Webinar

From Byproducts to Business: Product Development from Industry Side Streams

Päijät-Hämeen liitto
The Regional Council of Päijät-Häme

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Regional Council of Häme

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Webinar

From Byproducts to Business: Product Development from Industry Side Streams

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From Byproducts to Business: Product Development from Industry Side Streams

A part of HÄMILIS Project

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HÄMILIS Project

Waste to a Minimum, Added Value to a Maximum

Partners: (1) Häme University of Applied Sciences, (2) LAB University of Applied Sciences, and (3) Häme Vocational Institute Ltd.

Funding: European Regional Development Fund (ERDF)

Target group: Food companies in Häme region

Specific project goals:

- ✓ Reduce waste in Small and Medium-sized Enterprises (SMEs) and to exploit side streams.
- ✓ Develop a precise tool for SMEs to manage food waste.
- ✓ Exploit the environment and laboratories of the project partners for the benefit of businesses and to develop services that meet their needs.
- ✓ Develop new products, in particular from food byproducts, and carry out various experiments with businesses.
- ✓ Increase cooperation between SMEs at regional and international level.

Duration: 1.3.2024-31.12.2026

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From Byproducts to Business: Product Development from Industry Side Streams

Program:

09:00-09:05: Opening words, Thao Ho, Principal Research Scientist (tenure track), HAMK

09:05-10:05: Company introductions and their side streams

1) OlutMylly Oy
2) MBH Breweries Oy, Malmgårdin Panimo
3) Temperance Brewing Co.
4) Suomen Hiiva Oy

10:05-10:35: From Byproducts to Business: Product Development from Industry Side Streams (Thao Ho, HAMK)

10:35-11:00: Discussion and closure

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OlutMylly ”BeerMill” - Numbers and responsibility

Our annual production 2024
55 000 litres (varies)

The malts we use
Av. 11 000 kilos

Established in 2018

Gradually grown
6 times more from the start

Waste is minimised by continuously identifying opportunities for improvement

Our products are manufactured in accordance with responsible practices

MYLLÄRI beers; locally produced, supportive of the environment and community.

Family business: Anne and Mikko Silmälä
Aiming for quality and responsible beers

IMPACT
Environmentally friendly solutions in beer brewing

ENVIRONMENT
Responsible production methods

COMMUNITY
Strengthening the local community through cooperation

FINANCE
Acting in line with sustainable development

Supporting localism
Supporting local partners
Reducing waste

OlutMylly's sustainability actions and background

- Different uses of the by-product of beer production, i.e. mash/spent grain.
  - Exploitation of the mash/malt residue:
    - Cooperation with a local bakery that makes products from spent grain
- Using other operators' waste in beer production.
- Cooperation with many local actors.
- We build and repair our equipment ourselves.
- We monitor water and electricity consumption.
  - Monitoring energy consumption:
    - Daily optimisation of brewing equipment
- We innovatively develop our operations and products in line with our sustainability values.

Spent grain

The by-product mash/spent grain is used to produce both malted bread and malt cakes in a local bakery.

**Utilisation of mash
in bakery products reduces waste and promotes
circular economy.**

How else to make use of it?

The beer production process generates a lot of spent grain, much of which ends up in the local biogas plant, Nevel Oy.

The mash/spent grain supports the production of renewable energy in a local biogas plant, reducing the need for fossil fuels.

The fertiliser produced by the biogas plant will help agriculture move towards more sustainable farming methods.

Electricity produced from biogas is fed into the national grid. Biogas is also refined to fuel cars. The end products of the biogas plant are processed into fertilisers for agricultural use and mulch products for landscaping.

Mash is nutritious for animal feed

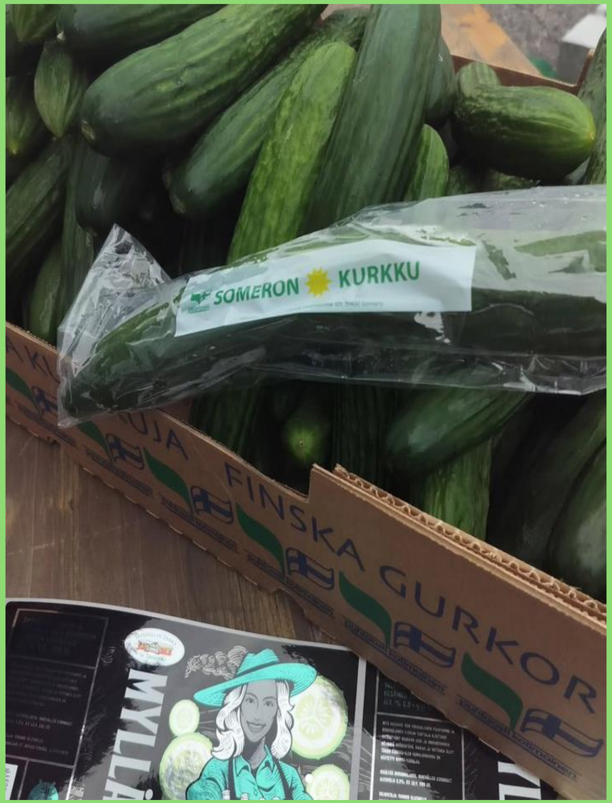
You can also mix part of the mash into animal feed. Good for digestion gor all.

The use of lime in animal feed offers a more sustainable alternative and reduces the need for other feed raw materials, supporting the circular economy.

Reducing losses from other operators

Beer from a local vegetable farmer's waste cucumbers.

Beer made from the waste cucumbers of a local vegetable farmer reduces food waste and supports local farming.



Waste Apple beer

We brew Gose beer from local waste apples, which we use to make beer. This supports sustainable development and reduces waste.

Local cooperation

HAMK
Häme University
of Applied Sciences

- With educational institutions
- Bakery
  - Cooperation between educational institutions and
  - development and strengthen the local community.

LOUNAIS-HÄMEEN
KOULUTUSKUNTAYHTYMÄ

fai

As an example of cooperation that works, we have taken products from other local breweries for sale and we have managed to share transport.

We build and repair our equipment

- Here is an example of a bottling and corking line built by Mikko, which also uses an old grid plane and other parts and pieces of sheet metal, for example. (Savings 3 500 €)

  - We build and repair our equipment ourselves, as in this example. This reduces the need to purchase materials and/or equipment and supports the sustainable use of resources.

- Mikko built the tank washing system by using an old Inva ramp from the warehouse, 2 old large beer kegs, metal scraps and a spare pump. (Savings 3 000 €)

Canning line service
Sharing resources

Since we will not be purchasing our own canning equipment, we will be using a shared one with a partner brewery.

This is not only cost-effective, but also environmentally friendly, as it reduces the environmental impact of equipment not being used.

The use of shared equipment supports the circular economy and helps us focus on the quality and development of beer.

We monitor water and electricity consumption on an annual basis

The heat generated in the brewing process helps to heat the brewery - an example of resource efficiency.

A funny picture of how beer is made to heat the brewery.

Heat-using brewing equipment

We innovatively develop our operations and products in line with our sustainability values.

Intelligent system for loss management

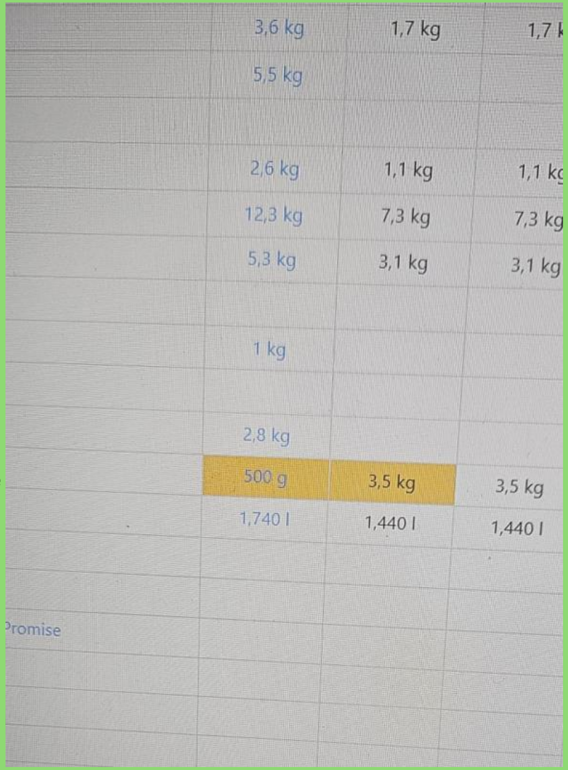
We have an advanced system, Brewos, which manages everything from raw materials to recipes. To production plans and reporting.

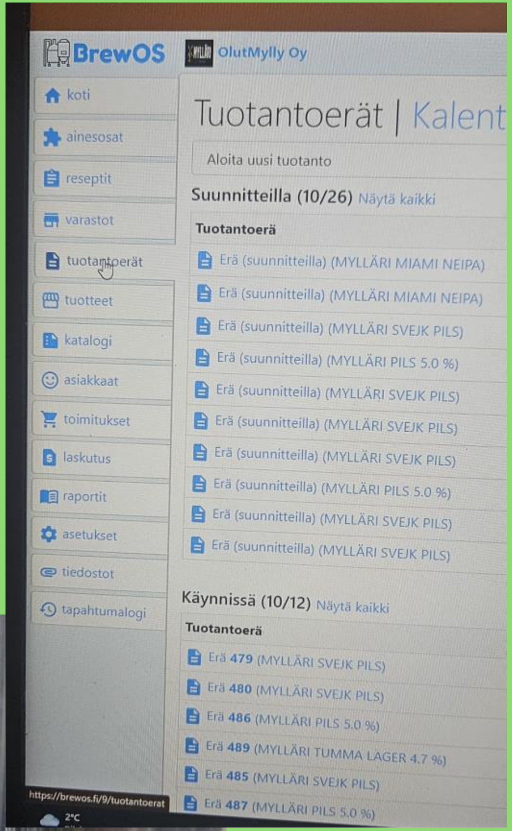
This is how the system optimises:

- Displays, to the nearest gram, the raw materials used according to recipes
- Alerts you when raw materials need to be ordered.
- Ensure that there are no disruptions due to unnecessary orders.

