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BIO-SCOPE Project 5405



Recommendations for the upgrade of Irish potato waste.





Irish potato supply chain “waste” made available for upgrade into new food products – no more waste.



1 (or 2) strategically located upgrade facilities in Ireland.



New potato derived ingredients – protein & fibre – produced in conjunction with other processing activity (starch?, biofuel?).



Sales to ingredients companies and/or end user food companies in Irish and global markets.



Raw material: in the region of 150,000 to 250,000 tonnes of potatoes could potentially be available for upgrade every year.



Location: potential for strategic location of new processing capability.



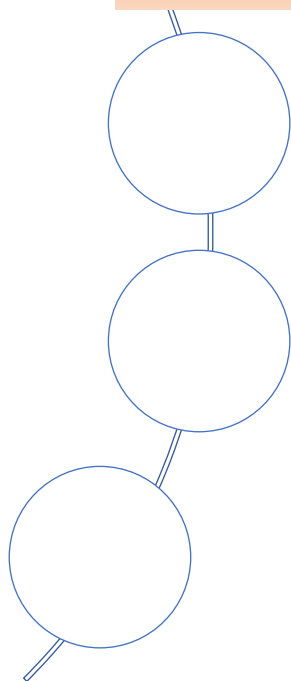
Technical requirements: know-how exists in Ireland to produce new food ingredients.



End use & markets: Irish & global market demand exists for new ingredients.



Raw material: by far, the largest source of food loss in the Irish vegetable supply chain comes from out graded potatoes and potato processing waste. This waste is generated at all stages in the supply chain.





On average, Ireland produces about **350,000 tonnes of potatoes each year.**

The potato crop varies from year to year due the many factors that influence yield, the harvest and also on market forces.

In any one year **between 150,000 and 250,000 tonnes of potatoes are potentially wasted.**

Ireland also imports substantial volumes of potatoes each year, estimated to be in the region of 70,000 tonnes.

Potato contains valuable starch, protein & fibre.



On average, **between 40% and 60% of the Irish potato crop can be lost from the supply chain every year.**

At farm level - weather, pests, disease and damage during harvest can lead to losses. In addition, cosmetic expectations and grading also result in substantial volumes of whole potatoes being rejected.

Consequently, **an estimated 15% to 30% of the Irish potato crop remains on the farm each year.**

Note that losses can **vary substantially from year to year** due to the number of factors in play.



At the distribution and processing level - further losses occur during storage and grading.

Around 30% of Ireland's potatoes are processed in some way and this generates substantial volumes of peelings and out graded material.

An estimated 30% to 40% of the Irish crop is lost at the distribution and processing level every year.

Note that losses also vary substantially from year to year at this level in the supply chain.

What we know so far



Location: there is potential in Ireland for strategic location of new processing capability.



There are around 600 commercial potato growers in Ireland and most of the production (over half) is concentrated in key growing regions in North Leinster, Meath, Dublin and Louth.

There is potential for the strategic location of 1 (or 2) centralised processing facilities -

- as part of an existing processing activity;
- new, dedicated processing facility.



Based on the legal definition of waste, any potato resources to be upgraded into new food fibre ingredients, if modified or processed in any way prior to receipt at the upgrade facility, would need to be transported, stored and processed in compliance with the provisions of current waste management regulations.

This would entail the use of suitably licensed waste contractors and facilities.

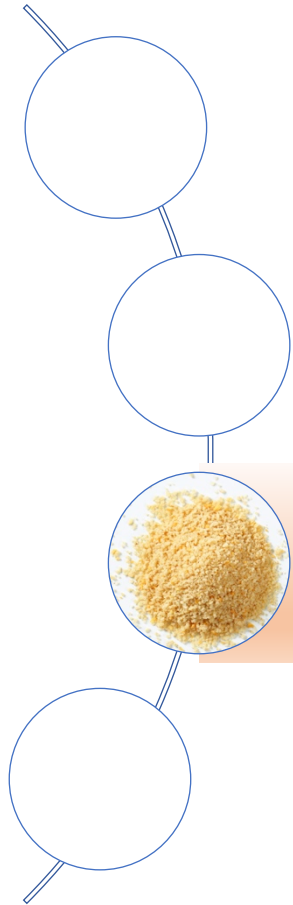
Transport cost of raw materials is likely to be the limiting factor and will influence the supply radius for any centralized facility and a cost benefit analysis will be required.



There may be some scope for the reclassification of potato processing waste streams under current legislation *e.g.* By-Product Declaration or End of Waste Classification.

Detail & clarification from EPA will be required.

Processed vegetable waste streams are prone to rapid degradation by food spoilage organisms and naturally occurring enzymes. Stabilisation of waste streams at source *e.g.* drying or treatment with preservatives would serve to prevent this and may have a bearing on reclassification.



