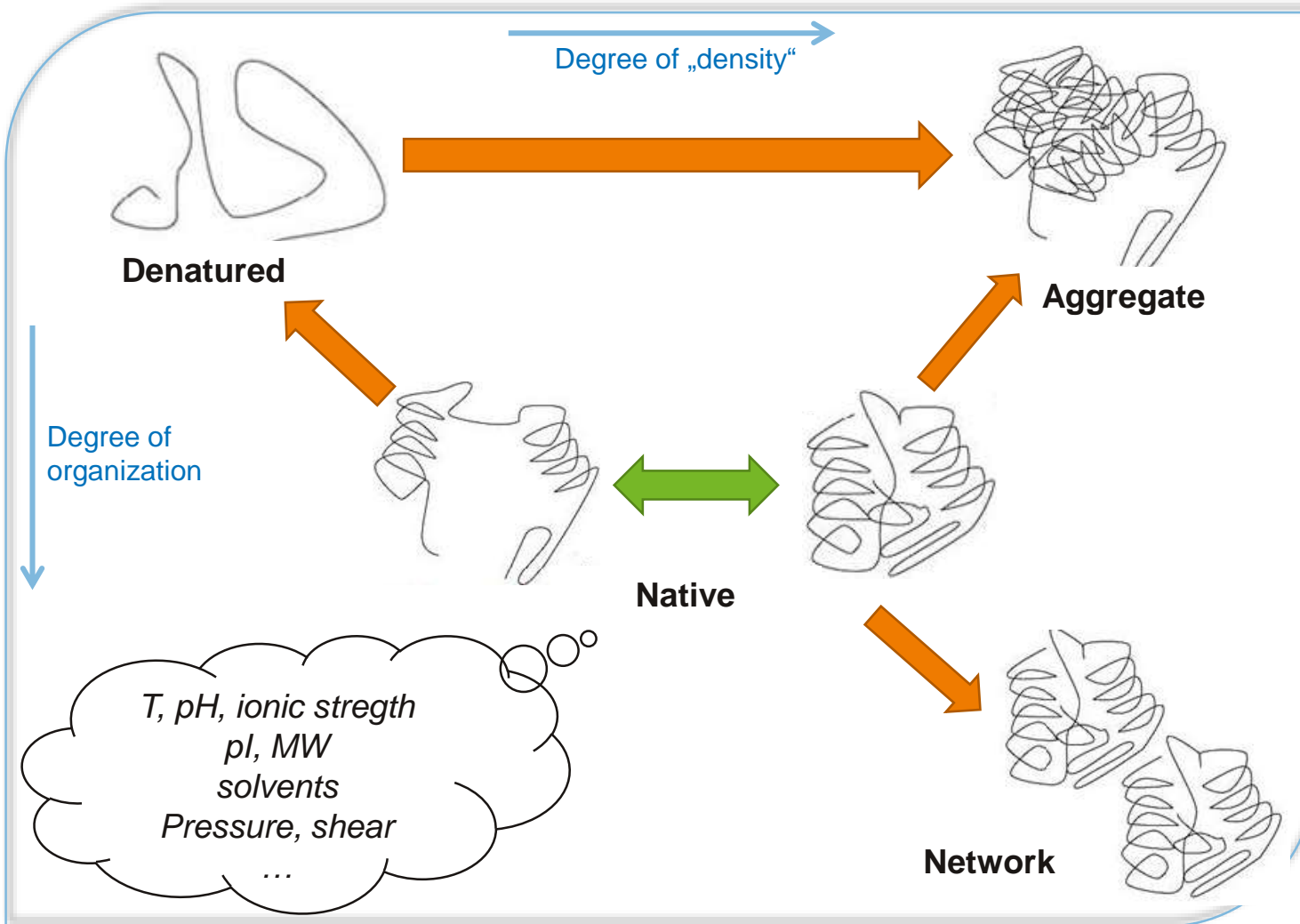
3D folding due to side chain interactions (disulfide bridges)