Orders are not placed in small batches - we plan orders so that the pallet is only filled with the ingredients you need.

This ensures that we can minimise waste, while producing high quality products.





Innovative
local cooperation

Earrings from waste empty used Mylläri can metal

MYLLÄRI

Olut yhdistää.

Thank you!

Anne Silmälä

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anne@olutmylly.fi

www.olutmylly.fi

YRITTÄJÄNAISET

VASTUULLINEN YRITTÄJÄNAINEN

TEMPERANCE

BREWING CO.

Brewery & shop in Hämeenlinna. Est. 2024.

Annual maximum production capacity 60 000 l.
5 x 500 l vertical fermentation tanks.
4 x 500 l horizontal fermentation tanks.
Customer base consists of restaurants,
bars, brewery / beer shops & private customers.
Beers are packaged in plastic “kegs” and
aluminum cans.

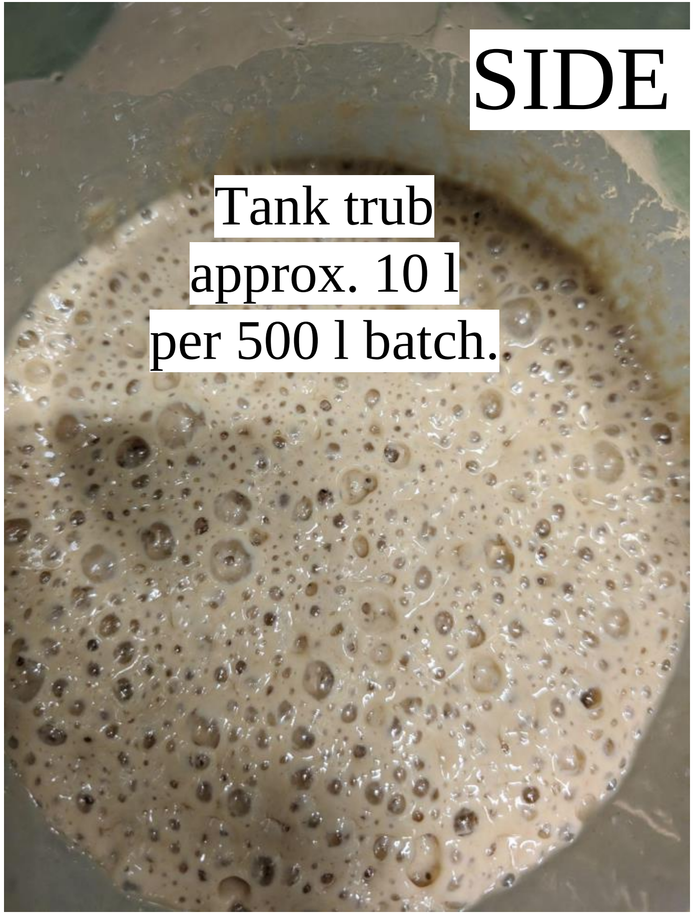

Very Fond of Trees
IPA 6,7%
Very very fond of trees
DIPA 8%
Secondary Colours
Hazy DIPA
8%
TEMPERANCE BREWING CO.

PRODUCTS


Pils
4,9%
Katuma
Very Fond of Amarillo
IPA
6,7%
Something Sinister To It
Porter
Primary Colours
NEIPA
6,5%
TEMPERANCE BREWING CO.


Pils
4,9%
Katuma
TEMPERANCE BREWING CO.
Hops
Loral
Styrian kolibri

SIDE STREAMS



Tank trub
approx. 10 l
per 500 l batch.

Spent grain
approx. 350 kg
wet weight per
500 l batch.

Thank you!

www.temperancebrewing.fi

Lallemand Finland Oy / Suomen Hiiva

Suomen
HIIVA
PARASTA LEIVONTAAN VUODESTA 1889

LALLEMAND

Lallemand around the world (2024)

North America

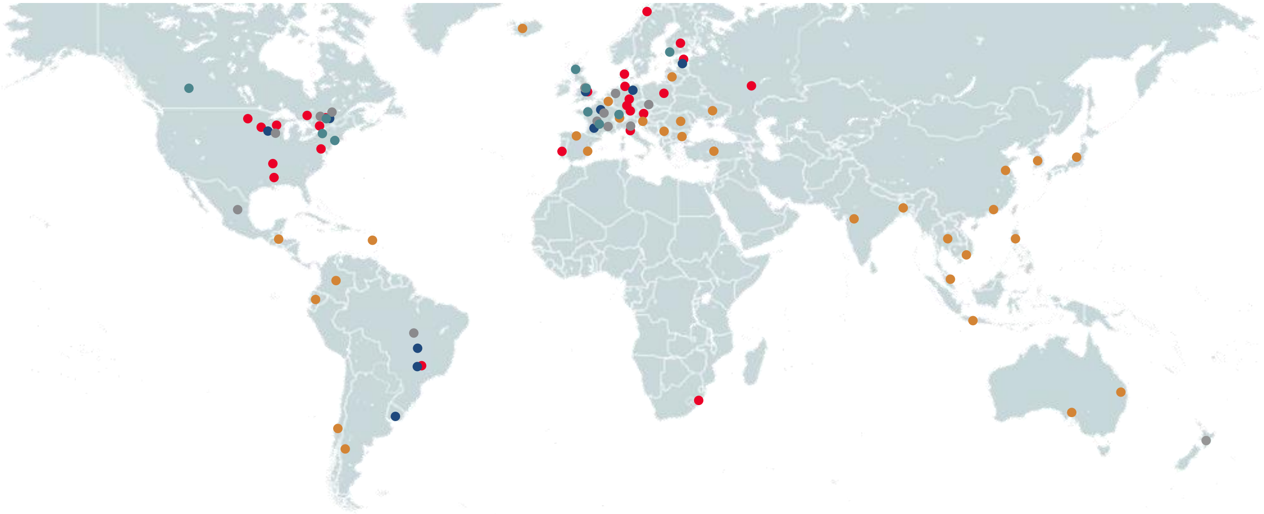
- 9 yeast plants (2 downstream)
- 3 bacteria plants
- 4 other plants
- 5 research labs

Europe

- 14 yeast plants (3 downstream)
- 5 bacteria and fungi plants
- 7 other plants
- 7 research labs

Africa, Asia, South America and Australia

- 2 yeast plants
- 3 bacteria and fungi plants
- 2 other plants
- 1 research lab



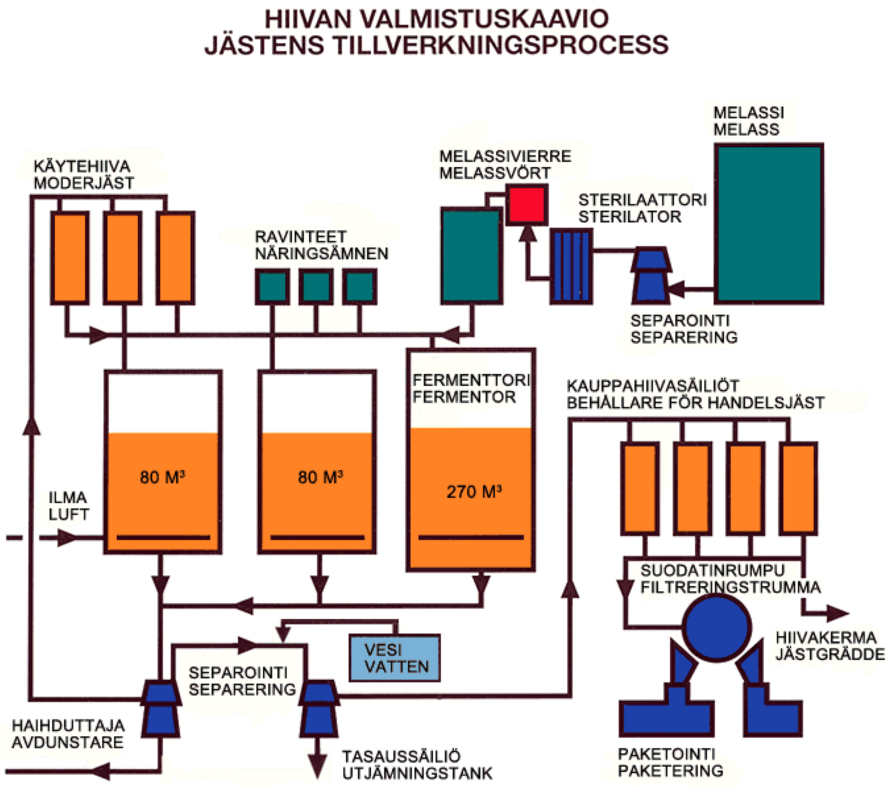
● Yeast plants ● Bacteria / Fungi plants ● Other plants ● Research labs ● Commercial / Distribution

