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ProSafeBeef

Advancing Beef Safety and Quality through Research and Innovation

Integrated Project in FP6

Periodic Activity Report: Publishable Executive Summary

Period covered: March 2008 to March 2009

Start date of project: March 2007

Duration: 5 years

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Project Manager: Robert Mooney

Coordinating Body: Teagasc, Ashtown Food Research Centre



PUBLISHABLE EXECUTIVE SUMMARY

Background and objectives of *ProSafeBeef*

Beef production within the EU region is an activity of major economic importance, valued at €75 billion. However, reforms to the Common Agricultural Policy, increased globalisation, reduced commodity prices and an increasingly sophisticated, health-conscious consumer are requiring the industry to produce beef and beef products that are convenient, traceable, nutritious and of consistent quality. Alongside these considerations, today's consumer demands assurances regarding food safety and health, which is of paramount importance given the serious impact of beef related health scares. In order to boost consumer trust and invigorate the industry, *ProSafeBeef* is examining new ways of reducing contaminants in the beef chain from 'farm to fork' as well as enhancing quality, choice and diversity.

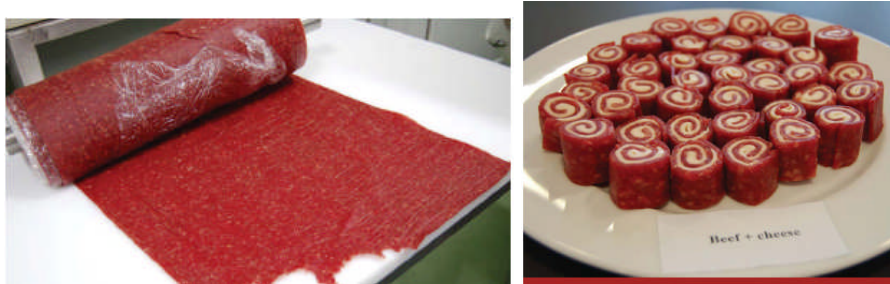


To address these critical issues in the beef chain, the following scientific and technological objectives of *ProSafeBeef* are

- To apply the tools of quantitative risk assessment to reduce microbial and chemical hazards along the beef chain (fork-to-farm) in order to maximise beef safety and enhance consumer confidence.
- To develop novel and innovative control and intervention strategies for implementation along the beef chain (fork-to-farm) to ensure the safety of beef and beef products.
- To satisfy consumer demand for choice and both invigorate and add value to the beef chain (fork-to-farm) by developing innovative beef processing techniques and innovative beef products that are safe, attractive to the customer and of high nutritional quality.
- To engage with SME's, expert collaborators from third countries and INCO partners with a vested interest in beef export to assist in delivery of the *ProSafeBeef* project.

- To transfer technologies and disseminate information from the RTD and ITD Pillars in the *ProSafeBeef* to the end users and wider stakeholders in the beef industry.

These activities will permit *ProSafeBeef* to deliver to the beef industry a toolbox of strategies to reduce microbiological and chemical contaminants in the beef supply chain through an integrated fork-to-farm framework approach, and to develop a range of novel products that are safe, convenient, of high quality and attractive to the consumer.



Highlights to date

ProSafeBeef highlights to date are summarised below

Quantitative risk assessment of microbial and chemical hazards to maximise beef safety

- Research on tools for online detection of faecal contamination on beef carcasses have identified 2 potential indicators (Mg-Chlorophyllin and Px : a heat protected extract from lucerne) for use in a spectroscopic imaging assay. In addition core microbiota in cattle faeces have been identified which can be targeted in a DNA diagnostic test for faecal microfora.
- Data gathering on the prevalence and concentration of four key pathogens (VTEC, *Salmonella*, *L. monocytogenes* and *Campylobacter* at key points in the beef chain is ongoing in addition to data on key practices and factors in the beef chain which impact on pathogens. This is facilitating the development of exposure assessment models for the above four pathogens in beef and beef products
- Research has been conducted to characterise four key pathogens (VTEC, *Campylobacter*, *L. monocytogenes*, and *Salmonella*) recovered from different parts of the beef chain in different geographic regions by virulence profiling, antibiotic resistance, and genetic fingerprinting. This data is being used to assess the human virulence potential of these pathogen transmitted by beef and will be used in the development of exposure assessment risk models
- A novel Liquid Chromotography/Mass Spectroscopy (LC/MS/MS) method has been developed for the detection of 38 anti-parasitic drug residues in Beef. The method has been validated according to 2002/657/EC requirements and transfer of the technology to other laboratories underway, including European Community Reference laboratories. A study of beef for the presence of these anti-parastic agents has commenced and initial survey results indicate the incidence of these agents is higher in extensive beef production systems.