### Quaternary protein structure

3D complexes of amino acids chains

# Why behave protein ingredient so differently?

## 2) Functionality depends on processing history



**Limited functionality**

**Specific functionalities**

- Solubility
- Emulsification
- Foaming

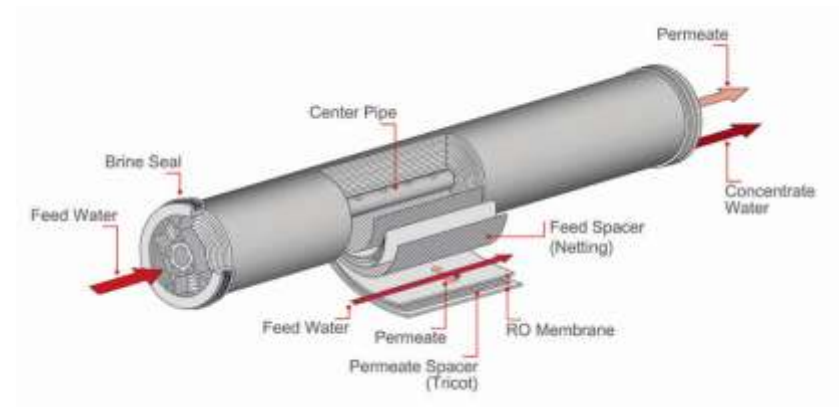
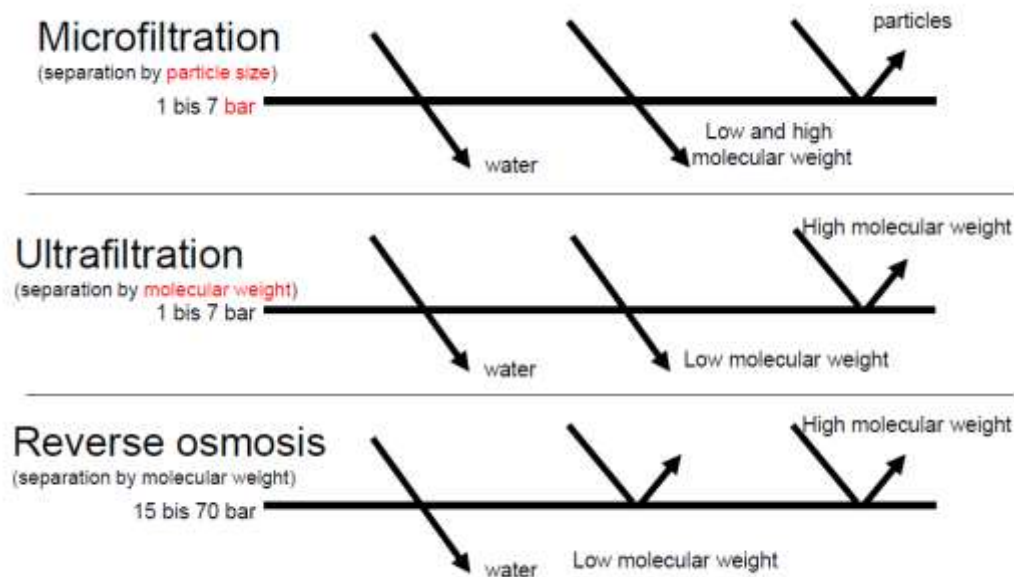
**Texturizing**

- Viscosity
- Gelation

# Membrane Filtration Technology

## ...for protein concentration and purification

- Mild and cost-efficient technology for separation of molecules
- Filtration cutoff determined by membrane type





# State-of the Art Technology for Protein Processing e. g. milk proteins, gelatin, etc.



## Food, Dairy, Beverage Industry

- Dark and light Juice Clarification, concentration & Debittering
- Must Concentration
- Wine & lees Clarification
- Animal/vegetable Protein Concentration, Demineralization & Water Reuse
- Dairy processing



## Pharma & Biotech Industry

- Medical Imaging contrast Media
- Antibiotics Production
- Product recovery from organic solvent /water mixture
- Concentration and desalting of proteins, enzymes, peptides, amino acids