LALLEMAND

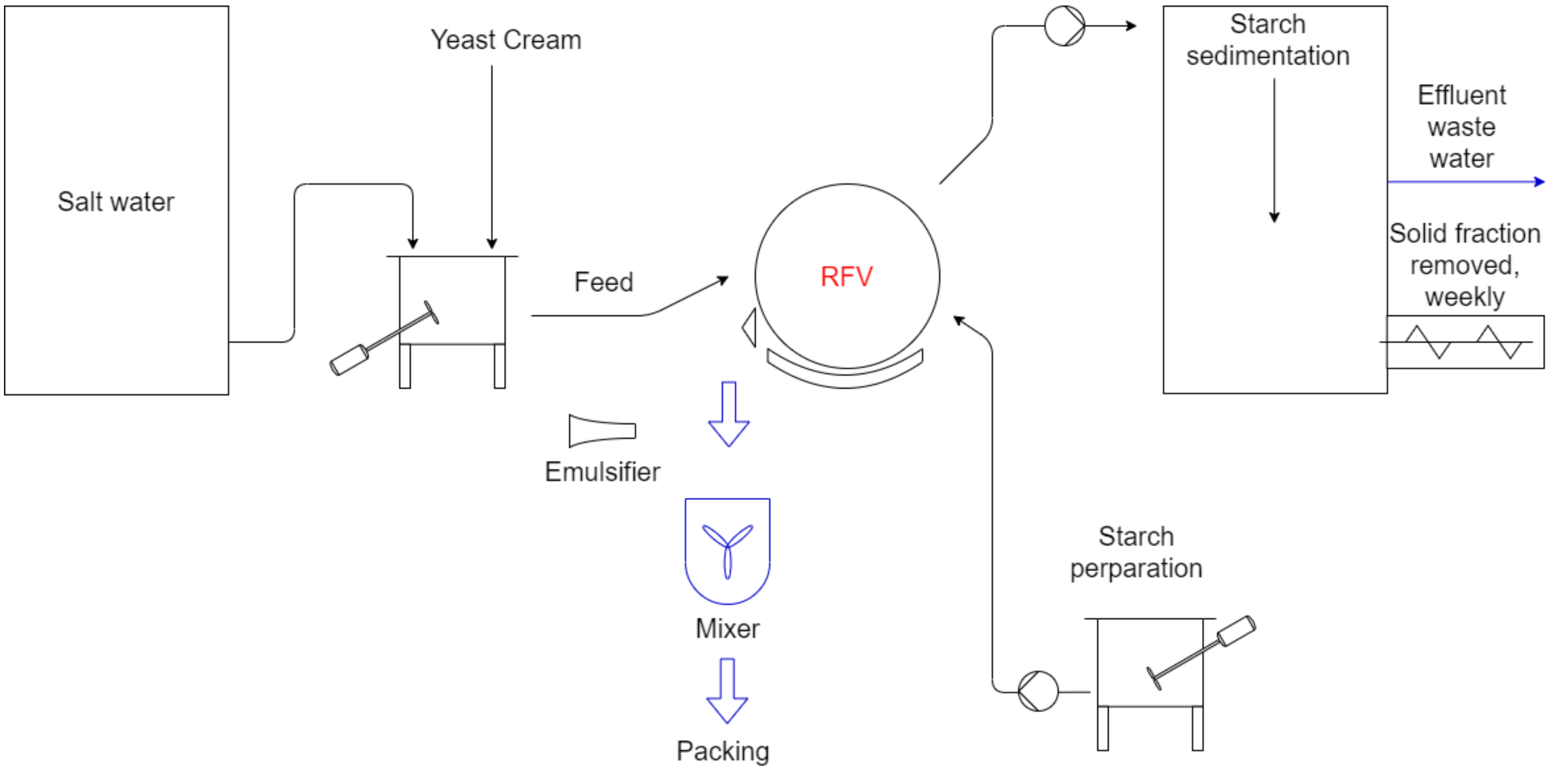
Lallemand Finland Oy / Suomen Hiiva history

1885 Yeast production started in Finland
1897 Yeast production started in Lahti
1973 The yeast factory moved to new facilities
1993 Finnish Yeast Ltd was founded
1997 Yeast production was centralized to modernized plant in Lahti.
2006 New ownership, Lallemand GmbH

Production process



RVF



Salt water
Yeast Cream
Feed
RFV
Emulsifier
Mixer
Packing
Starch sedimentation
Effluent waste water
Solid fraction removed, weekly
Starch perparation

Shipping

- Rinsing water from IBCs
- Rinsing water from tanks
- Rinsing water from trucks

Quality and Certificates

- FSSC 22000 food safety
- ISO 9001 2015
- Kosher
- Halal

- Factory is allergen free area
- All used materials are GMO-free

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Side streams valorized into functional foods include:

MYLLÄRI, MALMGÅRD, TEMPERANCE BREWING CO.:

1) Spent grain
2) Spent hops
3) Hot trub
4) Yeast

Suomen HIIVA:

1) Molasses
2) Yeast
3) Spent starch
4) Vinassess

Combined:

1) Spent grain
2) Spent hops
3) Hot trub
4) Yeast
5) Molassess
6) Vinassess

How to valorize them into functional foods?

1). Composition/components

2). Functional food products

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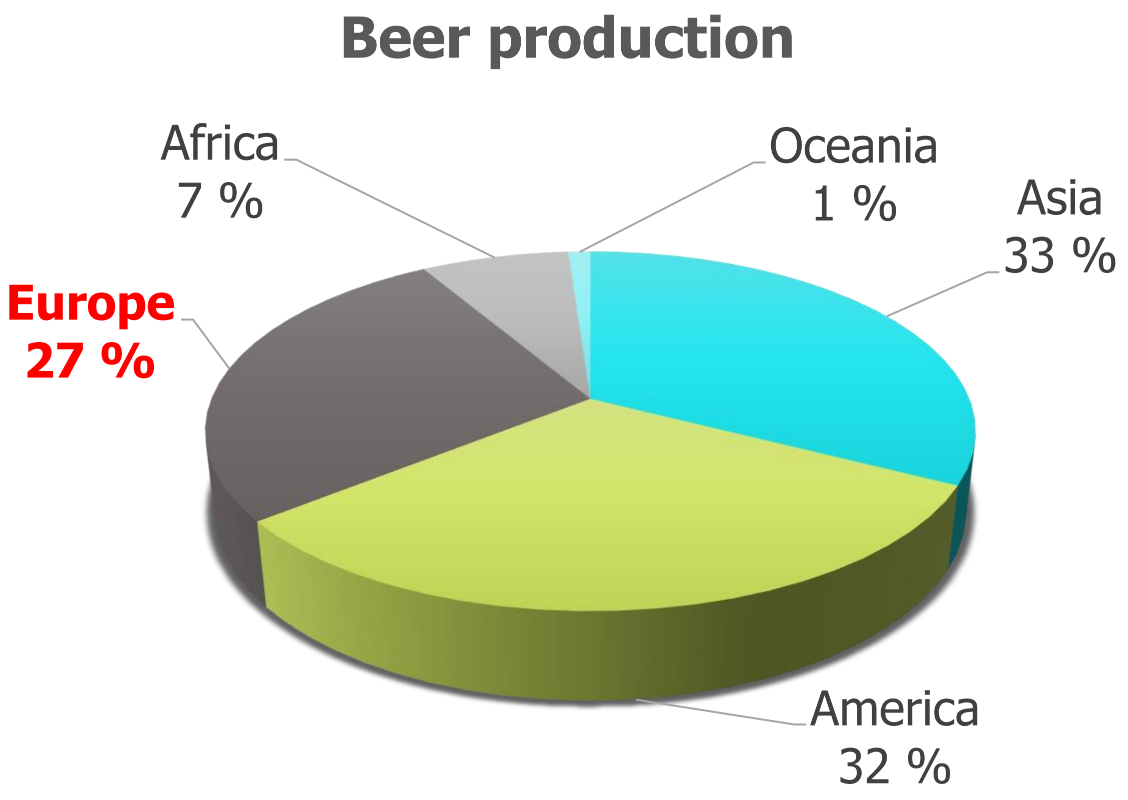
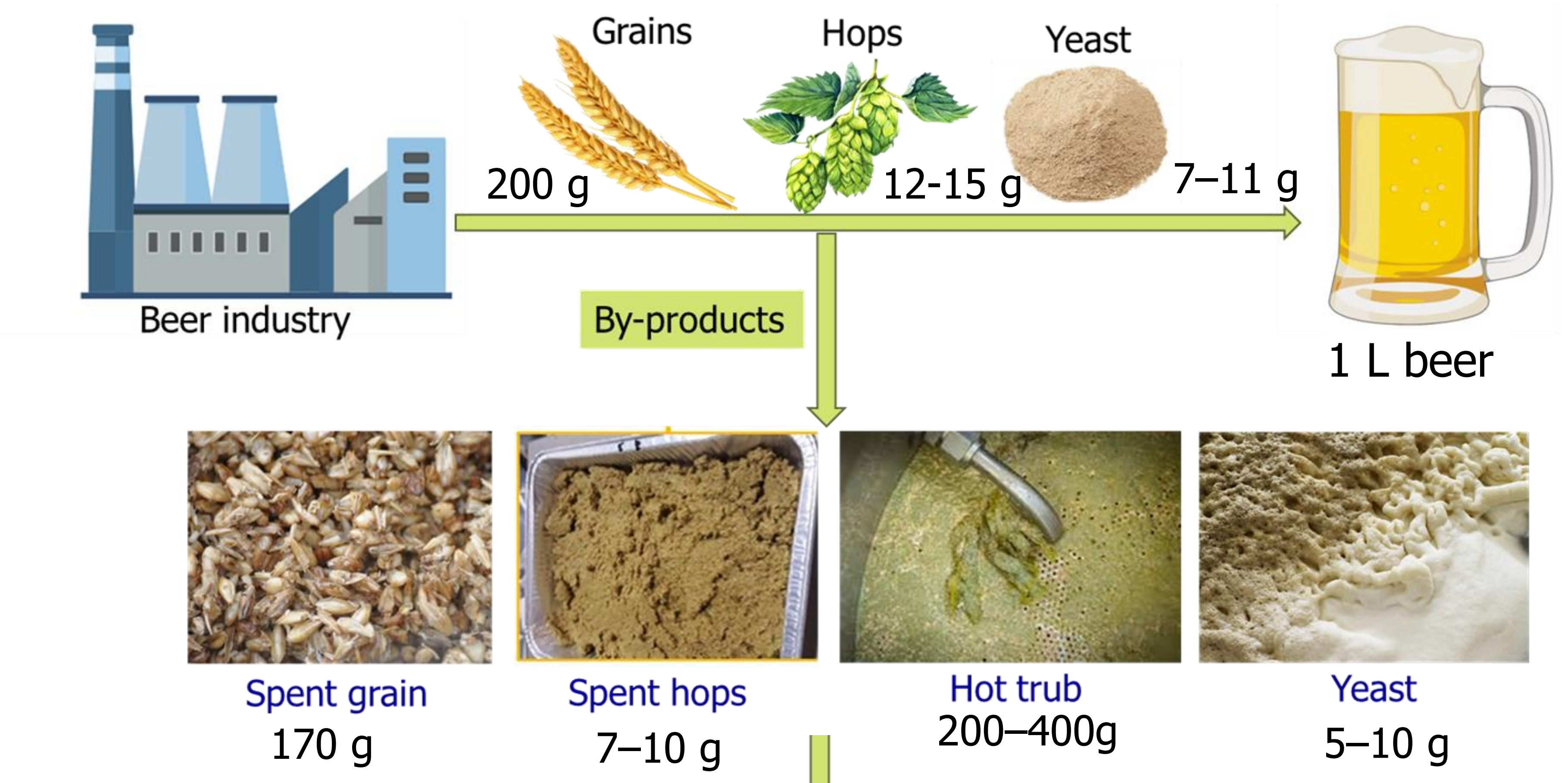
Beer industry and its main side streams…



