

INTRODUCTION

STATE-OF-THE-ART

Meat consumption has surged globally, reaching 346 million metric tons in 2021 (FAO, 2021), driven by its nutritional richness and delectable flavours. However, meat and its products are highly susceptible to colonization by a diverse range of microorganisms (Cauchie *et al.*, 2020). Meat spoilage constitutes a significant global challenge, responsible for up to 20% of total meat production losses (Karwowska *et al.*, 2021). Furthermore, raw beef can harbour pathogenic threats, including *Listeria monocytogenes*, *Salmonella spp.*, and pathogenic *Escherichia coli*, posing health risks. The advent of next-generation sequencing has revolutionized microbial ecosystem analysis by harnessing extensive data, transcending the limitations of culture-based and PCR-based methods (Almeida and De Martinis, 2019).

PROJECT SUMMARY

This Ph.D. research project develops in collaboration with Dawn Meats Group, a main meat producer and processor in Ireland. Our mission is to identify and understand the key microbial culprits responsible for spoilage and pathogenicity, tracing their potential sources of contamination across the entire meat production chain – from the farm and slaughterhouses to processing, packaging, transport, retailers, and ultimately, the consumer's table. We will employ cutting-edge culture-independent shotgun metagenomics to uncover microbial genes linked to hazards such as antibiotic resistance, virulence factors, and toxin production, alongside spoilage-related activities like proteolysis, volatile compound production, off-odours, slime, and biofilm formation. Additionally, we explore innovative preservation methods like Plasma Activated Water (PAW) to enhance beef safety and prolong shelf life.

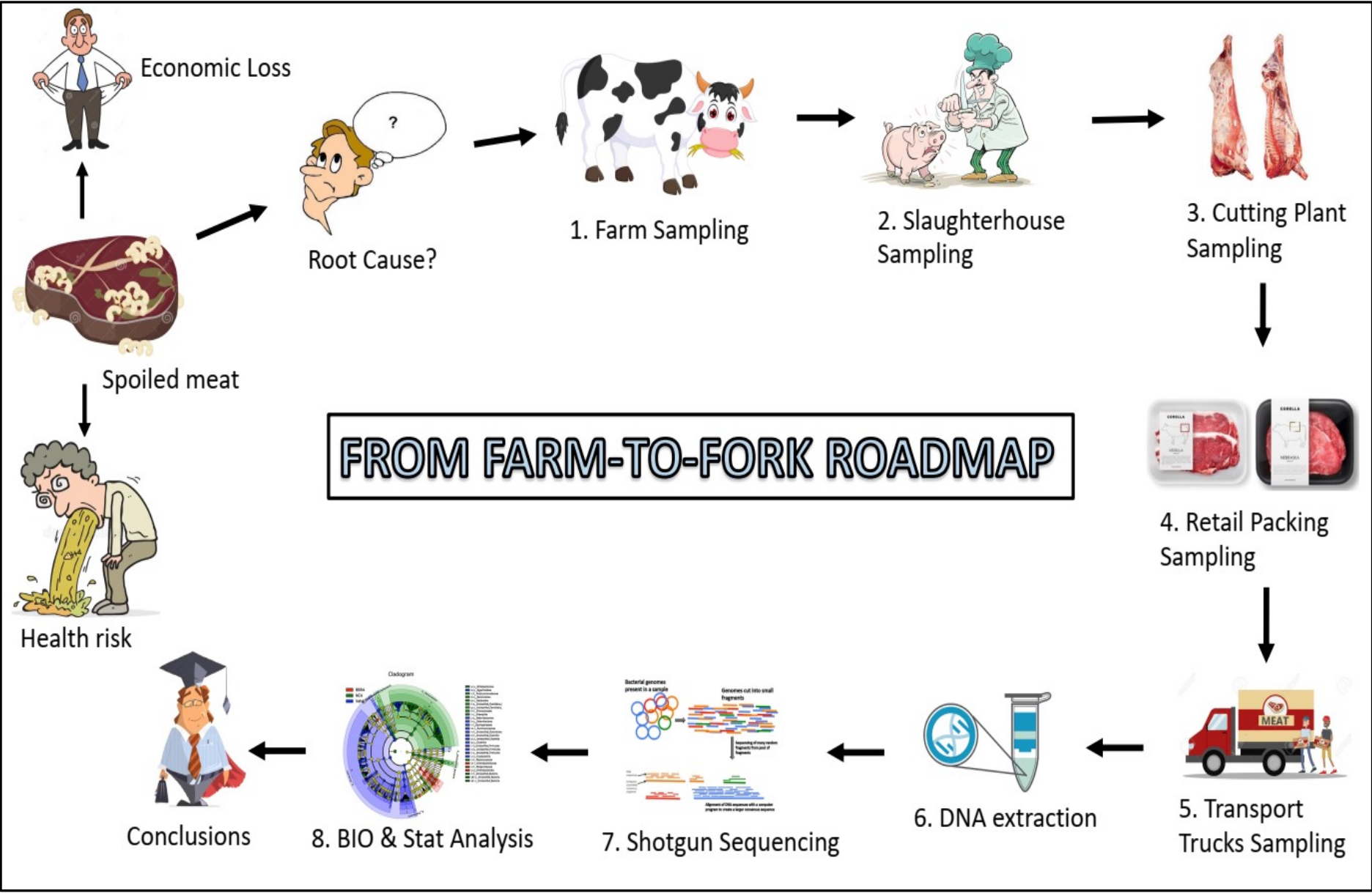
Ph.D. THESIS OBJECTIVE AND MILESTONES

S. No	Milestones	Time Frame (3 Years)								
		1 st January 2023 – 31 st December 2025								
		2023			2024			2025		
A1)	Literature review on the role of microbiome on fresh beef spoilage	Q1	Q2	Q3	Q1	Q2	Q3	Q1	Q2	Q3
A2)	Analysis of contamination routes in raw beef chain									
	1) Microbiome Sampling from different locations and in different seasons (2 times)									
	2) DNA extraction and shotgun metagenome sequencing									
	3) Bioinformatics data analysis									
A3)	Exploring new strategies for meat prevention and preservation									
	1) Evaluating Plasma Activated Water (Secondment at Univ. Leon, Spain)									
A4)	Thesis and Publications writeup									
A5)	Research Dissemination									

SAMPLING INFORMATION

Location	Env. swabs	Meat samples
Grannagh	63	14
Charleville	63	4
Ballyhaunis	63	14
Kilbeggan	63	4
Carrolls Cross	40	132
Grand Total	292	168

METHODOLOGY



NOVELTY ASPECTS

- Microbial tracing on a large scale throughout the beef supply chain.
- Investigations cover a period of two seasons.
- Tracing the spread of antibiotic resistance.
- New strategy will be employed for spoilage prevention and meat preservation.

EXPECTED OUTCOMES

- Mapping the taxonomic and functional microbial diversity along the entire beef production chain.
- Detection of microbial spoilers and pathogens routes of contamination along the entire beef chain.
- Identification of genes involved in meat spoilage or potentially harmful activities.

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