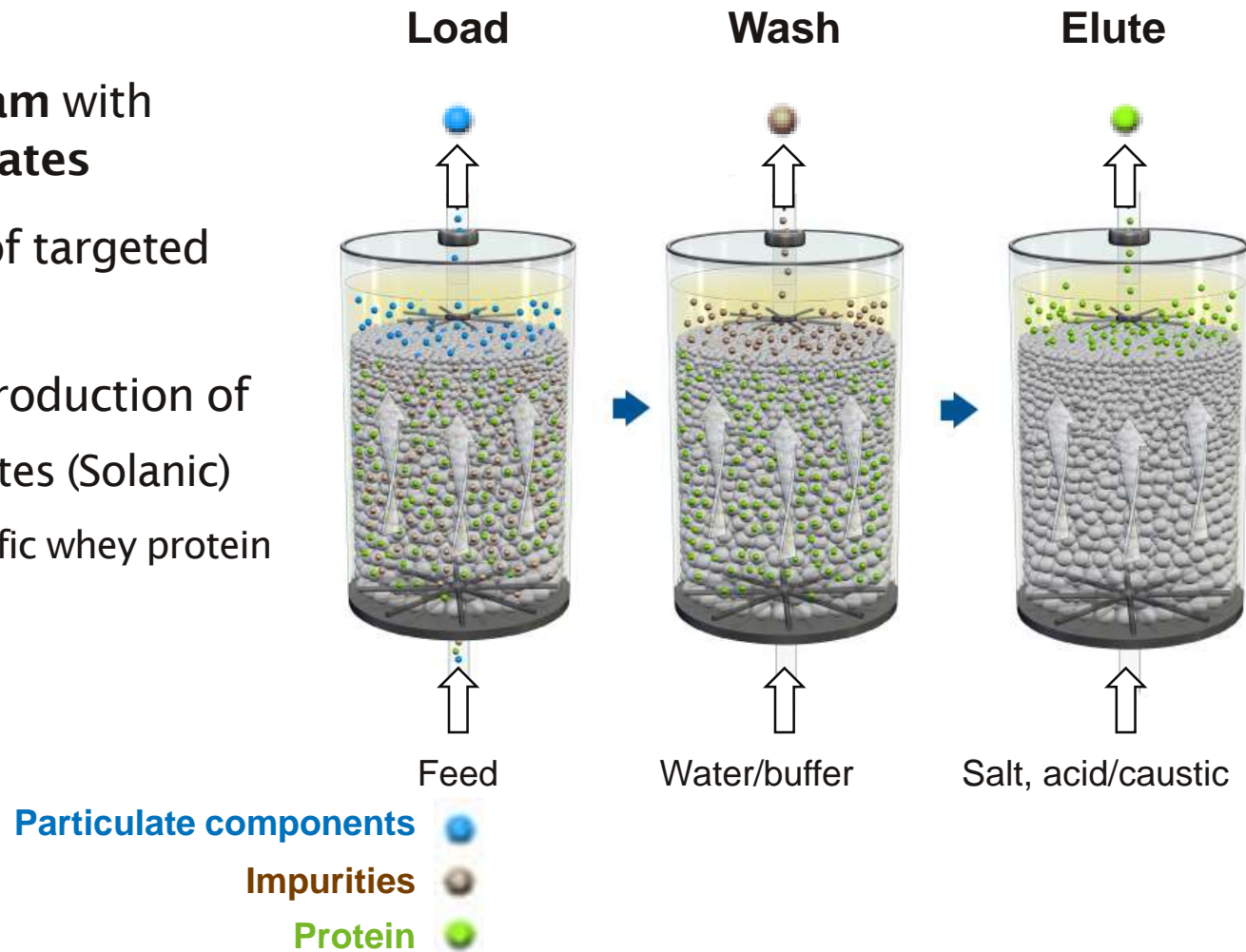
## Sugar & Yeast Industry

- Water Reuse
- Starch and derivatives
- Clarification of Dextrose
- Separation of Active Carbon
- Sweetener manufacturing
- Sugar concentration
- Sweetener fractioning