- European production (not include the input of Russia): **over 7.7 billion liters** (Hejna et al., 2024).

Beer industry and its main side streams…



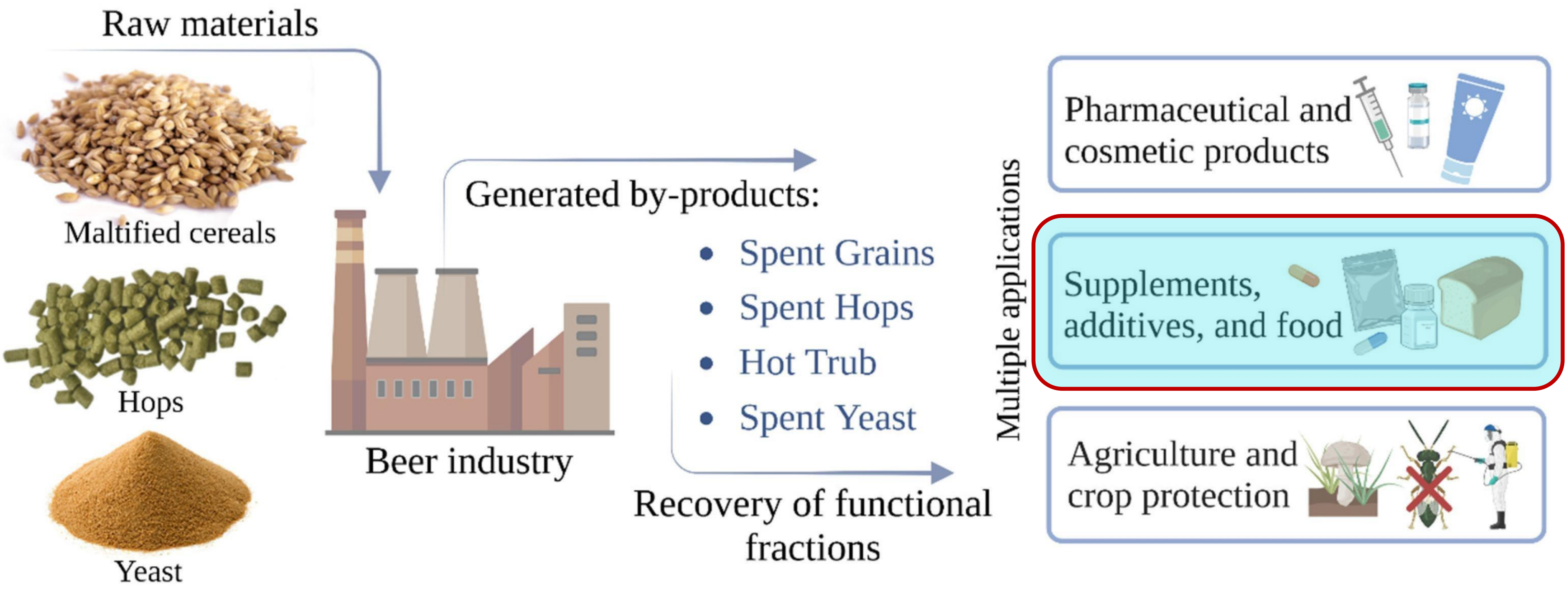
Food applications

3 million tons per year in Europe
(Qazanfarzadeh et al., 2023).

Note: A high amount of side streams is a results of accounting the amount of water used in beer production

(de Mello et al. 2014, Jacob et al., 2019 , Basnet 2022, Chetrariu & Dabija, 2023)

Beer industry and its main side streams…



(Salanță et al., 2023)

Spent grain

Compostion of spent grain...

Composition	%
Moisture	63–80
Proteins	15–32
Lipids	6–10
Fibre	19–70
Ash	0.2–8

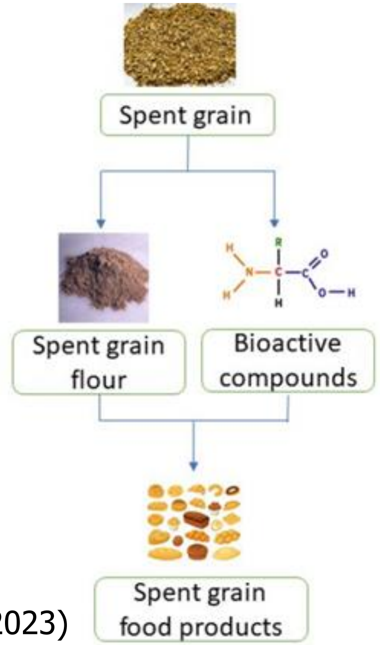
Vitamins	mg/100g
Choline	180
Niacin	4.4
Pantothenic acid	0.85
Riboflavin	0.15

(Olivares-Galván et al., 2022)

Phenolic compounds	mg/100g
Ferulic acid	35–336.3
p-coumaric acid	6.7–137.3
Catechin	41.30
Caffeic acid	0.8–13.7
Gallocatechin	162.2
Epigallocatechin	50.59

Minerals	mg/100g
Phosphorous (P)	460–600
Calcium (Ca)	8.2–352
Potassium (K)	70–157
Sodium (Na)	10–31
Iron (Fe)	10–21

- Relatively high levels of dietary fibers in the form of β-glucan and arabinoxylan (20-70%).
- High protein content (15-30%).
- Polyphenols which display high antioxidant or other nutritional properties.



(Chetrariu & Dabija, 2023)

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Valorization of spent grain...

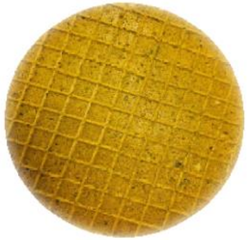
(1). As an ingredient in bakery products such as bread (Waters et al., 2012), **chocolate cakes** (Paiva et al., 2025), **cookies** (Rigo et al., 2017), **wafers** (Raza et al., 2016), **pasta** (Nocente et al., 2021),...

- Increase protein, fiber (β-glucan) content
- Increase antioxidant capacity
- Increase vitamin and minerals

Control 40% spent grain 60% spent grain

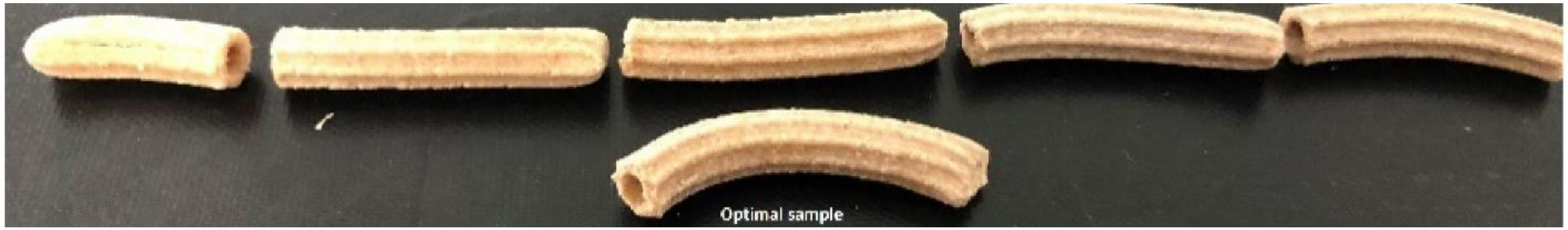
Chocolate cakes with 40% substitution level of spent grain was better accepted by consumers, particularly in terms of flavor.

