CLEAN TECHNOLOGY CENTRE CTC

BIM Ireland's Seafood Development Agency

FOOD HEROES

Final Report

Contents

Food Heroes - Improving Resource Efficiency Through Designing Innovative Solutions to Reduce Food Waste

Relevance – why is the project necessary?

FAO estimates that each year, approximately one-third of all food produced for human consumption in the world is lost or wasted (FAO; Food Wastage Footprint, impact on natural resources, 2013). This means a huge waste of resources and of money. FAO distinguishes between 'upstream' and 'downstream' food waste; the first referring to the production and post-harvest part of the chain; and the latter to the processing, distribution and consumer part of the chain. Both upstream and downstream parts of the chain are responsible for an almost equal share of food waste (54% - 46%). This is not just a waste of money; it is especially a waste of valuable resources needed to produce and transport food.

In recent years several projects have investigated this topic, with a focus on the last parts of the chain: distribution and consumers, responsible for 40% of food waste in the EU. In this project we want to focus on 'start-of-pipe solutions' in the first parts of the food chain, from production to processing, in total responsible for 60% of the food waste in the EU.

Reducing food waste and a transition to a circular model is an important challenge for the Agri food sector to meet increasing food demands at a global level (more food, higher value food). This is not an easy task.

Food waste occurs everywhere in NWE. Currently, in fish processors throughout Ireland there is a significant quantity of raw material wasted during the filleting process. Approximately only 50% of whitefish and 65% of salmon is used for human consumption. This is mainly in the form of fillets with the remaining pieces primarily used for low value fish meal. There are approximately 10,000-12,000 tonnes of whitefish waste and 3,000 tonnes of salmon waste generated in Ireland annually.

The challenges in reducing food waste are huge and involve a broad range of stakeholders. Only a co-creative approach in which all partners in the agri-food sector jointly work together can bring the new solutions that will be able to address the significant challenges that this proposal aims to address.

The Food Heroes project aims to use a design thinking approach for the development of new food products and/or services that place a higher value on currently wasted resources and investigate new technological solutions to the food waste issue. Our approach in this project has been based on three principles:

- Co-creation: all partners in the food chain are involved

- Design thinking: using the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity.
- Cross industry approach: cooperation between the food industry and the creative industries. Creative industries bring inspiration and new insights to rethink the food chain.

Figure 1 Co - Creation Session

Developing Solutions to Reduce Food Waste

In advance of commencement of the above approach, preliminary research into by product utilisation in the fish industry was carried out (Appendix 1). Subsequently, Bord Iascaigh Mhara (BIM) and Clean Technology Centre (CTC) and other relevant stakeholders held numerous co-creative sessions and meetings with a focus on one key question:

How do we create value from existing whitefish and salmon by-products?

The results of these sessions generated the following five final ideas:

- **New product development from by-products**
- **Applying drying technologies to create revenue from by-product**
- **New technology for extracting meat from bones**

- **Search (new) markets that see value in our "waste"**
- **Monitoring waste metrics based on form across the sector - volumes available in various forms (e.g. frames, skin, heads)**

From these collaborative ideas BIM and its project partners developed three solutions to reduce food waste in the Irish seafood sector. These are described in the following sections.

However, before discussing these, it is very important to note that while these solutions have been explored, and in some cases have produced very successful results, the most significant result that the Food Heroes project has had has been its impact on the attitude of the industry in Ireland to food waste from the fish processing sector. Heretofore, fish process wastes were viewed as just that – a waste that needed to be managed and removed from site as quickly as possible. Through participation in this project BIM, and the fish processors that have been engaged, have developed an evolved viewpoint regarding these 'wastes'. These are now, rightfully, seen as a resource that need, and can, be harnessed for the betterment of the industry and of course from an environmental perspective as well. While impossible to measure this impact in the short term, this mindset shift will be one of the lasting legacies that the Interreg Food Heroes project has had for Ireland.

1. **Improved meat extraction and extraction of other parts of the anatomy from whitefish and salmon production after filleting**

(a) Rationale: Collaborative project with a seafood processor/SME in Donegal and University College Dublin. Mince for use in fish cakes and roulades using the Baader technology and their various drum sizes. Possibility of adding in extra fibre to make a healthier product.