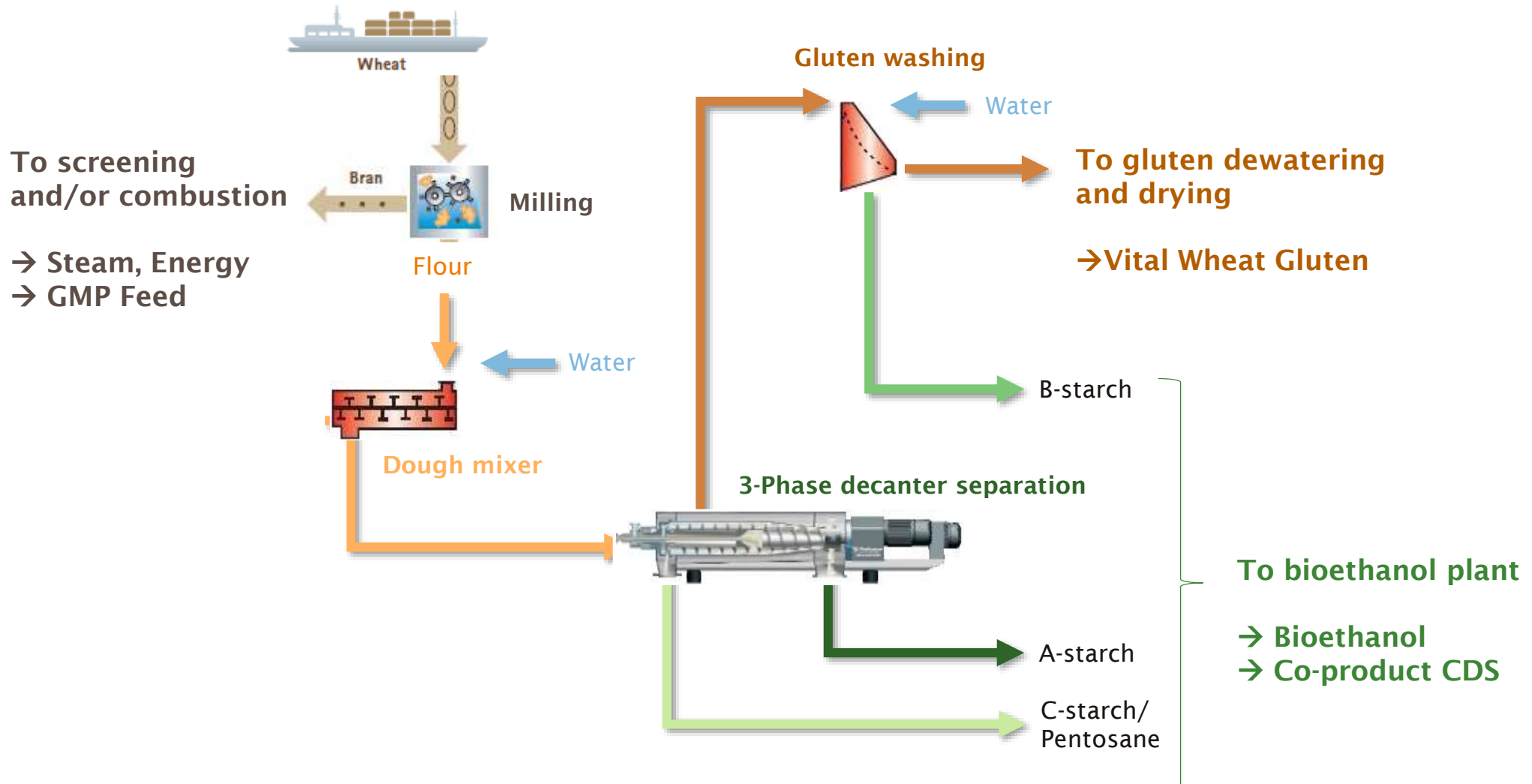
# Expanded Bed Adsorption Technology (EBA) ... for specific protein isolation



- Applicable in **crude feed stream** with **soluble proteins** and **particulates**
- Selective binding and elution of targeted proteins in **high purity**
- **Established technology** for production of
  - soluble potato protein isolates (Solanic)
  - whey protein isolates and specific whey protein fractions