Spent grain cookies



Spent grain wafers

Control 5% 10% 15% 20% spent grain



Spent grain pasta with various spent grain content

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Valorization of spent grain...

(2). As an ingredient in meat products such as meat sausages (Nagy et al., 2017), **hamburgers** (Saraiva et al., 2019), **chicken sausages** (Choi et al., 2014),...

- Replace fat to improve the hardness, gumminess, and chewiness
- Enhance health-promoting properties
- Decline microbial load during storage

(3). As an ingredient in dairy products such as yogurt and plant-based yogurt alternatives (Naibaho et al., 2022)

- Decrease fermentation time
- Increase water-holding capacity, shear stress and viscosity

(4). Fruit beverages (McCarthy et al., 2013)

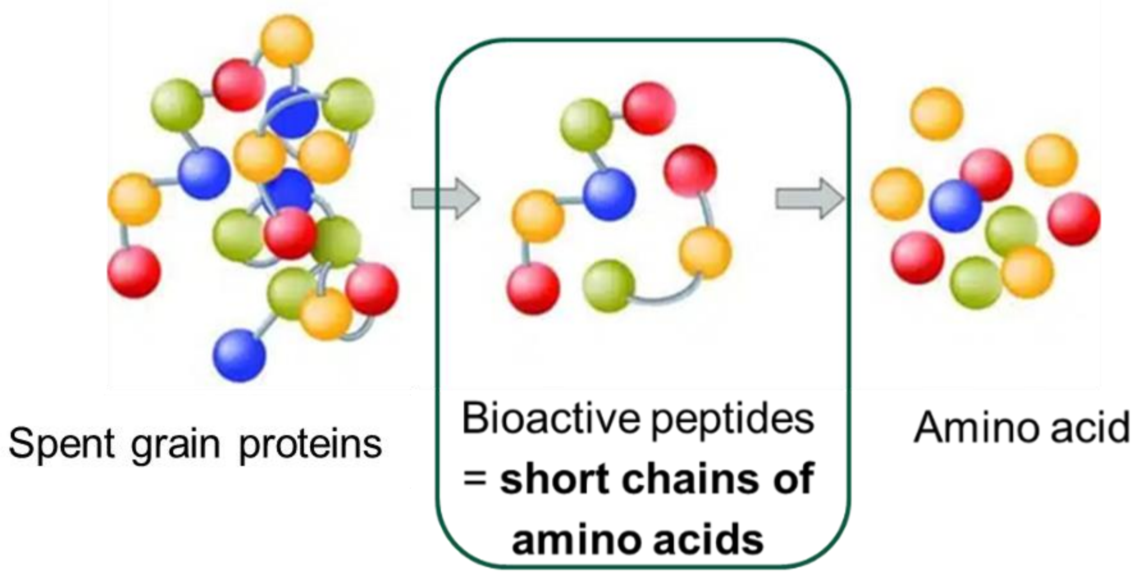
- Phenolic extract of spent grain can be added cranberry juice to increase antioxidant activities.

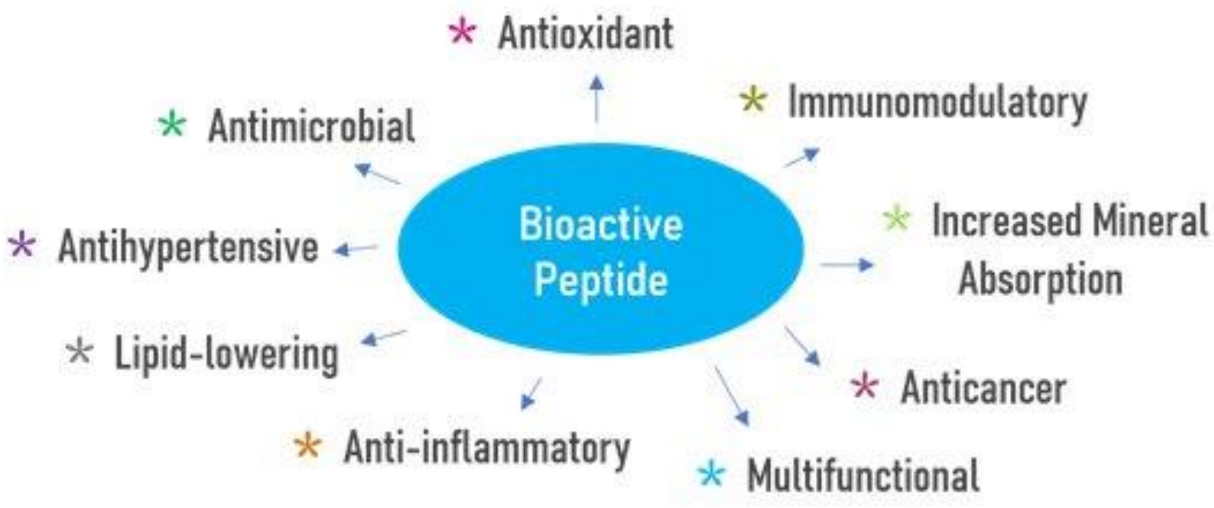
Valorization of spent grain…

(5). As an substrate to grow the edible fungi for a new kind of protein (Parchami et al., 2021)

(6). As a source for producing bioactive peptides (Bazsefidpar et al., 2024)

- Hydrolysis by enzyme and bacteria
- Drying into the bioactive peptide powders - functional powders

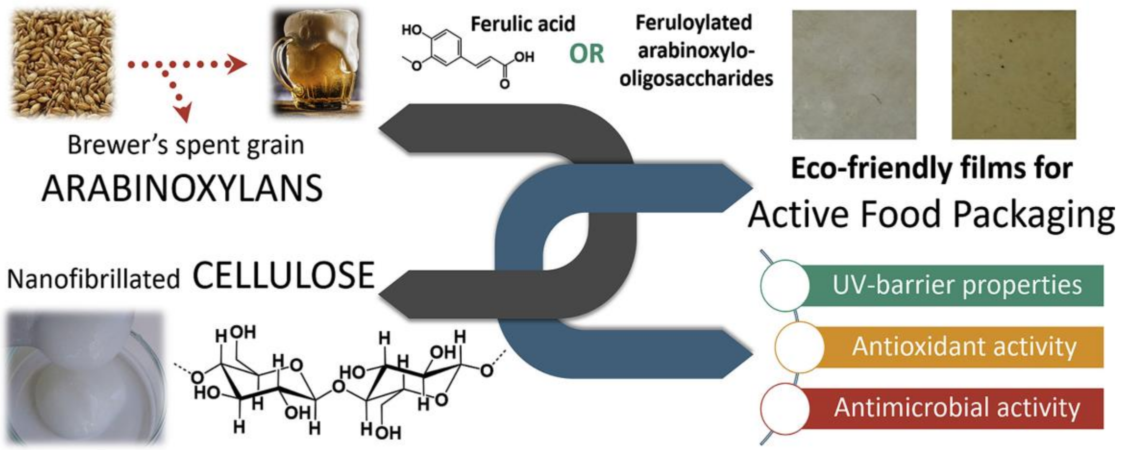




Valorization of spent grain…

(7). Sustainable food packaging

- **Antioxidant and antimicrobial films** for active packaging (Moreirinha et al., 2020)
  - Thermal stability up to 230 °C
  - Good mechanical properties
  - High UV–Vis barrier properties, antioxidant activity, and antimicrobial activity.



- **Biodegradable trays** based on cassava starch blended with spent grain (Ferreira et al., 2020)
  - RH > 60%: high water sorption capacity
  - Trays with 20 or 30% of spent grain are completely degraded after 60 days.

Spent yeast

Compostion of spent yeast...

Composition	%
Moisture	85–90
Proteins	**15–78**
Lipids	0.2–10
Carbohydrates	13–45
Fibre	**3–36**
Ash	5–22

Phenolic compounds	mg/100g
Ferulic acid	0.01–9.22
p-coumaric acid	0.01–10.3
Catechin	24.6–34.2
Protocatechuic acid	13.1
Gallic acid	0.02–2.11
Cinnamic acid	1.24

Vitamins	**mg/ 100g**
Riboflavin (B2)	1.2–11
Nicotinic acid (B3)	68-104
Pyridoxine (B6)	3.1–55
Folic Acid (B9	0.25–5

(Olivares-Galván et al., 2022)

Minerals	**mg/100g**
Calcium (Ca)	16–27
Potassium (K)	6248–9148
Magnesium (Mg)	210–273
Sodium (Na)	88–1228
Iron (Fe)	0.1–12
Zinc (Zn)	4.6–22.6

- Second major side stream from the brewing industry.
- A good source of fibre (mainly β-glucans), proteins, vitamins and minerals (Coldea et al., 2017).

Valorization of spent yeast...

(1). Vegan cakes (Coldea et al., 2017).