(b) Rationale: Boxmeer and Marel Reforming technology project to produce a fish fillet product using existing waste parts (mince from frames, belly flap, trimmings from filleting)

2. **Fishing for new markets – Utilising frozen salmon heads and frames in Asia and Africa as a food for human consumption**

Rationale: Currently in Ireland, only the fillet is used in salmon and whitefish production, the rest of the fish is generally classed as an animal by-product (once dropped into the offal stream must be treated accordingly), unless the by-product is maintained to a food safety standard and then can be reused. BIM 's aim in this project was to identify new markets where salmon and whitefish frames and heads are eaten and set-up a link between potential buyers and Irish seafood processors.

3. Dried salmon and whitefish products

(a) Rationale: Investigating technologies for drying salmon and whitefish by-products in a cost-effective manner using heat recovery techniques to power the technology. BIM will investigate various methods of drying fish to meet the product specification of the identified markets and work with SME's to validate the times and temperatures of the drying method. In parallel to this, BIM will investigate the feasibility of using heat recovery from wasted heat from the existing chillers and freezers in the Irish seafood processing plants and use this wasted heat to power the Drying equipment.

(b) Rationale: In addition to investigating the potential of exporting large volumes of dried by-product, a secondary exploration of using dried by product in local, niche artisan markets will be carried out. This will focus primarily on the potential for dried fish skins to be converted into a health food/food service product.

Solution 1- Improved meat extraction and extraction of other parts of the anatomy from whitefish and salmon production after filleting

Initially research was completed into the current methods of fish meat extraction and recovery and BIM met with local partners to develop a formal action strategy. The team initially discussed research focus areas and met with representatives from Matis and Nofima from Iceland and Norway. This provided an opportunity to explore and gain insights on current trends in whitefish processing. Subsequently a survey of whitefish processors was developed to get baseline information on current practices in relation to whitefish processing in Ireland. A co-creation session was held in 2018 with several members from the seafood industry as well as representatives from other industries. This brain-storming session was focused on ideas around the utilisation of by-product from salmon and whitefish. The results from the initial research and the co-creation session highlighted the potential for Irish processors to recover and reform by-product and to produce products utilising this recovered flesh.

Figure 2 Co-Creation Session

BIM identified a suitable SME to explore technology that can reform by-product into natural looking fillet-shaped pieces. Two BIM staff travelled to Boxmeer to facilitate a trial of Marel portioning equipment for the SME This was to support in efforts to find uses for by-products

(cod bellies and mince from frames) in the factory. The guiding theory was that these products could be reformed into frozen fish portions that could be sold to fish and chip shops to be sold as battered product.

Figure 3 Boxmeer Marel Trial

BIM and SME went on a site visit to Nienstedt to view a machine that can reform frozen by-product (e.g. trimmings, mince). A further trial was carried out there. Results from these trials highlighted that there was indeed an opportunity to reform by-products into natural looking fillet portions while maintaining texture and structure. The Nienstedt technology was deemed to be the most suitable for the reforming needs of Irish processors as the technology can replicate a full, hand cut fillet with a shaped product.