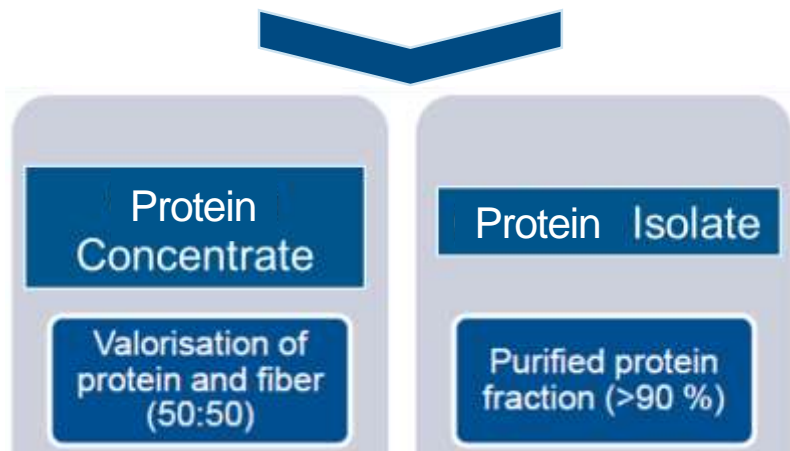
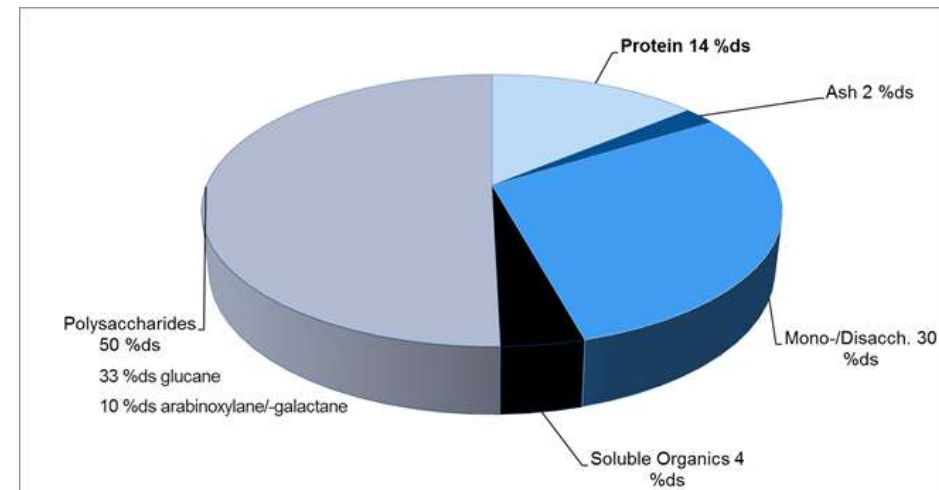


# Example: BioEthanol Factory Process Flowchart



# Wheat solubles as Promising Stream for Protein Valorization

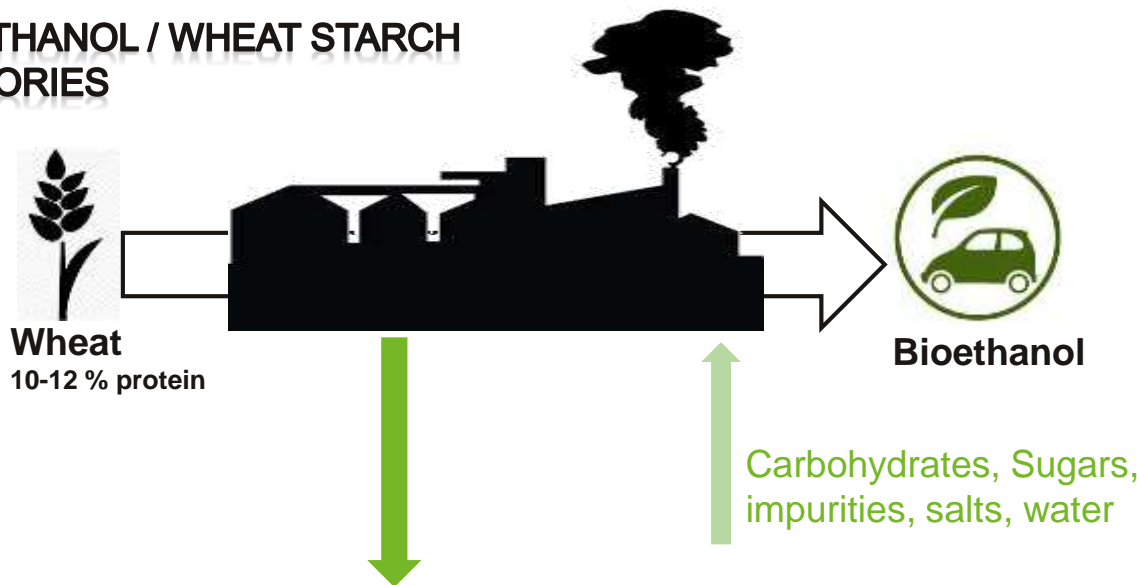
- Wheat solubles side-stream containing **fiber** (arabinoxylans) and **1,2-1,5 % protein**
  - soluble, **native** albumin/globulin fractions
  - Nutritional interesting amino acid profile
  - Functional protein
- **Applying mild processing technologies**



