

NEW TECHNOLOGIES FOR VALORISING BREWERS' BY-PRODUCTS AS SECONDARY MATERIALS FOR NEW HIGH VALUE APPROACHES



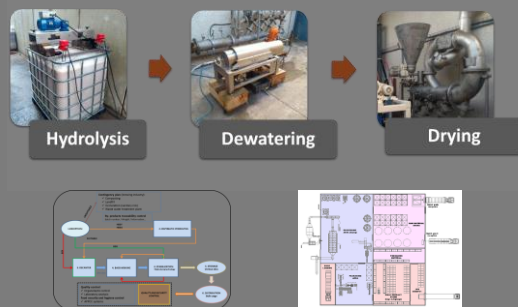
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Index



1. Objectives & Challenges

**High value solution for
brewers' by-products**



2. Technological solution

**Best available
techniques; Recovery
scheme & Eco-designed
Production plant**



Food ingredient

Aquafeed

3. Market value

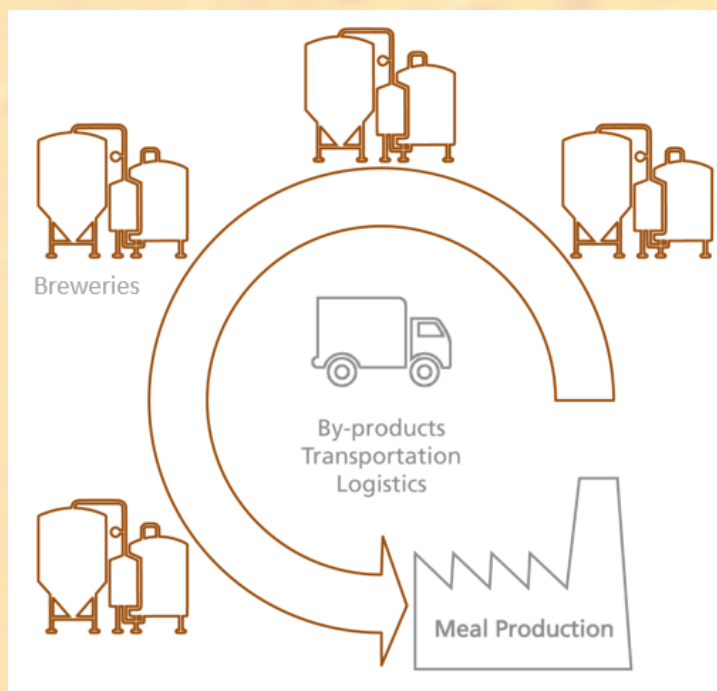
**Production & Food and
Feed alternatives**



4. Benefits & KPIs

**Sustainability of beer
industry**

1. Objectives



General objective:

To **define and demonstrate** the feasibility of an innovative and sustainable **Technological solution to valorise brewers' by-products as secondary materials for new high –value approaches:**

- At semi-industrial scale and in a real operational conditions
- In a real case study representative of a EU brewing producing region → Spain

1. Challenges



Enzymatic Hydrolysis of protein

- To assess the potential of **hydrolysis** to obtain other high value compounds (nutraceutical; food; feed; etc.) and/or to increase the ingredients digestibility (aquafeed) to give more value to brewers' by-products.



Stabilization by drying

- To develop an **innovative and efficient drying process** which ensures:
1) nutritional quality 2) food security & safety 3) economic feasibility for obtaining:
 - Dried spent yeast
 - Hydrolysed and dried spent yeast
 - Dried spent grain
 - Hydrolysed and dried spent grain