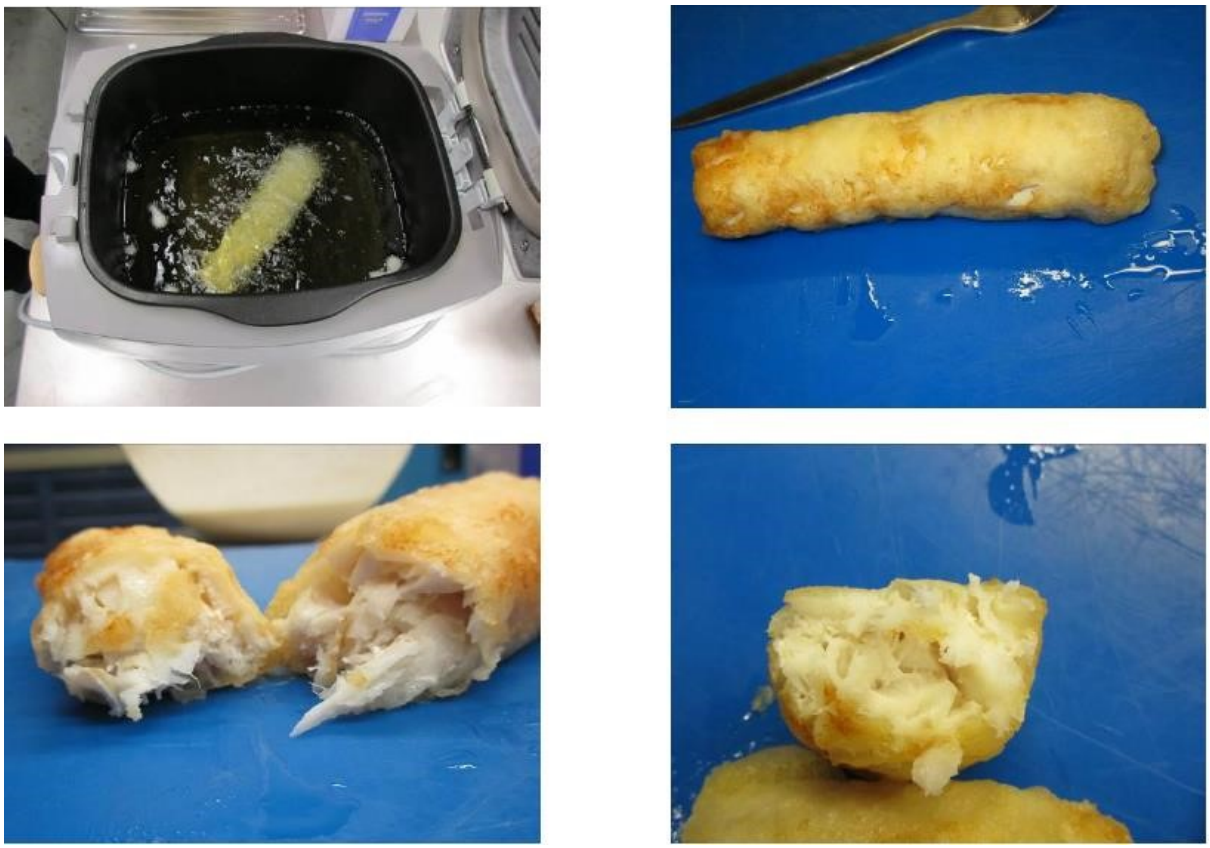


Figure 4 Nienstedt Trial

The Food Heroes team then decided to bring this technology to Ireland, so the SME could produce samples for customers. Additionally, other client companies with significant volume of raw material suitable for reforming were to be invited to a week-long demonstration/trail of this reforming technology.

As part of this reforming solution, BIM worked with the SME to produce mince from fish frames. Frames are usually viewed as waste. However, when they are processed through a recovery machine, they can produce mince. BIM identified the BAADER meat recovery machine and this was used to recover flesh from frames by SME. Two grades of mince were produced from cod and pollock frames. This recovered mince was frozen into 7.5kg bocks and brought to University College Dublin where they tested the mince for several characteristics including gel strength. Prototypes of products were developed; fish cakes, fingers and terrines. However, after microbiological testing these prototypes were found to have high Total volatile base nitrogen (TVBN) values. Consequently, further development of these prototypes did not happen. Therefore, the Food Heroes solution that BIM and the SME decided to focus on was the reforming of by-product for use in the fast-food industry in Ireland.

Figure 5 UCD Mince Trials

BIM partnered with Nienstedt to showcase their food shaping technology to the Irish seafood sector. A test shaper was brought over to Ireland and BIM hosted a 3-day innovation workshop to demonstrate this technology in the Seafood Innovation Hub in Clonakilty. The technology has the potential to help businesses in processing sector to reduce the amount of food wasted in the production process, allowing them to build scale and increase competitiveness both nationally and internationally.

Figure 6 Nienstedt Reforming Trial

The Nienstedt Food Shaper enables producers to manufacture reformed products with the highest level of accuracy from frozen blocks of fish trimmings and/or recovered flesh. Natural looking fish fillets can be produced as well as a wide variety of other shapes; i.e. steaks, burgers, fish cakes or 3D shapes for added value products such as bowls or boats.

