

SymbioBeer

How Industrial Symbiosis turned Bread into Beer

Key Messages:

- SymbioBeer is an EPA Green Enterprise Funded industrial symbiosis demonstration pilot, facilitated by Irish Manufacturing Research (IMR) between St. Mel's Independent Brewing Company and Panelto Foods between 2020-2021.
- Industrial symbiosis, a key strategy in a circular economy model, refers to when the production residues from one business is valorised by transforming it into a higher value material substitute for another business.
- Valorising production residues into higher value applications are a means to increase competitiveness and resilience whilst reducing greenhouse gas emissions (GHGs).

Background

SymbioBeer is a project which addressed the EPA Green Enterprise Fund 2019 themes of "Food Waste Prevention" and "Promoting innovative waste prevention solutions across the food production and food processing sectors".

SymbioBeer is a collaboration facilitated by Irish Manufacturing Research (IMR) between St. Mel's Independent Brewing Company (a micro-enterprise) and Panelto Foods (an industrial bakery) The project which ran from 2020-2021 created an industrial symbiosis demonstration pilot in the industrial area of Longford. Industrial symbiosis is a key strategy in the circular economy whereby the residual waste from one business is valorised by transforming it into a higher value material substitute for another business.

Through this innovation demonstration project St Mel's and Panelto Foods investigated how to increase their revenue potential, create new revenue streams through new product development, reduce waste management/logistics costs and accompanying greenhouse gas emissions (GHGs).



Demonstration Pilot Scope

During the project, both partners explored the use of different residues as substitutes for a proportion of their key ingredients.

St. Mel's Brewery experimented with multiple different types of surplus breads from Panelto Foods seeking to find a substitute for malted barley which had a neutral impact on taste –enabling them to test the feasibility of utilising cooked dough as a substitute across their portfolio of beers.

St Mel's Brewery's pilot batches identified a new "bread to beer" recipe which they were able to produce at industrial scale launching "[SymbioBeer Project#1](#)" a Belgian Style Golden Ale in December 2020.



Panelto Foods initially experimented with **utilising yeast** from St Mel's beer production for its bread production. The beer yeast fell short of leavening the bread proving incompatible with product development specifications and ultimately their production line. Next, Panelto Foods explored possibilities of using Brewers Spent Grains (BSG) as a "flavour – crumb volume" ingredient and as a potential high nutritional value ingredient.

Several attempts were made to create a new bread recipe aligned with their product parameters utilising the BSG in its wet, undried form. All these experiments failed however, as the gluten network deteriorated, not allowing for completion of the fermentation process. Panelto Foods concluded that the only feasible way to incorporate BSG into the baking process was as a flour form of spent grains which would require dehydrating and milling the BSG.

Economic & Environmental Impact

In the SymbioBeer pilot both St Mel's and Panelto Foods were able to test the feasibility of utilising a lower amount of (virgin) ingredients through their partial substitution.

1) St. Mel's Brewery developed a new recipe that replaced 15% of malt with surplus bread from Panelto Foods.

2) Panelto Foods experimented with BSG (a by-product from St. Mel's) as a new high nutritional value ingredient for their bread (3% of the dough by weight).

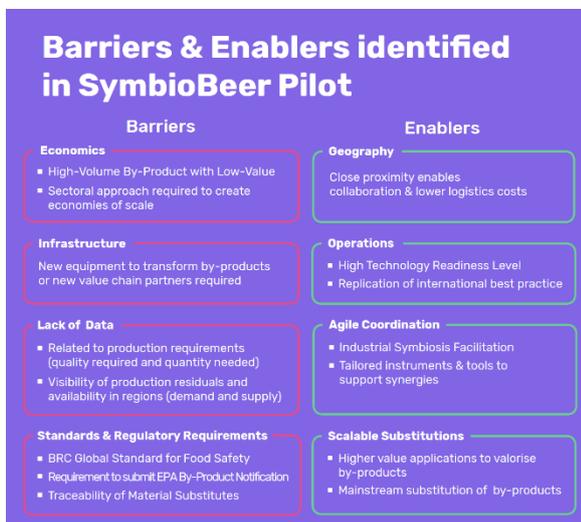
While neither St Mel's & Panelto Foods encountered any additional costs associated labour, packaging, water, or energy usage in the pilot the additional residue transformation costs raised the estimated cost of the final products disproportionately making it economically not viable. However, both St Mel's and Panelto Foods believe that improved efficiencies associated with transforming larger volumes of production residues can make the industrial synergy commercially viable. This is due to the gains

from operational efficiencies and the economies of scale in mass production. Moreover, even a small material substitution of imported ingredients was deemed to be strategically important due to the increased importation costs of ingredients due to Brexit.