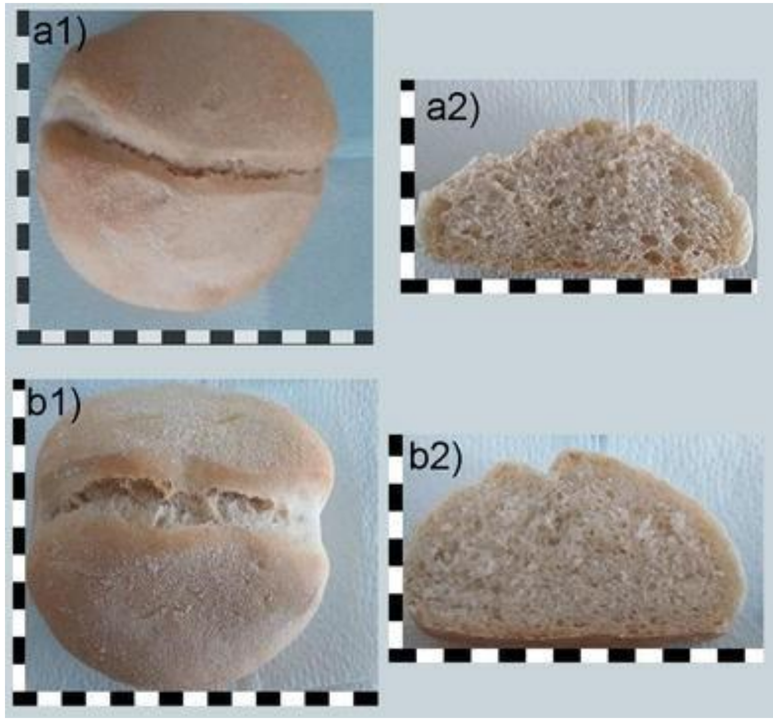
- Increase nutritional values (protein, fibre, vitamin B, minerals)

(2). Bread (Martins et al., 2018; Martins et al., 2015).

- Increase β-glucan (total dietary fibre content by 40%)

(3). Salad dressing (Melo et al., 2015).

- Extraction of **mannoproteins** from spent yeast
- Mannoproteins as an emulsifier to stabilize salad dressing

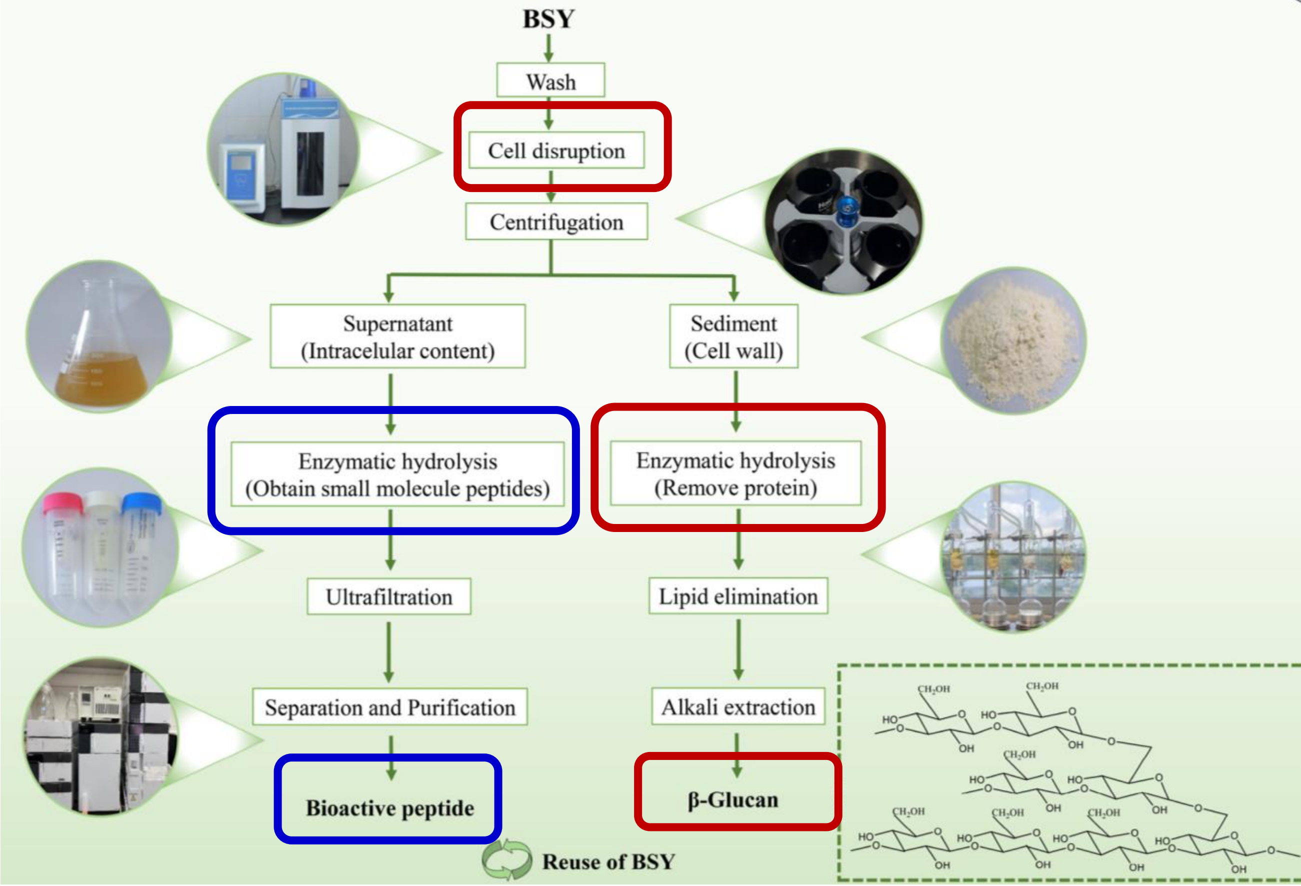


(1) Overall observations (2) cross-sections of breads. (a) Control bread, (b) bread fortified with spent yeast (75g/1.5kg flour) (Martins et al., 2018).

Valorization of spent yeast...

(4). Beta-glucan extraction for **food additives** in yogurt, muffin, biscuits and bread, **prebiotic materials** (Wei et al., 2024), **protecting materials** for drying of probiotics (da Silva Guedes et al., 2019)

- A major component of the yeast cell wall (50% of dry weight of cell wall)



(5). Bioactive peptide production

(Oliveira et al., 2022; Wei et al., 2024; Jaeger et al., 2020; Vieira et al., 2017)

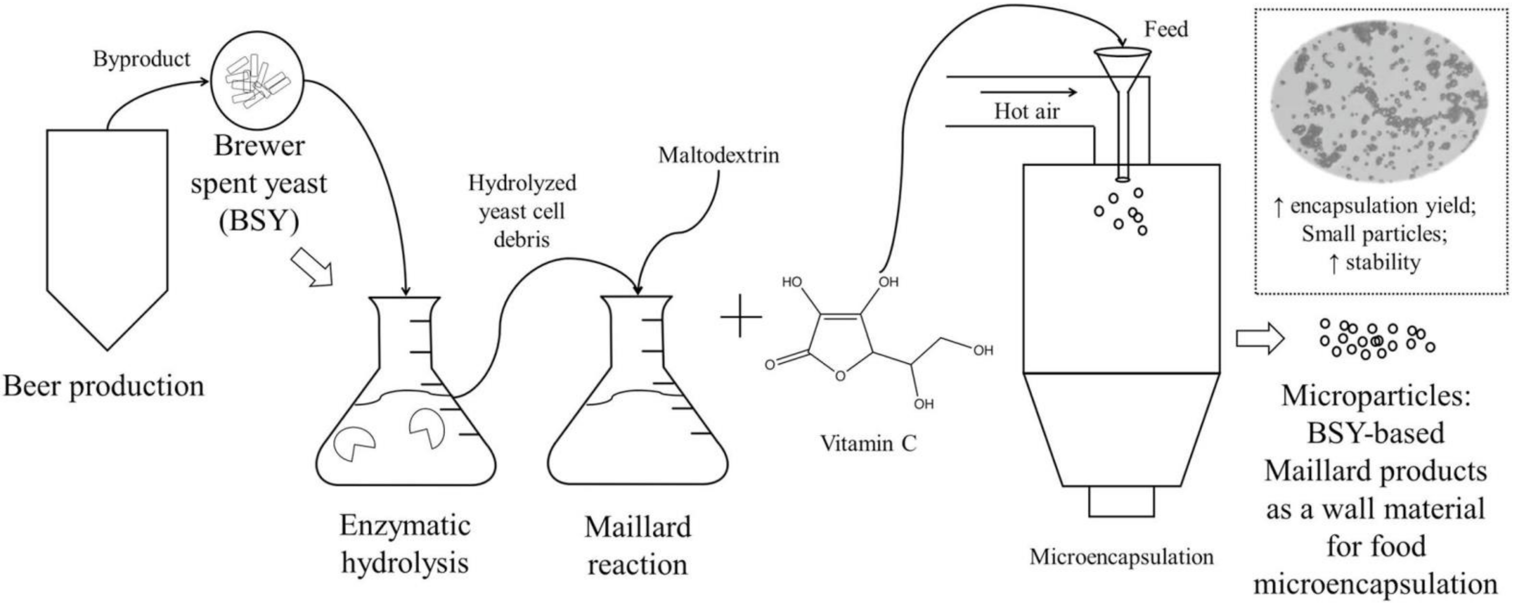
- Protein content in dried yeast: 50%
- Strong antioxidant, antihypertensive, cholesterol-lowering activities
- Hydrolysates for flavor-enhancing ingredient (meaty, umami flavors) in savory products (soups and sauces), and as an ingredient in the formulation of meat substitutes.

Valorization of spent yeast...

(6). Protecting materials for microencapsulation

(Marson et al., 2020)

- Enzyme-hydrolysed spent yeast
- Good protect vitamin C during spray drying



(7). Fermentation substrate

(Radosavljević et al., 2020)

- Providing nitrogen source for microorganism growth (lactic acid bacteria)
- Low carbon-to-nitrogen ratio which is desirable for an additive to fermentation media.