BIM also partnered with the Dutch company Smedes Fine Food who produce innovative premium quality batters for this workshop. This allowed the attendees of the workshop to view the entire reforming process; from frozen block through to tasting the finished cooked product.

Figure 7 Nienstedt Reforming Trial/Demo

The workshop was held over three days with one open day which was attended by 7 SME fish processing companies. These client companies got the opportunity to work with the Nienstedt technicians on their specific reforming needs.
One SME has produced samples using their own by product and these have been sent to customers for feedback. Food Hero partners have also produced samples which they have also sent to customers.

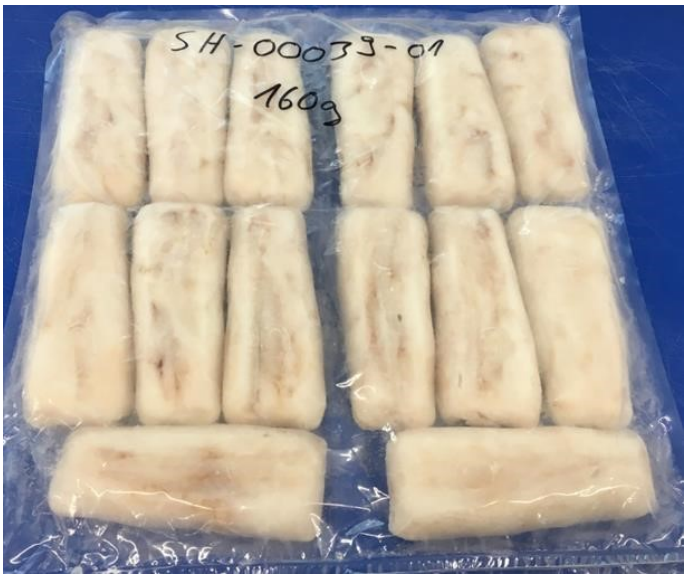


Figure 8 Reformed Fillets

Impact of the Solution

How much food was saved by this solution during the project?

Project was only brought to prototype stage

How much food do you expect to save in 2020?

No investment in technology at this stage

How much food will be saved 5 years after the end of the project?

250 Tonnes

How much food will be saved 10 years after the end of the project?

400 Tonnes

Explanation of Long-Term Impact

There is huge potential for this solution to save food waste. Annually in Ireland there is 10,000-12,000 tonnes of whitefish waste produced. A significant percentage of this is wasted flesh, fish trimmings and residual flesh left on the bone.

Conservative estimates, extrapolated across 5 and 10 years, illustrate that significant savings of food waste can be achieved if even three of Irelands largest whitefish producers invest in this reforming technology. There is huge scope for Irish whitefish processors to utilise this technology.

Solution 2 - Fishing for new markets – Identifying and Developing New Markets for Frozen Heads and Frames

Currently in Ireland, only the fillet is utilised in salmon and whitefish production, the rest of the fish is classed as an animal by-product and must be treated as waste. BIM 's aim with this solution is to identify new markets where salmon and whitefish frames and heads are eaten and develop a link between potential buyers and Irish seafood processors. The BIM team surveyed key seafood processors to understand the volume of by-products that the processors have available and what is currently done with this by-product.

Figure 9 Frozen Heads & Frames

Following this Eolas international were commissioned to produce a report on by-products entitled: Value Chain Assessment for Utilisation of Whitefish, Salmon and Their By-Products. This report provided the Food Heroes team with information on the current trends in relation to by-products in Norway and Iceland. The report provided details on the markets where by-products are sent, and the values achieved for these (See Appendix 2).

The findings were presented to BIM staff to allow for questions and discussion. Eolas then presented the report at an industry grouping.

Figure 10 Presentation to BIM Staff

Following this initial scoping exercise further market research was commissioned for a deeper dive to explore 'route to market solutions' for those markets identified through the Eolas research. Subsequently, samples of frozen heads and frames in different formats (i.e. with and without collarbone) were then sent with these results to potential buyers. These buyers included a wholesaler in the UK (Ideal Foods Ltd) which had been identified as a key player in the by-products market.