2. Technological solution

➤ Best available techniques



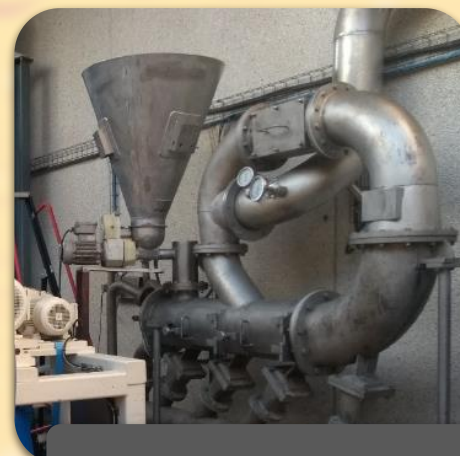
Hydrolysis

Enzymatic hydrolysis
High-value molecules
Digestibility



Dewatering

Decanter & Centrifuge
More efficient and less energy
demanding



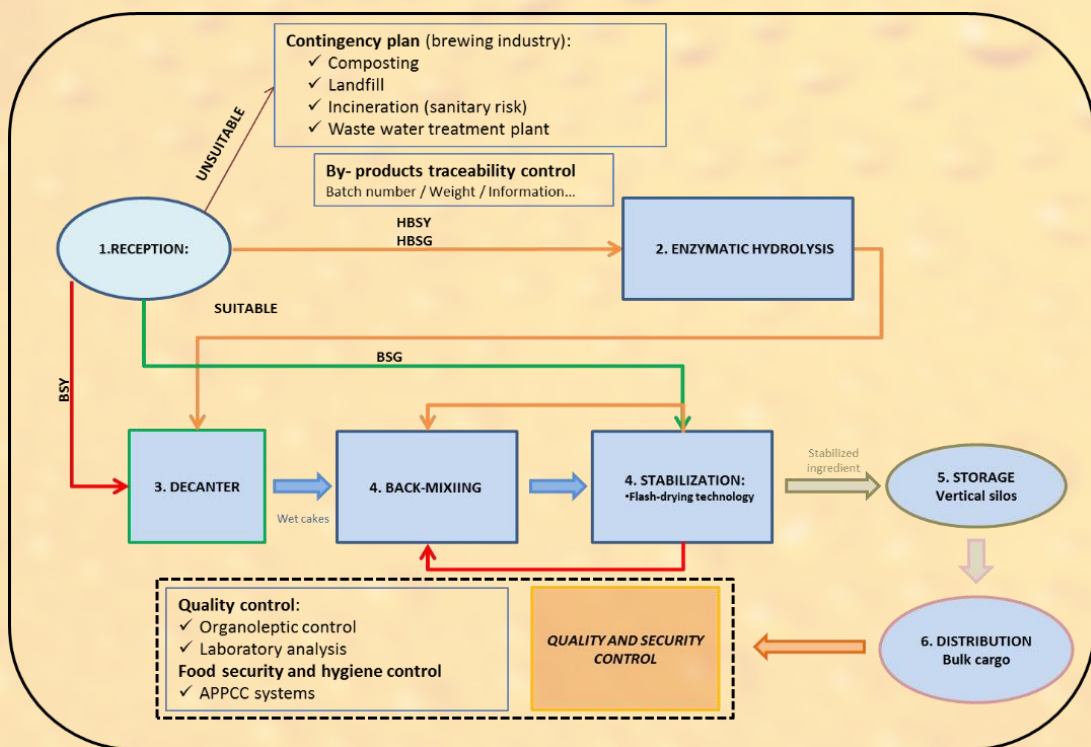
Drying

Flash drying
High-efficient but more
energy demanding



2. Technological solution

➤ Recovery scheme



All the stages of the Value chain
Innovative, safe and secure

- Food grade -human consumption- and/or other approaches
- Nutritional value maintaining