Hot trub

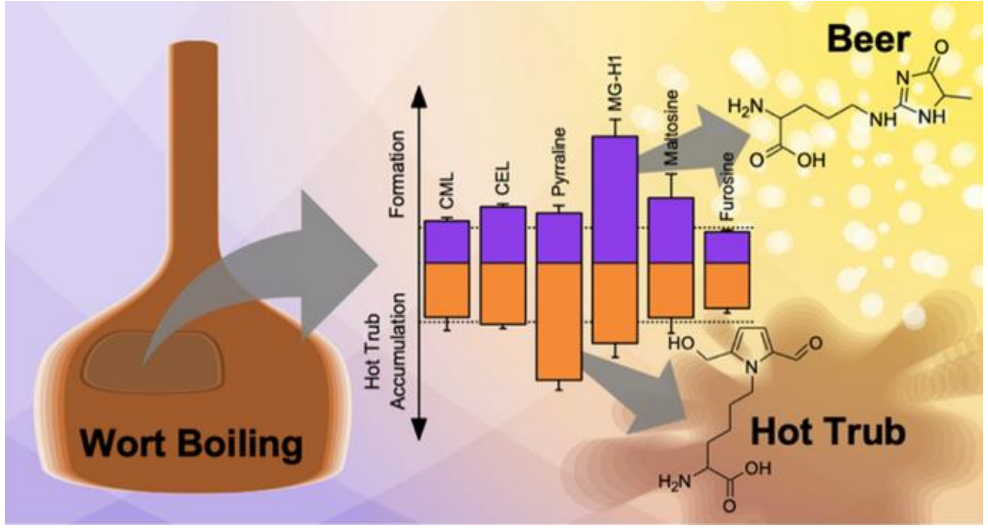
Compostion of hot trub…

Composition	%
Moisture	80-90
Proteins	**40-70**
Lipids	1-2
Carbohydrates	4-8
Polyphenols	5-10
Ash	3-5
Hops bitter substances non isomerized	10-20

A precipitated product of the wort boiling process that includes

(Fărcaş et al., 2017)

- Insoluble hops
- Wort proteins, and isomerized hop acids
- Trace amounts of fats and fatty acids from malt and hops
- Small amounts of starches and polysaccharides from malt
- Polyphenols (tannins) from hops and malt



(Stegmann et al. 2023)

Valorization of hot trub…

(1). As a source of protein for the food industry (Santos & Martins, 2024)

Dried in an oven (HTO) or lyophilized (HTL)

(2). Stabilizer for emulsion gels (López-García et al., 2021).

(3). Protein-enriched ice cream (Saraiva et al., 2020)

- 5% protein enrichment of ice cream
- Increase viscosity, consistency, gel strength and ability to recovery from deformation
- Longer melting time

(4). As a active ingredient (Senna Ferreira Costa et al., 2021)

- Extracts from hot trub powders
- Capable of acting as antioxidants.
- Natural antimicrobials
- Safe for food use

(5). Cheese (Saraiva et al., 2023)

- Water extracts from hot trub powders (1%)
- Increase antioxidant activity by almost 90%
- Reduce lipid oxidation by 55%

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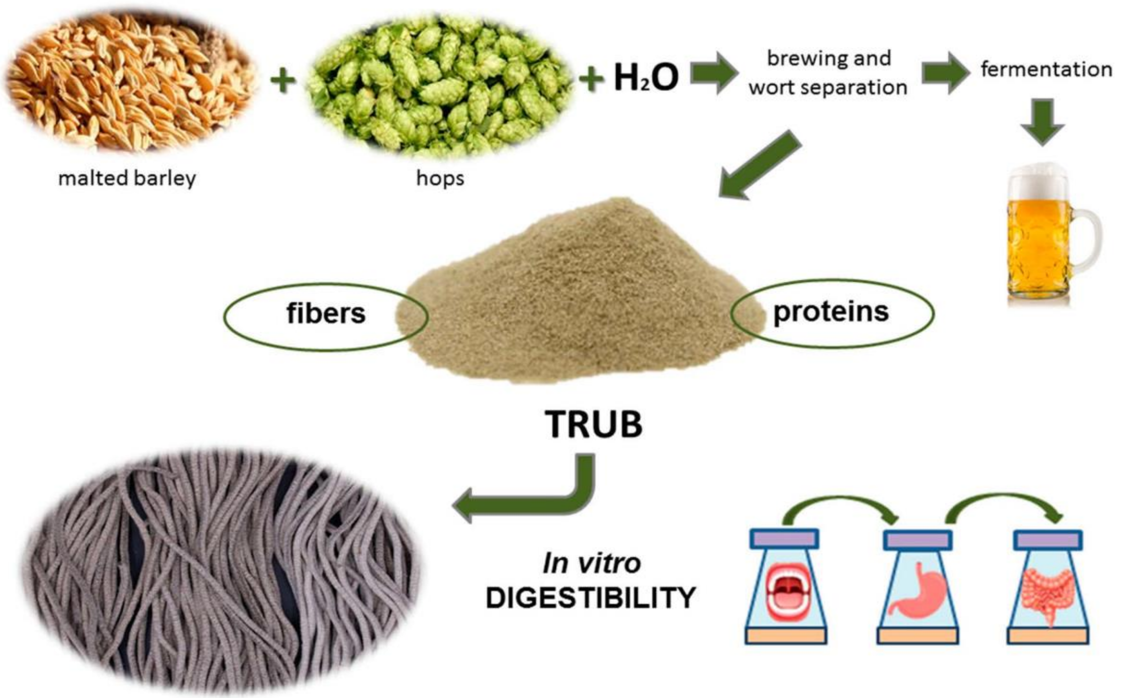
Valorization of hot trub...

(6). Pasta (Saraiva et al., 2022; Lomuscio et al., 2022)

- Increase nutritional content (protein)
- Improve structure (soft and cohesive texture, high water absorption).
- Reduce glucose release during digestion



Spent hops

Compostion of spent hops…

Composition	%
Moisture	80–90
Proteins	20–70
Lipids	4.5–10
Carbohydrates	10–20
Reduced sugars	2.24–26
Fibre	2–6.5
Ash	0.2–8

Phenolic compounds	mg/100g
Catechin	82-282
Kaempferol	52-163
Quercetin	32-144
Proanthocyanidins C2	29-88

(Olivares-Galván et al., 2022)

- The spent hops represents the the solid residue from hops used in the brewing industry.
- Only 15% of the hops’ constituents will be transferred into the beer, whereas 85% will become a byproduct (Bedini et al., 2015).
- High proteins (20–70%) among brewing residues and high phenolic content.
- The main challenge in food industrial use: bitterness conferred by isomerized α-acids and polyphenols.

Valorization of spent hops...

(1). As a source to extract the phenolic compounds for food preservation

- Repellents for insects of stored foods (Bedini et al., 2015)
- Food preservation films (Codina-Torella et al., 2021)
- Against food pathogens marinated meat (Kramer et al., 2015)

(2). As as a flavoring agent in relaxation drinks such as hop water, hop tea, hop soda,...

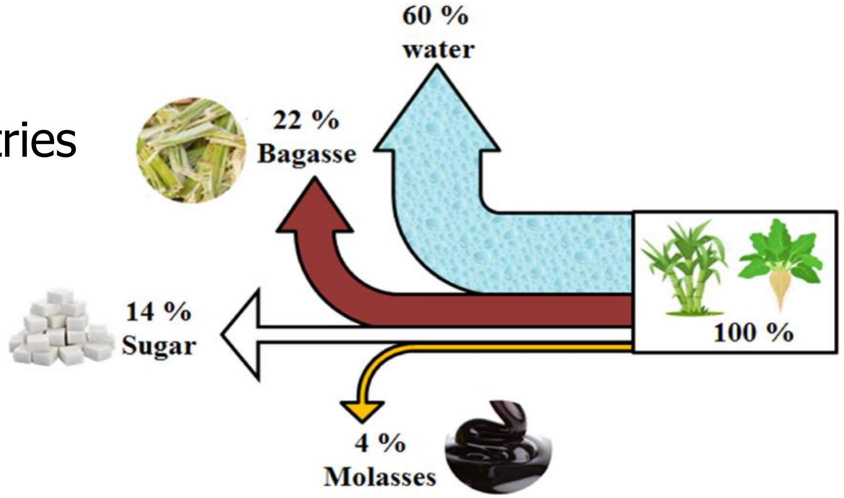
(Salanta et al., 2023)

