



An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

Food Institutional Research Measure

Final Report

BioOpps: Opportunities for functional and bioactive protein ingredients derived from co-products of the Irish meat industry – Desk Study

DAFM Project Reference No: 15/F/707
Start date: 01/05/2017
End Date: 30/04/2018

Principal Coordinator and Institution: Anne Maria Mullen, Teagasc Food Research Centre Ashtown
Email: anne.mullen@teagasc.ie

Collaborating Research Institutions and Researchers: Maeve Henchion (Teagasc)

Please place one "x" below in the appropriate area on the research continuum where you feel this project fits

Basic/Fundamental	→	Applied	→	Pre Commercial		
1	2	3	4	5x	6	7

Please specify priority area(s) of research this project relates to from the National Prioritisation Research Exercise* (NRPE) report;

Priority Area (s)	Sustainable food production and processing
-------------------	--

Key words: (max 4) Recover value, commercial, meat, co-products

1. Rationale for Undertaking the Research

The meat industry plays an important part in the Irish economy. Total Irish meat exports accounted for approximately €3.8 billion in 2017, and the value of beef exports alone reached €2.5 billion (Bord Bia). The production of meat inevitably generates co-products and side streams whose value is generally lower than that of meat. Indeed, meat yield represents around 50% of the total live weight of pigs and bovines, while the remaining material brings many low, neutral or negative values to the industry. While some reach edible markets other have applications in the animal feed, pet food, fertilisers, and bio-energy generation sectors. Simultaneously, more environmentally friendly sources of proteins are being researched and the number of consumers opting for reduction or removal of meat from diets is increasing. This feeds into a wider scenario in which sustainability is key and establishing steps to minimise food waste at every stage of the processing chain is critical with a view to identifying opportunities to reduce, recycle or valorise.

The DAFM-funded ReValueProtein project was launched in 2012 and identified lower value meat co-products and side streams which could potentially be revalorised. They include bovine and porcine blood, lungs and hearts; ham exudates and cooking loss; and stick water from edible fat rendering. All these products contain proteins for which commercial applications can be developed in order to optimise their economic value, and also to improve the overall sustainability of proteins from animal sources.

To enable exploitation of these opportunities more information is needed on the relevant commercial/market landscape. The BioOpps desk study, launched in 2017, was designed to give an overview of the current protein market and encourage commercial opportunities for Irish meat producers, focusing on proteins from animal co-products identified by the ReValueProtein project. Indeed, the BioOpps project builds on the knowledge and expertise generated regarding material composition, functional properties and processing methods.

A critical challenge for successful technology/knowledge transfer is a lack of in-depth understanding of opportunities for downstream commercialisation. This understanding needs to encompass aspects such as marketplace analysis, product quality specifications, process-flow for product generation etc. BioOpps was established to contribute to the generation of this body of knowledge.

2. Research Approach

The approach taken in this project was to initially review potential target compounds for generation of higher value protein products. Information relating to proteins markets was gathered by reading through Market Reports, and consulting relevant web pages, researchers and state agencies. A number of interviews were conducted with relevant stakeholders such as meat processors, ingredient companies, equipment suppliers etc. Company focused events (Food Protein Vision, IBERS workshop, Food Ingredients Europe, Bridge2Food etc) were attended to gather relevant information. A report was generated and a stakeholders event organized to disseminate information generated. This approach was unique in that it focused specifically on opportunities for the Irish sector.

Research is aligned with objectives from Food Wise 2025 etc for increasing the value added in the agri-food sector and for job creation, and is consistent with the trend for increasing demand for protein/protein products, in particular protein from meat. It is also in line with key objectives of Horizon 2020: efficient use of resources and supporting innovation in industry.

3. Research Achievements/Results

BioOpps outcomes include an analysis of the different markets relevant to animal protein ingredients and current players; an outline of current uses for selected animal co-products, especially in Ireland, and their potential applications. The supply capability of the Irish meat sector and the volumes of proteins which could be extracted are evaluated against the current market demands, costs and available technology. Additionally, the current legislative scenario and particular applicable regulations which govern this area were reviewed. There was a significant amount of activity on this task over the 12 months of the project as key information was gathered from direct interactions with stakeholders. A lot of the insights gained were not always immediately available through internet or literature searches and hence this proved invaluable to informing all the tasks on the project.