Replicable to any European region

- Flexible and adaptable to any scenario

Sustainable

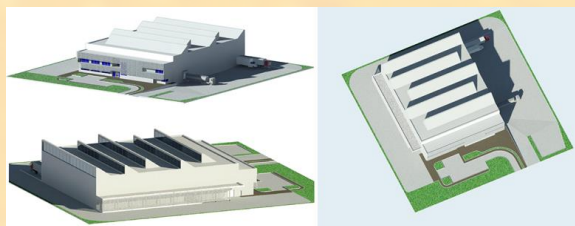
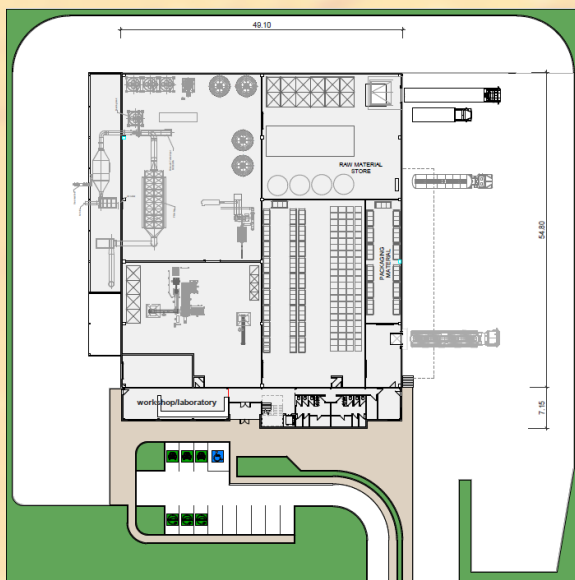
- Eco-designed at industrial level

High-Efficient

- Low energy demanding
- Adaptable to any energy source: surplus, renewable

2. Technological solution

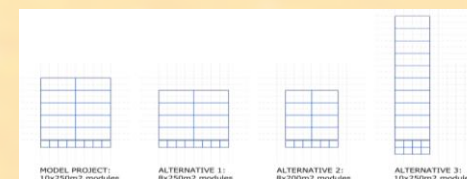
➤ Production plant



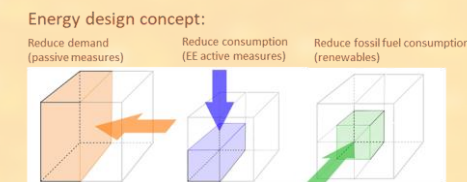
→ Eco-design methodology applied (ISO 14006)

- **Location analysis** → *Thermal envelope to reduce Heat loss / excessive gains*
- **Bioclimatic design** → *Solar gains and Protection to reduce Energy demands*
- **Environmental certification criteria** (BREEAM, LEED and WELL)
- **Material / structural selection based on LCA** → Cradle to grave, EPDs
- **Responsible sourcing** → ISO 14001
- **EU legislation** → Energy Performance Building Directives (EPBD, NZEB), National Energy Efficiency Action & Energy and Climate Plans (NEEAP & NECP)
- **Energy performance simulations** → *Renewable energy analysis*

→ Flexibility



→ Turnkey solution is available



3. Market value of final products

Scope of demonstration trial:

- In a **representative** case study
- At a **semi-industrial** scale
- A **real operation** conditions

15 tons of BSG and BSY



1.5 tons of BSG and BSY ingredients

1. Dried spent yeast
2. Hydrolysed and dried spent yeast
3. Dried spent grain
4. Hydrolysed and dried spent grain



3. Market value of final products

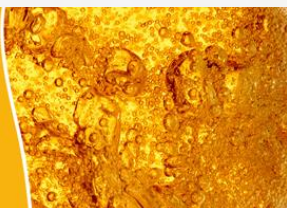
1.- New food ingredients:

- **Nutritional value** → High protein content; Antimicrobial capacity (E.Coli / Salmonella spp. / Staphylococcus spp.); Anti-oxidant capacity; Anti-hypertensive capacity; Glucans

BASIC PARAMETERS	Unit	Yeast	H-Yeast	Grain	H-Grain
		Office	Office	Office	Office
Moisture	%	5,81	4,54	6,02	5,23
Ash	%	5,65	5,26	4,33	4,70
Crude Protein	%	37,98	38,51	25,90	22,20
Crude fat	%	2,06	1,87	8,06	6,74
Gross Energy	KJ/100g	1546,00	1571,00	1685,00	1666,00
Phosphorus	%	1,12	1,08	0,50	0,38
Crude fiber	%	1,18	1,35	15,96	17,58
Starch	%	21,87	27,07	2,56	1,80

→ High EU protein market potential
→ High Ingredient value

- **Security & Safety** → Food grade



3. Market value of final products

2.- Aquafeed ingredients:

Tested with Gilthead seabream (*Sparus aurata*) and Rainbow trout (*Oncorhynchus mykiss*):

➤ **Adequate Digestibility for fishes** → **Digestibility tests** have been **positive**.