There have been various levels of engagement with Ideal Foods and the other buyers identified for the Irish processors. This was due to a variety of reasons; i.e. concentrating on their core business, financial and staffing constraints. The following summarises the experiences of the main processors that engaged in this process:

Processing partner 1 has been working consistently with Ideal Foods. They are currently working on a retail range of by-products – Salmon heads, trimmings and belly vacuum packed for Asian markets. It is still early in this relationship to say if there will be a strong enough demand to sustain this initial success. This will ultimately depend on price and whether the Asian retailers be willing to pay UK prices.

Note: Partner processor has also sold 50 tonnes of Salmon off cuts to Ideal Foods. While not Heads or Frames this still represents a huge food waste saving as previously these were sold to waste processors for a nominal amount.

Others sent samples to customers of various by-products including heads and frames. Through a contact developed in the market research undertaken they have opened a line of business where they are shipping frozen organic salmon heads to Ukraine and Belarus.

Another Processor 2 engaged with Ideal Foods and sent samples of heads and frames. Following this initial shipment, a line of business was opened where processor is now selling significant volumes of frozen heads and frames to an intermediary who then ships to Ideal Foods.

In late 2019 further research was commissioned into various markets identified in previous research and where preliminary evaluation had highlighted potential opportunities for Irish processors to sell by-product. The markets that were selected for a deeper dive were Japan, South Korea, Malaysia, Nigeria, Democratic Republic of Congo, China and Ukraine. The results of this research (See Appendix 3) were collated and summarised in early 2020 and will be presented to relevant processors and the industry (delayed due to Covid 19).

Impact of the Solution

How much food was saved by this solution during the project?

210 tonnes

How much food do you expect to save in 2020?

275 tonnes

How much food will be saved 5 years after the end of the project?

6000 – 8000 Tonnes

How much food will be saved 10 years after the end of the project?

14,000 – 16,000

Explanation of Long-Term Impact

To date: 260 tonnes of heads, frames and trim have been saved.

Potential for BIM clients in 2020 to further develop their relationship with the UK wholesaler as so far, they have only sent samples of heads and frames.

After 5 Years: potential for 10 companies with significant quantities of raw material and processing capabilities to ship heads, frames and other by-product to international markets.

After 10 Years: BIM envisages all Irish processors at this stage to view by products as food and to follow this model in shipping to growing international markets as a valuable protein source

Solution 3 (a) - Dried White Fish By-Products Utilising Heat Recovery

Currently, in fish processors throughout Ireland there is a significant quantity of raw material wasted during the filleting process. Approximately 45-50% of whitefish is utilised for human consumption. This is mainly in the form of fillets with the remaining pieces primarily used for low value fish meal. There are approximately 10,000-12,000 tonnes of whitefish waste generated annually in Ireland with fish heads and frames being a significant part of this. BIM sought to investigate the potential market opportunity for dried heads and frames in international markets where these are consumed or utilised for further processing.

For this to be a viable option, the team also sought to investigate technologies for drying whitefish heads and frames in a cost-effective manner, namely using heat recovery techniques to power the technology. BIM and CTC investigated various methods of drying fish to meet the product specification of the identified markets and work with SME's to validate the times and temperatures of the drying method (see internal CTC report in Appendix 4a). In parallel to this, BIM sought to determine the feasibility of using heat recovery from wasted heat from the existing chillers and freezers in the Irish seafood processing plants and use this wasted heat to power the drying equipment (see Appendix 5 for Seabox Report).

An initial drying trial was undertaken in BIMs Seafood Innovation Hub where by-products were dried and analysed both microbiologically and for energy requirements and consumption. CTC and BIM conducted a pinch energy analysis to determine was this an economically feasible solution for the Irish Industry. Preliminary calculations showed this was economically feasible if heat recovery/exchange technologies were employed to offset costs.