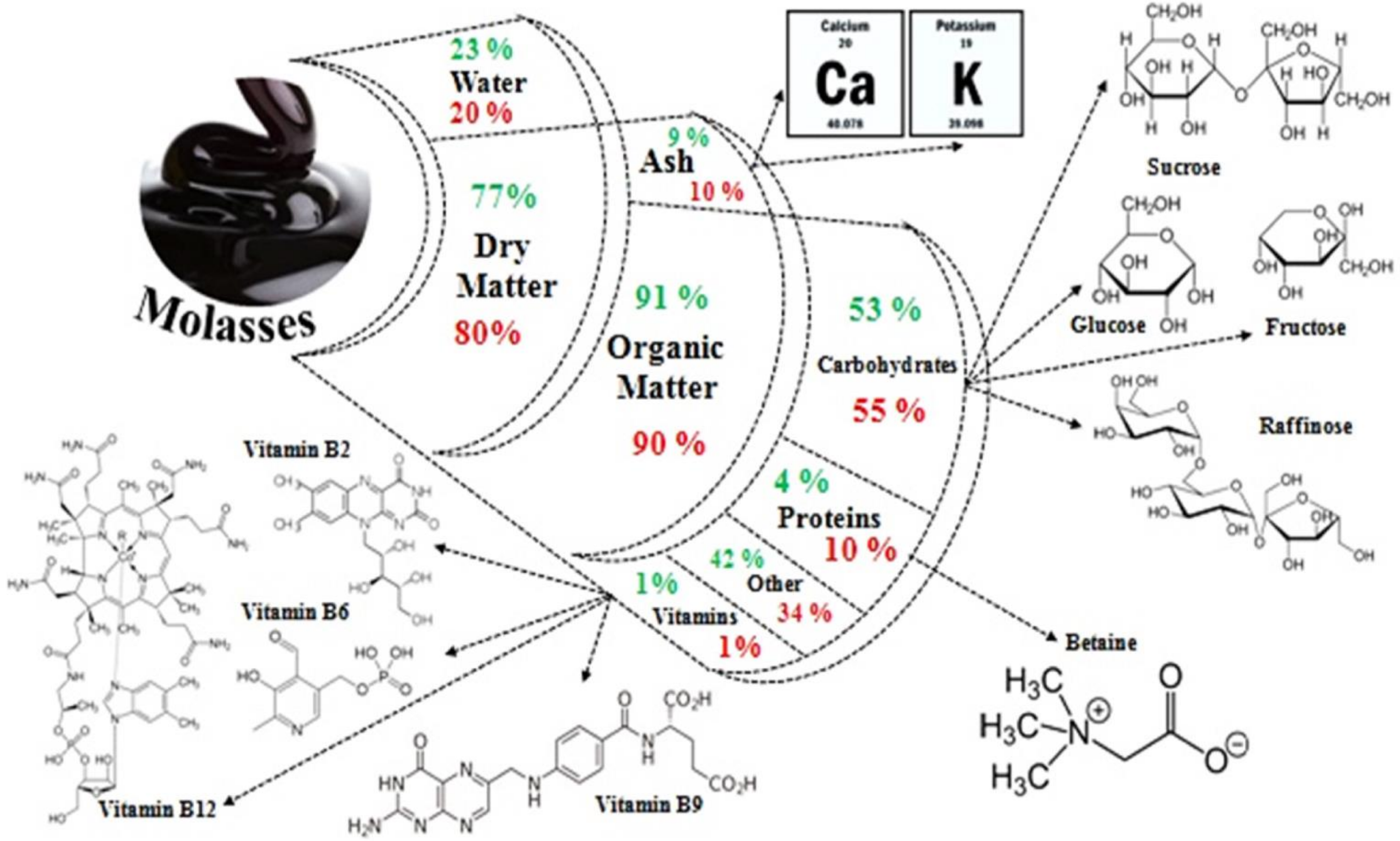
- The effect is at least partially due to 2-methyl-3-buten-2-ol, an oxidation product of hops' bitter compounds

Molasses

Compostion of molasses…

- Byproducts of the beet sugar, sugar cane, and citrus fruit processing industries
- Components: rich in sugars and minerals (Asri & Farag, 2023)





- Rich in phenolic compounds and flavonoids
  - ✓ Antibacteria (Chen et al., 2017)
  - ✓ Antioxidant (Chen and Yu, 2015)
  - ✓ Anticancer (Chen et al., 2015)
- Can be spray-dried into the powders with drying agents (maltodextrin,…) (Babaoğlu et al., 2022; Acan et al., 2020); oven-dried (then milled) (Filipcev et al., 207)

Valorization of molasses...

(1). Osmotic dehydration of fruits and vegetables (old applications)

(2). Bakery and dairy products: bread (Salamon et al., 2024; Simovic et al., 2022; Filipcev et al., 2010), gluten-free cookies (Filipcev et al., 207), biscuits (Filipcev et al., 2015), ice cream (Acan et al., 2020; Soukoulis & Tzia, 2018), yogurt (Rashwan et al. 2023).

- ✓ Improve techno-functional properties (minerals, vitamins)
- ✓ Enhance polyphenol content and antioxidant activities
- ✓ Inhibit spoiled microorgansims

(3). Rum production (Medeiros et al., 2017; Kassa et al., 2024)

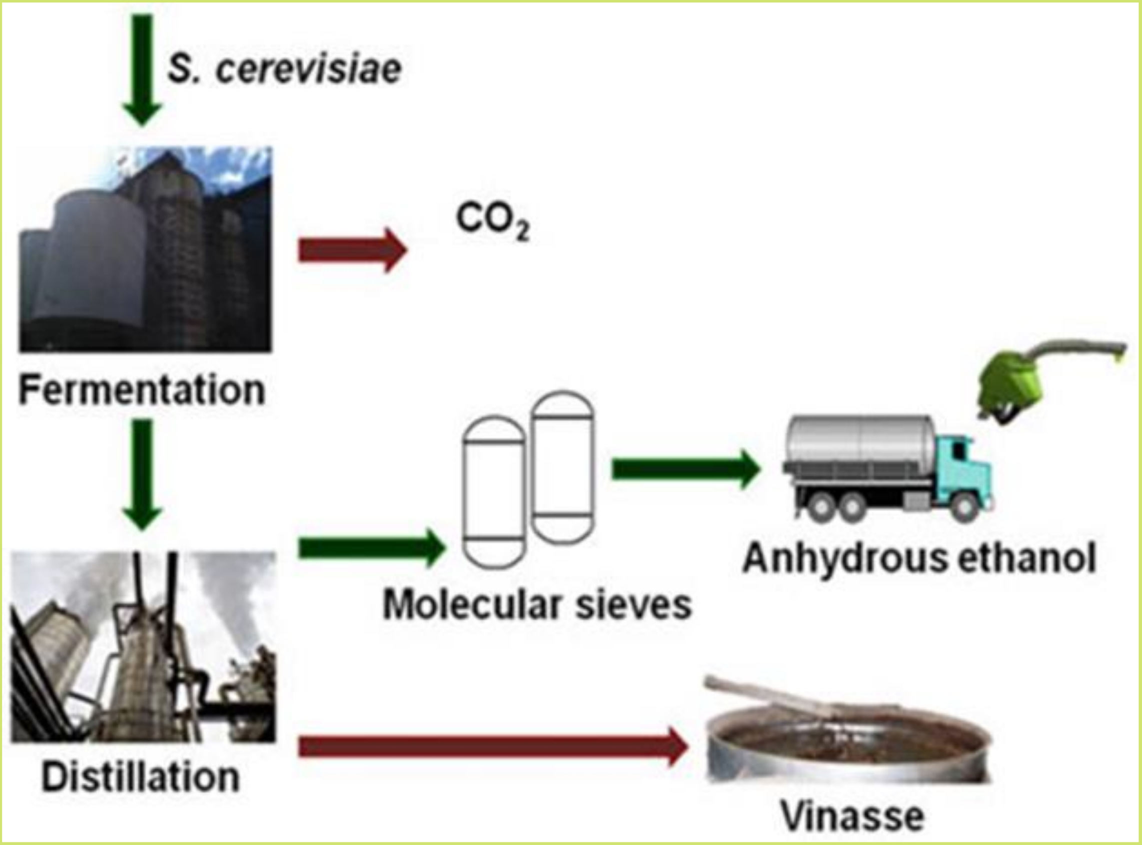
(4). Postbiotics (exopolysaccharides using lactic acid bacteria) (Ren et al., 2024)

(**5). Betaine recovery** (Generally Recognized as Safe by FDA, food ingredient by EU) (Mohammadzadeh et al., 2018)

Vinassess

Compostion of vinassess…

- A dark liquid byproduct of ethanol, sugar or yeast production
- Water: 85–95%.
- Organic components (20–40 g/L)
  - Sugars, organic acids, and phenolic compounds (10–30g/L).
  - Proteins and amino acids (0.5–2 g/L).
- Minerals: Potassium (30–50 g/L), calcium (0.1–1 g/L), magnesium (0.05–0.5 g/L), and sodium (0.1–0.8 g/L), iron (10–100 mg/L), zinc 1–10 mg/L, and manganese 1–10 mg/L.



Valorization of vinassess…

(1). Fermentation media

- Rich in minerals like potassium, magnesium, and other trace elements.
- A substrate for microbial fermentation (Lazaro et al., 2014).
- Production of high value added lipids (carotenoids and polyunsaturated fatty acids) (Fernandes et al., 2017)
- Production of bioactive peptides (Montalvo et al., 2019)

(2). Source of bioactive compounds (Contreras et al., 2020)

- Antioxidants and phenolics
- Natural preservatives

(3). Carboxymethyllysine inhibition (Wang et al., 2019)

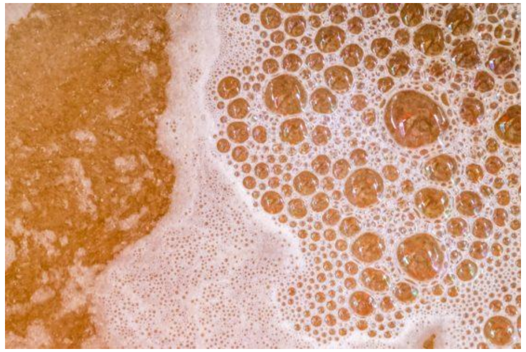
- Carboxymethyllysine: A Maillard reaction product produced during food processing such as dairy.
- Phenolic compounds extracted from vinasses: strong antioxidant capacity and inhibit the formation of carboxymethyllysine

Summary

(Spent) hops

Spent grain

Molassess



Hot trub

(Spent) yeast

Vinassess

How to valorize them into functional foods?

1). Composition/components

2). Functional food products

Euroopan unionin osarahoittama

Uudistuva ja osaava Suomi 2021–2027

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Thank you for your attention

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The Regional Council of Päijät-Häme

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Questions and discussion