Technology requirement: the technology and know-how to upgrade potato waste exists in Ireland.



Potatoes are a complex mixture of many potentially valuable components but of specific interest are the carbohydrate and protein components that can be targeted for the development of new food ingredients:

Potato protein – high value ingredient used for texture and nutritional functionality.

Potato fibres - used as water binders and stabilisers.

Starch – widely used as a thickener or as a feedstock for biofuel production.

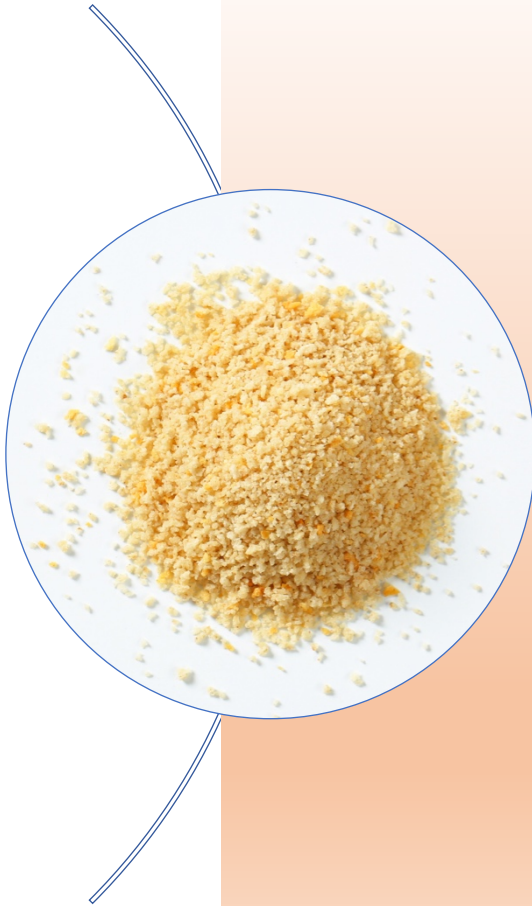


Potato protein can be extracted at laboratory scale (Irish Rooster potatoes) using a simple, cold extraction process.

The process makes use of standard protein extraction techniques in combination with membrane filtration.

The process was developed with the following in mind:

- suitable for use with whole or part-potato waste;
- suitable for incorporation into a multi-stream process to valorise fibres and starch;
- ease of transfer to potential scaled up production;
- cold processing more economical;
- simple processing, no chemical use or chemical waste.

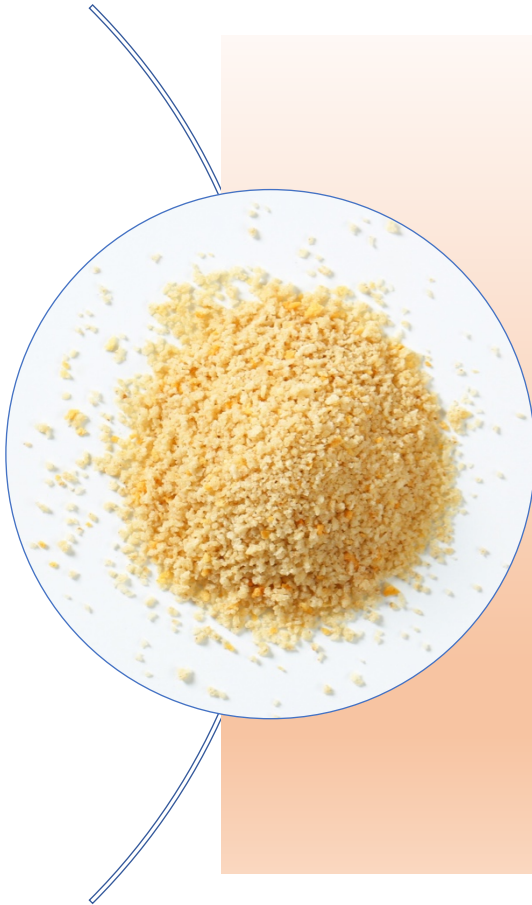


Total protein recovery was excellent for a preliminary study, a yield of 1.6% (as % of starting material) was achieved *c.f.* 1.5%-2% as reported in the literature.

The colour of the end product was comparable with market available products.

Gelling behaviour was promising although not as good as egg or market available potato proteins.

There is plenty of scope for optimisation of the process to improve colour and gelling capacity.



Simple processing (drying & milling) of potato processing waste &/or out graded whole potatoes will yield fibres with basic texture functionality & market demand. However, potato fibres typically have low value.

Additional processing does not deliver substantial improvements to functionality thus, the additional cost and effort is not justified.