Figure 11 Drying Trial SIH Clonakilty

BIM was aware that heat exchange technology is well established in other industries in both cooling and heating processes. However, using heat-exchange to recapture waste heat is not widely used throughout the Irish seafood industry, and if used at all, it is typically for space and hot water heating only. Therefore, to improve the viability of the Food Heroes solutions, BIM hired Sea Box Energy, with experience in heating and system designs and energy cost reduction, to conduct a detailed assessment of the potential of heat exchange to support these processes. The requested work was to include the following:

- *Examine four suitable seafood processors and determine the heat exchange potential (in terms of heat availability) from their current refrigeration systems.*
- *Conduct a cost-benefit for using this recovered heat to supplement Food Hero solutions.*

Sea Box Energy visited four different fish processing facilities to identify the availability of waste heat in the Irish fishing industry and to determine the feasibility of recovering it. During these visits, it became apparent that the industry's high reliance on refrigeration equipment in their facilities means that every site generates significant amounts of waste heat. Out of the four facilities visited, only one had a waste heat recovery system presently installed, but this system only recovered a small amount of the total waste heat energy. The site visits showed that there is a substantial amount of waste heat being generated in the Irish fish industry due to its reliance on refrigeration systems to prevent their products from spoiling. The limited sample of fish processing plants also indicated that waste heat recovery from refrigeration systems is uncommon in the industry.

Overall, there is an excellent opportunity for the recovery of waste heat energy in the Irish fish processing industry and to utilised for drying by products. It is also possible to use waste heat recovered from the refrigeration system in other processes, like space heating and DHW generation. More widespread usage of waste heat recovery will reduce the industry's operating cost and its carbon footprint.

However, due to the considerable set-up costs for these facilities to install drying equipment and heat exchange technology there was a reluctance to invest at this early stage. Thus, BIM identified a world leading company in terms of drying fish by-product who agreed to demonstrate the drying processors to Irish processors and produce samples using Irish origin fish by products. BIM brought whitefish processors to a demonstration of the drying process in the UK in early February 2020. The group were hosted by Ice-Group Grimsby Ltd. The facility visited is a dedicated drying facility capable of drying up to 30 tonnes of product over a six-day period. This product is then dry shipped to Africa and sold. The Ice-Group is one of the largest exporters of dried fish products from Iceland and Norway to Africa.

Figure 13 Grimsby Drying Trip

Dried heads and frames from whitefish are marketable in Africa and BIM want to determine if this activity could be a viable opportunity for Irish processors. The Ice-Group shared their extensive knowledge of the drying process with BIM and Irish processors. This included;

- How the drying process is undertaken and what it looks like from start to finish.
- What type of machine/equipment/system they use to dry products?
- What are the different parameters when drying i.e. typical drying times, temperature required, energy consumption etc.

BIM sent over Irish origin raw material prior to the workshop. These samples were dried for review at the demonstration.

Figure 14 Dried Heads and Frames

We were also joined on the visit by Harry Rea of Sea Box Energy Limited. Harry is a heat recovery specialist who is currently working with BIM to determine the feasibility of utilising Heat Recovery to offset the energy consumption the drying of fish.

This solution has been tested with four seafood processors' dried or and samples produced to customers. We are currently awaiting feedback. The main challenge is the cost involved and the need for greater volume of raw material to commercialise this. The next step involves the investment in the technology/machinery required.

Impact of the Solution

How much food was saved by this solution during the project?

Project was only brought to prototype stage

How much food do you expect to save in 2020?

No investment in technology at this stage

How much food will be saved 5 years after the end of the project?

125 – 200 Tonnes per year

How much food will be saved 10 years after the end of the project?

400 – 500 Tonnes per year

Explanation of Long-Term Impact

There is huge potential for this solution to save food waste. Annually in Ireland there is 10,000-12,000 tonnes of whitefish waste produced.

Once investment is made by Irish processors in the technology and the process there is potential to dry significant volumes of Irish origin by product for International markets.

Market research has proven there is a market for these products and BIM believe the Irish Seafood industry could become a significant supplier of dried fish by products to these diverse markets seeking sustainable protein solutions.

Solution 3 (b) – Fish Skin Crisps for the national market

The Fish Skin Crisps project aimed to create a marketable crisp product from the skins of salmon, thus reducing the levels of food waste currently produced through the traditional filleting process. The initial phase, which was carried out over twelve weeks at the Seafood Innovation Hub in Clonakilty, involved product research and the investigation of different fish skin crisp production methods. During this twelve-week study period a recommended method of production was decided on, a number of possible flavours were narrowed down to four, and a potential market, and route to market, was identified for the product.

This project happened in two phases and was divided into 3 parts: a research phase, a benchtop phase and an exploratory marketing phase.