After reviewing the literature, market reports, legislation and speaking to researchers and industry representatives, potential target compounds from which priority products were selected were identified. Blood and lungs were selected as the most promising co-products for the recovery of proteins, based on three factors: Production volumes, potential commercial applications and existing know-how.

These two co-product streams have been identified as sources of proteins possessing good nutritional and functional properties and showing potential as products for higher value applications. Due to their good nutritional quality and a variety of techno-functional properties, proteins from these streams could find applications in several processed products. Applications in human food represent a higher value opportunity, but collection of raw materials (lungs and blood) needs to conform to stringent regulatory rules. From the point of view of the current scenario in Irish slaughterhouses, the introduction of closed blood collection systems would allow collected blood to gain access to human food applications.

These meat co-products are a rich and underexplored source of proteins which also possess valuable techno-functional properties; as well as being suitable for the generation of bioactive hydrolysates and peptides. A number of these meat co-products currently command low (less than €1/kg), neutral or negative (disposal costs) values. With figures from DAFM indicating around 1.5 million bovine and over 3 million porcine slaughtered in Ireland in 2017, the scale of annual co-products generation is significant.

The outcomes of the BioOpps project have been disseminated at the workshop held in Teagasc Ashtown and a Technology update document will be issued shortly.

Recommendations were developed to direct future activities for a positive impact on the Irish economy. The core recommendation of this study is to encourage cross-sectorial collaboration between industries all along the value chain in order to allow for a protein network to be created in Ireland. That would allow for economies of scale, while capitalising on core competencies from players from different sectors.

4. Impact of the Research

This research project has provided a valuable opportunity to gather commercial / market specific information of relevance to the valorisation of meat co-products in an Irish context. While ReValueProtein, and other research detailed in the literature, have had successes mainly on the technical and scientific challenges to achieving this goal, BioOpps has provided key information relating to the market landscape and to key factors for consideration when developing business opportunities in this area.

4(a) Summary of Research Outcomes

(i) Collaborative links developed during this research

Either directly due to activity on BioOpps or through combined activity with ReValueProtein significant collaborative links have been developed. This include both industry and research institutes.

(ii) Outcomes where new products, technologies and processes were developed and/or adopted

This project was focused on gathering information relevant to the future generation of new products or processes hence this is one outcome in this category. Through the interaction with industry there are a number of examples of potential impact of the results. .

(iii) Outcomes with economic potential

Providing the industry with tools and knowhow to capitalise on extracting additional value from meat processing chain will generate revenue streams for Irish based industry. This will inevitably lead to job creation which, due to the nature of meat processing sector, is highly likely to benefit more rural communities.

(iv) Outcomes with national/ policy/social/environmental potential

Recommendations were developed to direct future activities for a positive impact on the Irish economy. The core recommendation of this study is to encourage cross-sectorial collaboration between industries all along the value chain in order to allow for a protein network to be created in Ireland. That would allow for economies of scale, while capitalising on core competencies from players from different sectors.

Any benefits which can be brought to reducing waste and using energy efficient processing, based on these outcomes, will be of relevance to government bodies in striving to reduce GHG and waste generation.

4 (b) Summary of Research Outputs

(i) Peer-reviewed publications, International Journal/Book chapters.

(ii) Popular non-scientific publications and abstracts including those presented at conferences

- BioOpps and ReValueProtein researchers co-authored three chapters for an upcoming Elsevier-Academic Press book: "Sustainable Meat Production & Processing". The book is in production and is due to publish on or before November 1, 2018.
- Chapter 4 - Proteins recovery from meat processing by-products. Liana Drummond, Carlos Álvarez and Anne Maria Mullen
- Chapter 5 - Blood Proteins as Functional Ingredients. Mònica Toldrà, Sarah A. Lynch, Romain Couture and Carlos Álvarez

- Chapter 12 - Facilitators and barriers for foods containing meat co-products. Maeve Henchion and Mary McCarthy
 - IFSTI, 46th Annual Food Science and Technology Conference, Ashtown, Dublin, Ireland. 6th – 7th December 2017 (Oral presentation: Finding market opportunities for animal proteins derived from low value streams from the meat processing chain, Romain Couture)
 - Invited Speaker: Oral Presentation: Maeve Henchion (2018) Traditional and emerging protein sources – working in synergy or fixed in competition Food Protein Vision, Amsterdam 7-9 March
- Invited Keynote Speaker: Anne Maria Mullen “Alternative uses for co-products: Harnessing the potential of valuable compounds from meat processing chains”. At 63rd International Congress of Meat Science & Technology (ICoMST), held in Cork, Ireland between 13-18th August 2017.