However, as part of an integrated process with other value generating streams, the fibre component is worthy of valorisation.



The focus of the BIOSCOPE project was on the high value protein and starch component was not examined.

However it is an essential part of any biorefinery approach to potato waste as it is the major component.

Starch is a common place functional thickener used in a variety of food applications such as sauces, bakery & meat application.

Typically, starch producers are large scale and only economic at this scale.



Starch: the challenge remains to assess the potential scale of potato starch production from Irish potato waste as part of any processing activity that would also derive protein and potentially fibre ingredients.

There is plenty of scope to use starch in food, as a feedstock for anaerobic digestion or biofuels production and other industrial uses.

Would this be viable in Ireland?

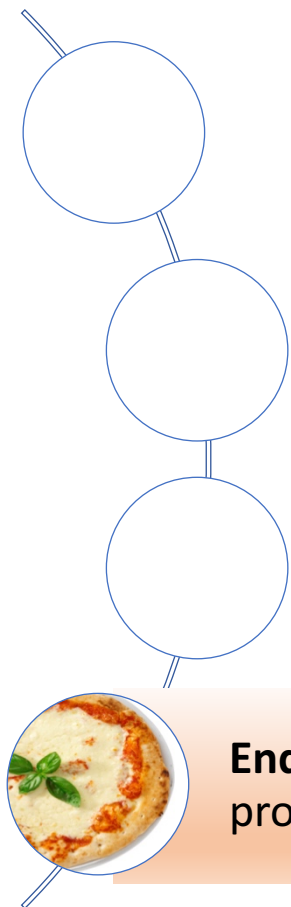
This will need further effort and potentially “out of the box thinking”.



Protein: protein extraction has been successfully demonstrated as proof of concept in the laboratory. Further work is required to optimise the process with scale up in mind.

Fibres: to date, all fibre processes have also been developed at laboratory scale (\approx kg quantities) albeit with larger scale production in mind.

A technical transfer study would need to be conducted to assess the feasibility of (i) incorporating new processing steps into an existing facility or (ii) establishing a new, dedicated processing facility - preferably as part of a potato biorefinery with multiple product streams.



End use and markets: there is global market demand for new potato protein & fibre ingredients.



There is real market demand for potato protein.

It has excellent technical functionality (gelling, foaming, emulsification).

Used in a wide range of food products including gluten free, egg-free, meat & meat analogues, dairy-free milks, cheese & ice creams, high-protein snacks.

It is nutritionally superior to many other plant derived proteins.

Potato proteins have higher market value (>€15/kg) than other plant derived proteins and are comparable in price to animal derived proteins such as casein, egg & whey.

Potato protein has a strong marketing message - non-GMO, sustainable, clean label, plant derived and non-allergenic.



Potato fibres are commercially available, they are mostly used in processed meat and bakery products for water management and texture control.

Potato fibres are widely used in Europe but to a lesser extent elsewhere.

Most market products are bi-products of starch extraction and thus contain \approx 60% - 70% fibre (mostly insoluble) with smaller/variable amounts of starch, pectin and protein.

Potato fibres are typically not very functional and fall into the lower price range for food fibres (€1-3/kg) but but they are widely used.



Potato protein and fibre ingredients need further evaluation to assess their technical potential and to determine any market positioning.

As a potentially highly functional protein, there is wide scope to evaluate Irish potato protein in a range of food applications and to identify higher value markets.

Potato fibres have relatively low functionality however, evaluation in application will give a better indication of true functionality and is essential to identify target applications.



CyberColloids maintains the necessary expertise to continue research into the development of extraction protocols, food applications and market intelligence.

However, expertise is now required to conceptualise and evaluate a biorefinery approach to the upgrade of potato waste.

Input from industry and stakeholders is also required to facilitate the interest and uptake of the research and to develop the necessary business strategy to derive this forward.

For more information about our research activities please contact

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or see our website www.cybercolloids.net

TACKLING FOOD LOSS IN IRELAND: NEW FOOD FIBRES FROM VEGETABLE WASTE

Food loss & waste: a global issue! Addressing the colossal problem of global food loss and food waste has become a strategic objective for politicians worldwide who are grappling with closing the food gap in a world where the population is expected to rise by a further 3 billion by 2050. Ireland is committed to addressing a number of targets focusing on food & nutrition security and resource efficiency set out under the Europe 2020 strategy or more specifically the current EU Green Deal and the new Farm to Fork and Net Zero targets highlighted in the new Green Deal Communication Action Plan. Reducing food loss and waste is highlighted as a core priority.

Potato & carrot processing waste: a valuable Irish resource. The Irish Farmers Association (IFA) estimates that potato losses of produce and green biomass of carrots are currently valued at around €50 million per year. In addition, the volume of potato and carrot waste is growing rapidly due to market requirements. Food loss in the Irish potato and carrot supply chain is therefore, a significant issue for the Irish potato and carrot sectors.