- The **research phase** entailed market research into the concept of fish skin crisps, the closest potential market competitors and the most effective way of creating the product.
- The **benchtop phase** involved making and perfecting the production process of the fish skins crisps. This work was conducted in the SIH in Clonakilty and also involved sensory analyses.
- The **marketing phase** combined both the preliminary research and the products developed to determine the most appropriate market for the products. This provided insights into the viability of the product in the marketplace. It was assumed that the product would be targeted towards high-end markets, possibly to the catering industry. However, it is envisaged that a few alternative scenarios could also be explored (e.g. local markets, retailers).

Following on from the initial research phase, a preliminary development stage occurred which tested a few production options. The second phase further refined the production process in a semi-industrial kitchen. The goal of this phase was to:

- Optimise process as needed
- Optimise recipe combinations
- Analyse result under Sensory and consumer testing in-house
- Carry out sensory and brand testing to a large cohort
- Research Sustainable packaging

After a series of production modifications were made – to ensure consistency and quality of product, different flavoured seasonings were obtained from local suppliers that offers seasonings, sauces, marinade for different areas of application. Their recommended application rate for this product is between 2-3%. More trials were carried out at this range using their specific seasoning. The important factors considered when using this application is the cost, flavour and area of distribution. The cost projections for the next stages in the Food Hero project were deemed to be important as this would be key in approaching manufacturers in terms of having the best and

most cost-effective possible product. Giving a general product price to include the ingredients and packaging was important as this will be marketed in addition to health benefits and flavour.

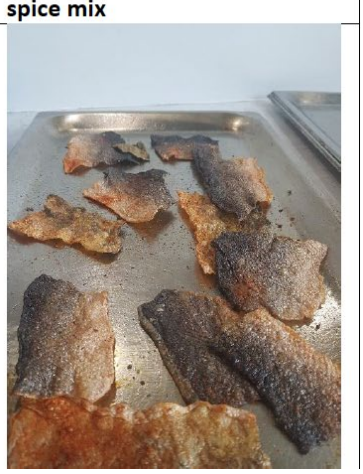
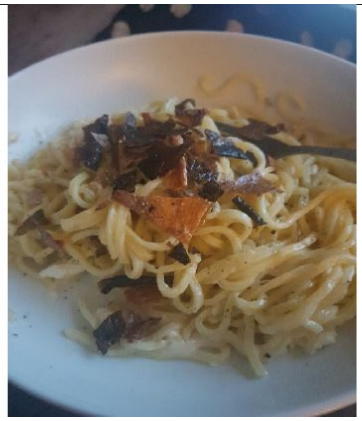
Step 1. **Defrosting salmon skins**	**Step 2.** **Removing excess meat and fat from skins.** **Descaling.**	**Step 3** **Placing skins in dehydrator.**
		
Step 4. **Skins placed on baking trays with oil**	**Step 5.** **Baking trays layered on top of each other**	**Step 6.** **Skins Seasoned with Cajun spice mix**
		
Step 7. **Skins broken up**	**Ideas for salmons skins in catering/food service** **Used as a condiment on dishes.**	
		

Figure 14 Fish Skin Crisps production process

In terms of product testing, brand analysis was carried out separately to the sensory testing.

Product Testing

Product testing was carried out in 2 phases: an initial scoping trial before refining the choices for a larger scale product test. The initial small sensory trial was conducted with 4 people to identify which main product would go forward to be tested on a larger cohort. Trial 7, which consisted of 94.72%- Dehydrated Salmon Skins, 3.71%- Seasoning, and 2.2%-Oil was the chosen product. 41 people took part in the final testing phase.

Figure 18 Product sensory testing

Based on the results, only 20% identified that they would buy this product. It is important to note that this was a relatively narrow sample in that the majority were in their early twenties and were not fish lovers. That said, to appeal to a wider audience, then further focus on improving the flavour would be required.

Brand

A variety of different brands were developed through CTC. In terms of creating a brand for crisps made from fish skins it was important that the brand conveyed a healthy snack message but was also transferable/scalable to a range of snacks/flavours. Through this branding development the following challenges were identified:

- For an island we in Ireland are not great for eating fish, never mind fish skin crisps.
- The idea of eating skin is unpleasant.
- Pork rinds or crackling crisps do not look like the skin form where they came.
- Fish skin crisps do look scaly and are a visual reminder of the source.