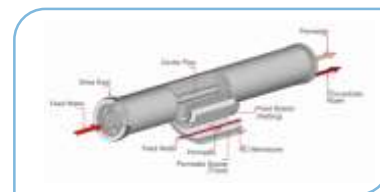
# Example Bioethanol Factory

## Valorization of protein-fiber hybrid ingredient

BIOETHANOL / WHEAT STARCH  
FACTORIES



Wheat solubles  
1,2-1,5 % protein



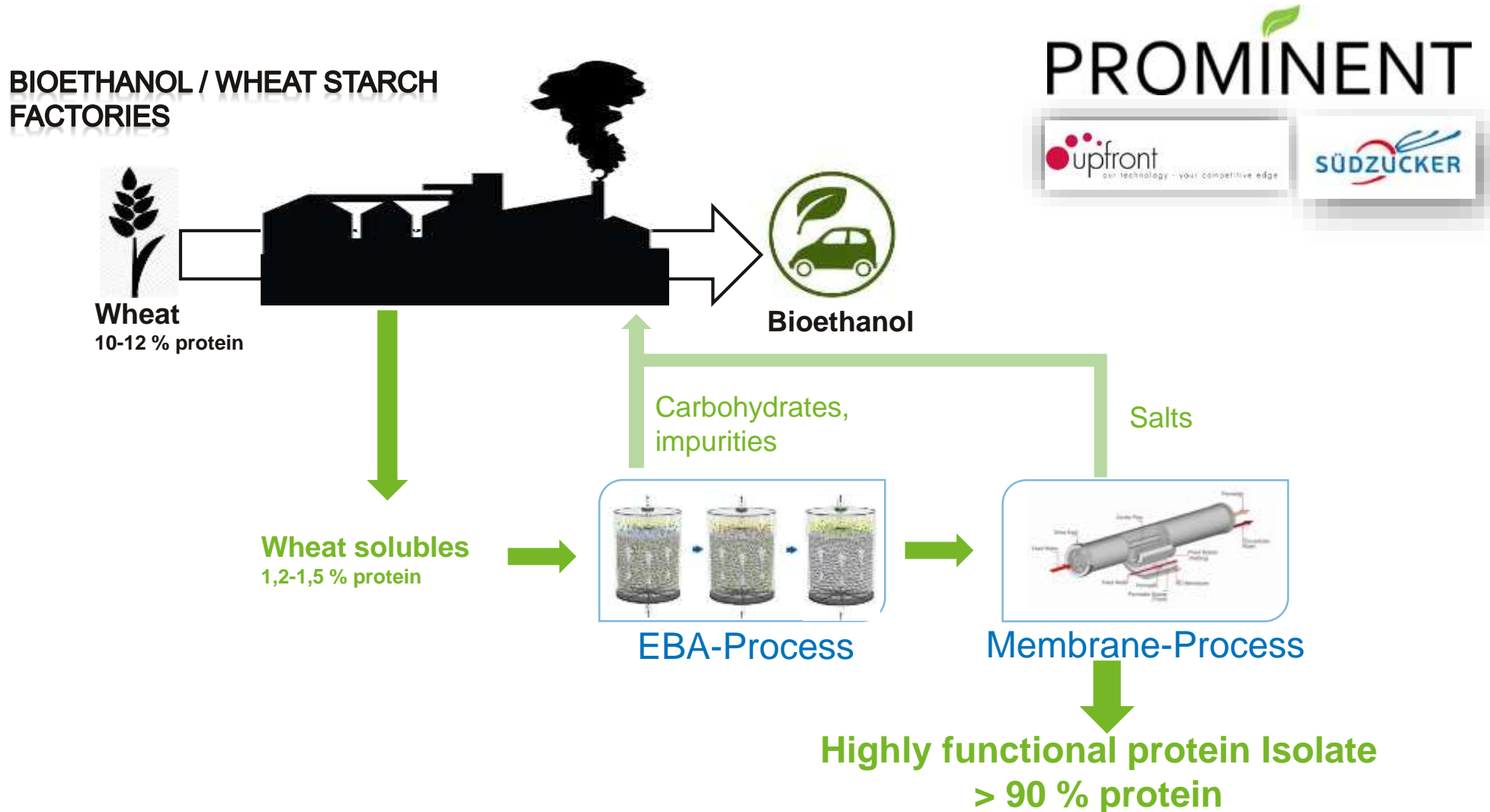
Membrane-Process



Protein-fiber  
hybrid ingredient  
> 40 % protein

# Example Bioethanol Factory

## Valorization of highly functional protein isolate



# The Prominent Pathway

# PROMINENT



**Mild extraction / processing technologies**



**Applicability** in food products



**LCA and socio-economic effects**

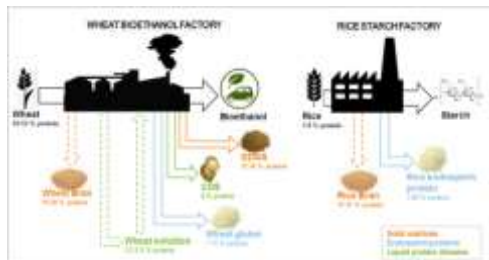


**New protein ingredients**

**Techno-functional and sensory quality**

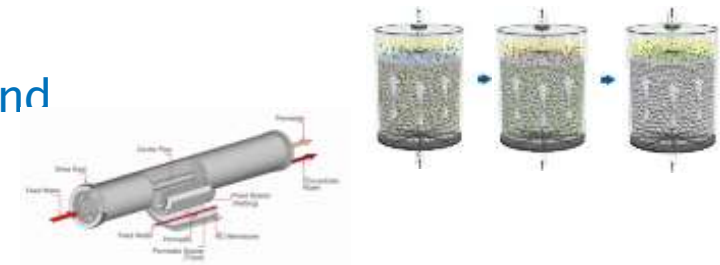
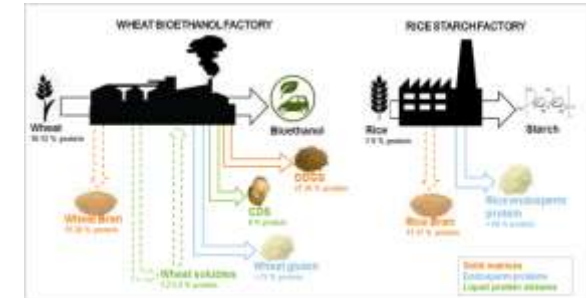
**Techno-economical evaluation of concept**

**Side-streams as new protein sources**



# Conclusions

- Valorization of **cereal side-streams** opens a route for **novel sustainable** protein ingredients
- **Quality of protein ingredients determines applicability**
- **Functional properties** are strongly influenced by **processing history**
- **Mild processing technologies** facilitate the isolation and concentration of protein ingredients





Thank you for your attention!

## PROMINENT – in a nutshell...

### ■ Objectives:

- **Disintegrate, fractionate and extract:** bioprocessing, dry and wet milling, air classification, novel extraction solvents, membrane separation, expanded bed adsorption
- **Improve techno-functional and sensory properties:** Enzymatic and thermo-mechanical methods
- **Apply in food products:** pasta, biscuits, cakes, yoghurt and beverages
- **Assess:** quality, techno-economic feasibility, sustainability and market potential
- **Design:** strategies for marketing, dissemination, and exploitation of innovations