On a global basis, roots and tubers, other vegetables and fruit represent the highest food and wastage levels of any food, with roughly 40% of the global crop being lost or wasted. This equating to 1.3 billion tonnes of food and feed waste per year.

Given its weather light it represents a commercially significant resource for upgraders into higher value products. CyberColloids recognised the potential and with support from BioBusiness Foods Ltd, the Irish Farmers Association and EPA, valued the research has used cutting-edge processing technology to produce a new functional vegetable fibre for use as a vegetable ingredient in food.



"The food currently lost and wasted in the food supply chain is a significant issue for the Irish food and agriculture sector."

A New Look at Carrot Waste

CyberColloids has just completed a second EPA Green Enterprise funded project which focussed on the upgrade of Irish vegetable processing and supply chain waste into new food ingredients. The specific focus was on the production of functionalised fibres from out-graded & "worky" carrots and carrot peawings.

Carrot fibres have excellent water binding and gelling properties, not to mention the cellulose and pectin that are naturally present. Fibres with water binding and gelling capacity can be used to provide structural functionality in food and drink, an important factor for food formulators. We reported earlier in the project that CyberColloids using Irish raw carrot fibres produced a commercially available carrot fibres and much higher water binding capacity than fibres derived from other vegetables.

With subsequent research we have been able to improve on this and can now produce carrot fibres that can bind in the region of 16 to 18 times their weight in water. Our new fibres therefore, have comparable water binding capacity to the citrus functioning in the citrus derived fibres that are considered as market leaders (Fig. 1).

This research was supported by EPA, Green Enterprise Funding and MacCraith Foods Ltd, Tullow, Waterford County.

A New Look at Carrot Waste

EPA Green Enterprise funded project update

In January 2017, CyberColloids began a second EPA funded project aimed at furthering our work to develop new food fibre ingredients from Irish vegetable processing and supply chain waste. The focus this time is on out-graded carrots and waste from the carrot processing industry.

In our previous Green Enterprise funded project – Vegetable Waste as a Fish Resource – we successfully demonstrated the potential for the development of new food fibres from carrot processing waste and their application in simple model food systems. In this project we aim to take this research further and to bring the new carrot fibres closer to market ready status. We have also submitted the research focus to include the use of whole carrots as we are aware that instead of being a big challenge when it comes to underutilised fruit and vegetable produce.

An estimated 3,000 to 5,000 tonnes of carrots remain on Irish farms as waste each year, either as out-grades or surplus to market requirements. This equates to a potential 300-500 tonnes of carrot fibre. Food fibre ingredients made from root and vegetable resources are currently in the global market place and sell for €4.5-€7/kg. Our approach therefore represents a significant opportunity to generate additional income for the Irish fruit & vegetable supply chain – as well as reducing the waste burden.

Contact Us
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EPA
BioBusiness Foods Ltd, Tullow, Waterford County

Scoping potential food waste in the Irish fruit & vegetable supply chain

February 2020

Key findings thus far

- Substantial waste biomass is generated across the fruit and vegetable supply chain in Ireland each year.
- An estimated 200,000 to 300,000 tonnes of fruit and vegetable waste is generated at processing level in 2018 (Table 1).
- In excess of 200,000 tonnes of fibre residues to potatoes alone.
- 45-70% of key Irish vegetable crops are potentially wasted each year (see overview).
- < 20% of key Irish fruit crops are potentially wasted each year (see overview).
- A further 40,000 - 60,000 tonnes of waste is potentially generated from the processing of the main 14 crops.
- Animal inputs a wide variety of other fruits & vegetables are combined in these figures.
- Many factors affect wastage in the supply chain and these vary substantially between crops & time year to year.

Project focus

Maximising food waste in the Irish agricultural sector is a key priority for the EPA. The global fruit and vegetable processing and supply chain generated a large amount of waste that is typically biomass, a financial and environmental burden to the processor. However, valuable fibre is known about the levels of fruit and vegetable waste that are generated during the processing stage of the supply chain in Ireland and this knowledge probably only extends to a small fraction of the processing plant from the Irish food supply chain every year.

With support from EPA, Green Enterprise funding and MacCraith Foods Ltd, Tullow, Waterford County, CyberColloids has embarked on a study that will (i) scope the quantities of waste and vegetables are lost or wasted from the food supply chain in Ireland; (ii) identify the current strengths and barriers for potential upgrade into new food fibre ingredients and (iii) other recommendations to the Irish industry that will aid in developing waste management and sustainability programmes.

EPA
BioBusiness Foods Ltd, Tullow, Waterford County

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