However, some positives were also identified:

- Eating fish gets plenty promotion as healthy eating.
- People's attitudes are changing.
- New brands spark curiosity so the visuals, name, brand should help this.
- We can take inspiration from the health snack industry.

The approach taken aimed to remind Irish people that they are islanders and that this is a product of island life. The brand was also to convey a sense of normality, or the sense of bringing a past into our present and that food in the past, was in ways, a healthier time. Based on this approach the following were developed.

Figure 16 Fish Skin Crisps Branding ideas

Based on the consumer feedback the following brand was chosen and full packaging materials designed to reflect all food packaging requirements. Significant analysis was carried out to ensure that all nutritional and product information was correct. This was achieved through using registered food testing laboratories.

Figure 17 Final Fish Skin Crisps Brand

Packaging Materials

A key aspect of this stage was to ensure that the packaging materials meet the ethical and sustainable approach that is being taken for the Food Hero Project. This encompasses the

reduction of waste, so it would therefore be beneficial to offer packaging that is also sustainable. This can come in different forms but, as always, the practical use of packaging must be considered as this product will be sold as an ambient food product. A number of different options were explored including compostable, paper, recyclable and plastic. All were deemed a viable option though further lifetime testing would be required.

Figure 18 Potential Packaging materials: Compostable, Paper, Recyclable and Plastic (clockwise from top left)

Conclusions

Based on this work there were two main recommendations to progress the development of fish skin crisps made. For both approaches the products needed to be shelf-life tested in the appropriate packaging. This, in conjunction with the results of the nutritional analysis, would be used to pitch the products to a small number of chefs and health food shops within Ireland. These would facilitate the following potential routes to market.

Route to market 1:

While preliminary tasting was carried out during this work, this was only used to refine the production method and the main flavours. Therefore, the first key recommendation would be to carry out a thorough market research with the food service industry and the fish-eating public. This would involve approaching some locations to examine the potential for the crisps in their sector (food service) and test the products with consumers. Their feedback would be used to decide on possible applications of the crisps in dishes and then providing them with the crisps with the aim of surveying the customer acceptance of the crisps. This process would also create a public awareness of the product.

Route to market 2:

As the restaurant industry is a limited market, this should be considered as a route to the snack food market, as well as getting feedback on crisp texture and flavours. The second recommended route to consider is that of a packaged product for the health food market. This would entail the design and development of appropriate packaging materials. The packaging will be developed at the same time as the restaurant trials and may involve renting specialised equipment. Once the packaging is finalised and the product details are refined, then it will be time to discuss the possibility of trialling the product with a sample of health food shops in the region. This will hopefully help with understanding the market demand and set a reasonable price which will provide a good profit margin.

The full reports produced as part of this work are given in Appendix 6.

Impact of the Solution

How much food was saved by this solution during the project?

Project was only brought to prototype stage

How much food do you expect to save in 2020?

No investment in solution yet. Covid halted exploratory work with fish processor.

How much food will be saved 5 years after the end of the project?

10 – 20 Tonnes per year

How much food will be saved 10 years after the end of the project?

40 – 50 Tonnes per year

Explanation of Long-Term Impact

There is good potential for this solution to save food waste, especially as part of a local health and artisan food production infrastructure.

Market research has proven there is a market for these products and BIM believe the Irish Seafood industry could become a significant supplier of fish skins to an appropriate producer.

Once investment is made by Irish processors in this product there is potential to market these as an indigenous Irish product for International markets.

Appendix 1: Preliminary research into By Product Utilisation in the fish processing industry

Appendix 2: Eolas Report, Value Chain Assessment for Utilisation of Whitefish, Salmon and Their By-Products

Appendix 3: In depth market analysis for frozen by-product in Japan, South Korea, Malaysia, Nigeria, Democratic Republic of Congo, China and Ukraine.

Appendix 4a. Internal CTC report investigating the feasibility of fish head drying using waste heat from refrigeration

Appendix 4b. Process in SIH for drying trial

Appendix 5: Heat recovery energy assessment from Sea Box Energy

Appendix 6: Report on development of Fish skin crisps