→ High level of inclusion in diets: 20 % in BSY and 15 % in BSG

➤ **High nutritional value** → **Growth and Feed efficiency trials** have been **positive**.

→ No differences with control

➤ **Tasty fishes** → **Sensory tests** have been **positive**.

→ No differences with control

→ EU market potential: 3,510,000 tonnes / year

→ High Ingredient value

4. Benefits

HIGH VALUE SOLUTIONS FOR BREWERS BY PRODUCTS

→ Contributing to the **Sustainability**
of beer industry.

1- FOOD INGREDIENTS

High-value solution for brewers' by-products.

2- AQUAFEED INGREDIENTS

Value solution for **large quantities** of by-product.



COMPETITIVENESS

→ Implementing a **new business activity** based
on Circular economy.

SUSTAINABILITY

→ **Sustainable products** have an **added value**
that gives them an advantage over the
competition.

ENVIRONMENTALLY FRIENDLY

→ Minimizing CO_2 emissions by:

1. **Valorising brewers' by-products** as
Secondary raw material
2. **Eco-design** of the processing plant.

4. Sustainability

ENVIRONMENTAL IMPACT KPIS



1. Brewery sector

Brewery by-products landfilling or treatment

- ↓ 513 kg CO2 eq. / tonne of BSG disposed in a landfill [Eco invent database]
- ↓ 83 kg CO2 eq. / tonne of BSY treated in a treatment plant [Eco invent database]

2. Aquaculture sector

Alternative ingredient in aquafeed:

- 15 % substitution of current raw materials by brewers' by-products in aquafeed:
→ ↓ 128 kg CO2 eq. / tonne of Aquafeed [Eco invent database]
- Fishing activity to produce fish meal → 2,140 kwh (Energy) / tonne of fish meal
[as far as this meal comes from Technosphere resources (supply chain products)]

4. Sustainability

ENVIRONMENTAL IMPACT KPIS

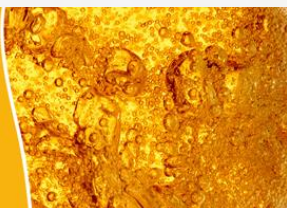
3. Comparison of Valorising brewer's by-product as aquaculture feed with: Incineration or landfilling:

↓ up to 300 kg of CO₂ eq. per ton of by-product.

Wet livestock feed:

↓ up to 140 kg of CO₂ eq. per ton of by product, due to the avoided impact of the replacement of soybean and fishmeal.





Conclusion about Proposed Technological solution

Innovative, safe and secure

- All the stages of the Value chain → **Feasibility** of solution has been demonstrated at semi-industrial scale
- Suitable for Food grade or other approaches → **Combination of both options** is possible
- Nutritional value; Safe and Secure → The **nutritional value of brewers' by-products** is protected

Replicable to any European region

- Flexible and adaptable to any scenario → Different **solutions** for different **scenarios**

Sustainable solution

- Eco-designed at industrial level → **Environmental aspects** have been considered

High-Efficient solution

- Low energy demanding → **Sustainability** and **Profitability** ensured
- Adaptable to any energy source: surplus, renewable → **Versatility**

Turnkey solution is available

- Design adapted to any requirement → Adaptable to any **business dimension**

Acknowledgments



1. Life BREWERY project (LIFE16ENV/ES/000160) is funded by **LIFE European Environment Programme** (<https://ec.europa.eu/easme/en/life>), which is the EU's financial instrument supporting environmental, nature conservation and climate action projects throughout the EU.



2. Brewers by-products samples used in this study were provided by **Mahou San—Miguel company** in Spain (www.mahou-sanmiguel.com).



3. All the enzymes used for the hydrolysis were provided by Ramiro Martínez, **Novozymes** Spain (www.novozymes.com).

Thank you – Any question?

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