■ **Budget: 3.1 m€**

■ **Duration: 3 years 2015-2018**

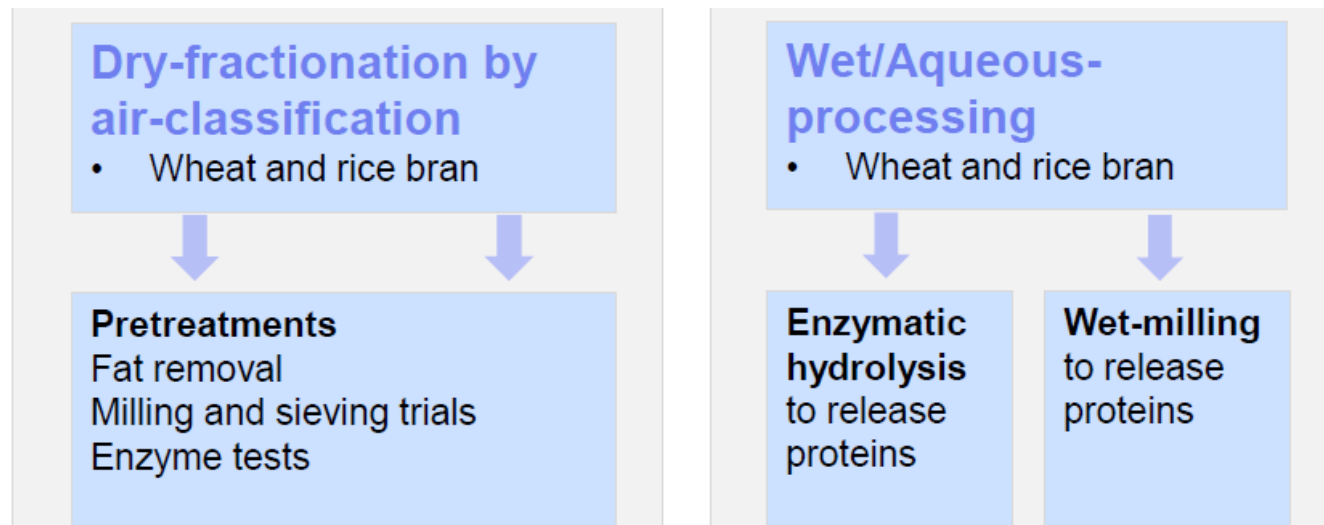


### ■ Consortium:

- Südzucker AG, Germany
- VTT Ltd, Finland (coordinator)
- AB Enzymes, Germany
- Upfront Chromatography, Denmark
- United Biscuits, UK
- Barilla, Italy
- Olvi, Finland
- LUKE, Finland
- Bridge2Food, The Netherlands

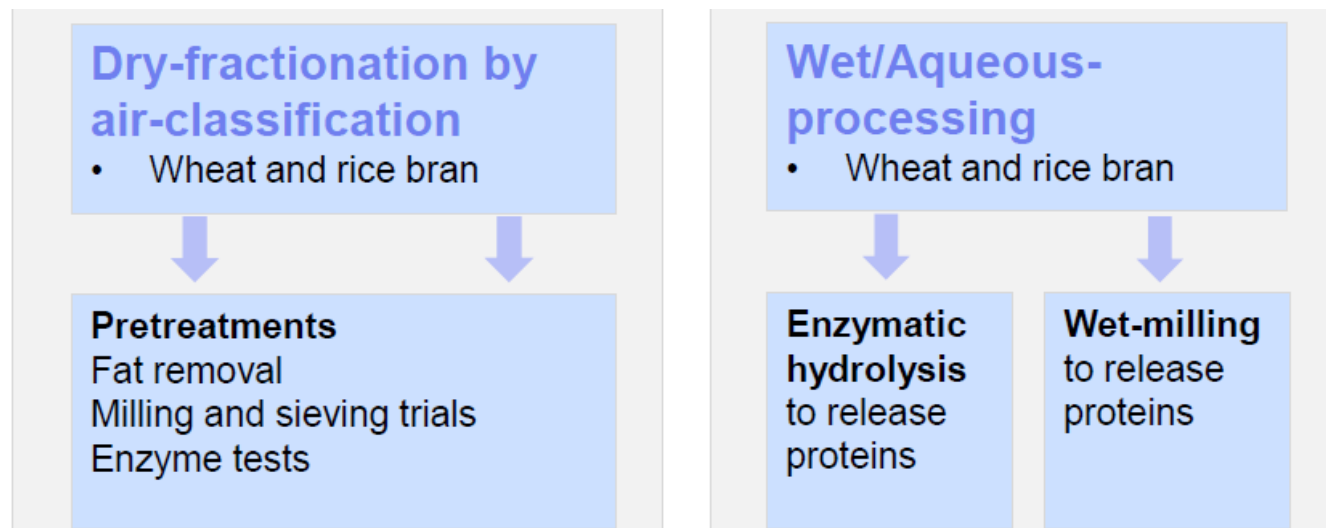
## Valorization of Rice Bran Protein

- Lipids must either be removed or the bran must be stabilized before processing or storage
- protein must be liberated from the complex bran structure by
  - **disruptive mechanical treatments** targeting the removal of non-protein bran components
  - **enzymatic hydrolysis** of either proteins or non-protein bran matrix
- Technologies to target protein enrichment (> 40 %) and protein isolation (>75 %)



## Valorization of Wheat Bran Protein

- Protein must be liberated from the complex bran structure by
  - **disruptive mechanical treatments** targeting the removal of non-protein bran components
  - **enzymatic hydrolysis** of proteins or non-protein bran components
- Technologies to target protein enrichment (> 40 %) and protein isolation (>75 %)



# General Factors affecting Protein Valorization