In terms of environmental benefits, if valorisation of cooked dough as a malted grain substitute was rolled out across St Mel’s portfolio of beers, it could deliver a potential annual reduction of 3% in CO₂ emissions reduction. This reduction is attributable to the use of a lower amount of virgin materials, as well as reduction of emissions from logistics (malt is usually supplied from Cork-270km away from Longford) from closer geographical proximity of Panelto Foods who are located across the road from St Mel’s.

Key Barriers & Enablers

Some of the key barriers encountered and enablers inferred for scaling-up to mass production from the pilot product development process are outlined (*please refer to the SymbioBeer project report for more detail*):



• New equipment/infrastructure requirements - a dryer and milling equipment were required to transform the by-products into suitable material substitutes to produce an industrial-scale batch of beer (using surplus bread), as well as to conduct further experiments to utilise BSG as an input in bread production.

For the purposes of the pilot, the drying and crumbing of the surplus bread and drying of the BSG was outsourced to Teagasc. However, scaling up the use of these residues for mass production would require St Mel’s and or Panelto Foods to invest in the equipment or partner with a third party to transform the by-products on their behalf.

• Food Safety Standard & Regulatory Requirements - For St Mel’s Brewery to supply Panelto Foods with a BSG flour beyond the pilot they would need to certify this new product to at least BRC Global Standard for Food Safety (Grade A) and submit an EPA by-product notification. For Panelto Foods to supply St Mel’s with cooked dough they would need to submit an EPA by-product notification.

• 1-2-1 by-product exchange insufficient to achieve economies of scale required for mass production - a cross-sectoral approach (a collaboration between multiple breweries and multiple industrial bakery) is necessary to achieve consistency in quality of material substitutes overtime (given variances in production residues) and necessary to make their mainstream application economically viable.

• **The lack of data on and poor visibility of demand and supply of production residues available in regions** is an additional barrier to scaling-up from limited edition pilots to utilising production residues for mainstream material substitution in the brewing and bakery sectors.

On the other hand, SymbioBeer has also highlighted **key enablers** for industrial symbiosis adoption in the brewing and bakery sectors namely:

• **Close proximity aids 1-2-1 by-product exchanges** – close proximity facilitates collaboration and reduces logistics costs for the material substitute relative to those for virgin materials;

• **Variety of higher-value applications & high technology readiness level to transform by-products** – SymbioBeer drew on international best practice regarding valorisation of residues in the bakery and brewing sectors. Identifying multiple potential higher value applications combined with high TRL technologies (e.g. industrial dryer & milling machines) required to transform production residues in question are key to mainstreaming their use in these sectors.

• **Role for Facilitator and Tailored Instruments/Tools:** synergies exist outside traditional supply-chains and tend to be cross-sectoral. Identification of new product development opportunities and facilitation of new collaborations in form of technical support, tailored instruments and online tools which make the availability of and demand for production residues visible are

key to scaling-up the implementation of industrial symbiosis.

Additional Case Studies: Brewing/Bakery Sectors

Many higher value applications of brewing and bakery production residues exist. Some illustrative examples include:

1) **High-value polyphenols from brewery by-products** - polyphenols, act as antioxidants in food & drinks, as well as cosmetics & pharmaceuticals – see [“Pureope”](#);

2) **Protein-Based Feed for Aquaculture & Animal Feed** - Brewing and distillery by-products and co-products can be transformed into cost-effective, high-quality protein nutrients for aquaculture and animal feed industries – see [Horizon Proteins](#);

3) **Biofuel from Bread** - surplus bread and bakery production residues can be transformed, with a 98-100% conversion efficiency, into 98% advanced ethanol – see [“Bread Circle”](#).

Conclusion

The SymbioBeer demonstration pilot illustrates how industrial symbiosis, a key part of a circular economy model, can be used to create new products from valorising production residues delivering greater supply-chain resilience whilst reducing GHGs in the bakery and brewing sectors.