A Technology Update is under preparation.

(iii) National Report

(iv) Workshops/seminars at which results were presented

A very successful seminar: ‘Onwards and upwards: business opportunities and challenges for co-products from the meat processing chain’, was held in Teagasc Ashtown, Dublin, Ireland on 26th April 2018, to coincide with the end of the BioOpps study period. The seminar gathered 40 participants from relevant companies, MTI, and experts in the various areas of significance for the study, and was divided into 3 sections: Session 1 included industry speakers who presented the current state of the market of animal co-products, and how they are facing challenges and opportunities in their field. Session2 comprised researchers speaking about new ways of utilising meat co-products, thus recovering their value and optimising the entire processing chain. BioOpps researcher, Romain Couture, gave a summary of the study outcomes. Session 3 focused on where to go from here, including a look at consumer perspectives and discussing available supports from government agencies.

(v) Intellectual Property applications/licences/patents

(vi) Other

The information presented in the progress report has direct relevance to industry and policy makers in particular. With a drive to recover as much value as feasible , in a sustainable manner, throughout our production and processing chains the information generated and disseminated holds much value in this regard

Industry interactions included Irish meat processors, renderers, ingredient companies and equipment suppliers.

5. Scientists trained by Project

Total Number of PhD theses: 0

Total Number of Masters theses: 1

Georgia Lavranou is undertaking an MSc.

Teagasc Supervisor: Dr Maeve Henchion

Academic Supervisors: Prof Mary McCarthy and Dr Seamus O'Reilly UCC

Anticipated Submission date: Q2 2019.

Title: Investigating consumers' attitudes to food products containing protein derived from different offal sources

While Georgia's research is closely aligned with ReValueProtein she has had interaction with the researcher on BioOpps which informed her work.

6. Permanent Researchers

Institution Name	Number of Permanent staff contributing to project	Total Time contribution (person years)
Teagasc	2	0.15FTE
Total		

7. Researchers Funded by DAFM

Type of Researcher	Number	Total Time contribution (person years)
Post Doctorates/Contract Researchers	1	1 FTE
PhD students		
Masters students		
Temporary researchers		
Other		
Total	1	1

8. Involvement in Agri Food Graduate Development Programme

Name of Postgraduate / contract researcher	Names and Dates of modules attended
n/a	

9. Project Expenditure

Total expenditure of the project: €66,295.12*

Total Award by DAFM: €90,817.79

Other sources of funding including benefit in kind and/or cash contribution(specify): €*

*Access to a variety of relevant market reports (referenced throughout the progress report) was facilitated by Enterprise Ireland, thus significantly reducing proposed budget expenses. Enterprise Ireland support is therefore hereby gratefully acknowledged.

Breakdown of Total Expenditure

Category	Name Institution 1	Total
Contract staff	42,141.72	42,141.72
Temporary staff		
Post doctorates		
Post graduates		
Consumables	45.01	45.01
Travel and subsistence	10,849.36	10,849.36
Sub total	53,036.09	53,036.09
Durable equipment		
Other		
Overheads	13,259.02	13,259.02
Total	66,295.12	66,295.12

10. Leveraging

Information generated on this project is feeding into proposal generation for funding from (a) EI – feasibility fund and (b) EU BBI-JU proposals.

11. Future Strategies

The outcomes of this project continue to support the strategy for recovery of value from meat co-products. On-going and future discussions with relevant stakeholders will be informed by outputs. Participation on proposal for further national (EI, FIRM etc) or EU funding will also be further strengthened both by the fact that we had a nationally funded project in this space and by the outcomes from the research project. These outcomes complement, not duplicate, data generated on the ReValueProtein project. The outputs of this study will have an impact in supporting exploitation of these opportunities on a number of levels. Important decision-making data will help the Irish meat sector to assess the current environment for investment in the ideas, knowledge and processes resulting from previous/current public-funded research. Additionally, the information generated will be of great value in guiding researchers to ensure the most cost-effective approaches are considered in experimental designs etc.