Control and intervention strategies which can be implemented along the fork to farm chain to ensure safe beef

- ***Antimicrobial packaging:*** A number of approaches including oregano essential oil (EO) (0.5%) in modified atmosphere packaging (MAP), Sorbitol-plasticized WP1 films with oregano oil (1.5%) and the incorporation of a *Lactobacillus sakei* protective culture (~ 10^6 cfu/cm²) into a Na-caseinate edible film are showing to be very effective in reducing the levels of spoilage flora and inhibiting pathogens. These are now being applied to both food model and beef samples
- ***Time temperature integrators:*** Research on Time temperature indicators (TTI) for use in the chill chain have focused on the use of Lactic acid Bacteria (*L. sakei*) as a microbial TTI system and it is showing considerable promise for its applicability to monitor quality of minced beef under MAP conditions.
- ***Bioprotective cultures:*** Cocktail strains of lactic acid bacteria are being investigated for impact on the microflora and pathogens on beef during storage and research is ongoing.
- ***Marinades:*** Olive oil marinades were shown to delay the development of beef spoilage at 5, 10 and 15°C but further addition of oregano essential oil, nisin, or polylysine had no additional antimicrobial activity. Lactic acid based marinades are also showing anti-microbial activity and testing of soy sauce and red wine based marination is ongoing.
- ***Hides:*** The impact of two on-hide microbial fixation treatments (an insect-produced natural resin, Shellac, and a hair spray for cosmetic purposes) were compared with decontamination with a sanitiser (Antisept G). Significant reduction of TVC, *Enterobacteriaceae* and generic *E. coli* were achieved with Shellac (up to 6.56 logs CFU/cm²), followed by the sanitiser (up to 4.90 logs) and hair spray (up to 3.40 logs). *E. coli* O157 prevalence on hides was reduced by >3-fold using the Shellac treatment. Further investigations will focus on further optimisation of the Shellac and other similar hide microflora-fixation treatments.
- ***Carcasses:*** A novel decontaminant based on a “natural” product extracted from milk resulted in significant reductions of pathogens on beef carcasses. Treatment

of the carcass with this dairy extract does leave a sour odour on the outside of the carcass which dissipates over a 24 h period in the chiller and further testing is ongoing. However as conventional carcass processing (deboning and cutting into retail cuts/trimming) has the effect of removing approximately 10% of what was originally the outer surface of the carcass and in continental Europe the whole outside layer of fat tissue (which was the original carcass surface) is often removed in a process called prêt à découper (PAD) (ready to slice) processing, this may not be an issue and the method has commercial potential.

- *Bovine gut*: Studies have investigated gene expression by Verocytotoxigenic *E.coli* in the bovine gut content by using microarray analysis in order to increase our knowledge on the physiology of this pathogen in the ruminant digestive tract and devise potential control strategies. Studies on the ability of a plant extract and a yeast based probiotic to control *Listeria* and *E. coli* O157 in model digestive systems were unsuccessful and the approach of the research has therefore shifted to investigate the effect of gut fauna programming of young animals with the use of probiotics in milk replacer.



Producing safe beef and beef products with enhanced nutritional and eating quality characteristics

- Studies on the effects of dietary strategies (oils and plant secondary compounds) on lipid metabolism in the rumen have progressed well and increased understanding of the microbial population associated with dietary-induced shifts in biohydrogenation have been achieved. Beef production studies are ongoing and it has been noted that there is a wide variation in the degree of “apparent” protection of dietary lipid in commercially available rumen-protected lipid products.
- Studies have demonstrated the ability to achieve large enhancement in long chain PUFA in beef muscle by injection and in beef burgers by use of encapsulated-DHA. In the burger studies and based on a 200g serving, this would supply 40, 68 and 96% of recommended daily allowance. Shelf life of both muscle and burger PCPUFA-enhanced products was shorter than commercially required but additional of additional antioxidant ameliorated this problem. SME partners suggest greater effort is concentrated on nutritional enhancement of beef products compared to beef muscle and this will be further investigated.

- Studies are ongoing to assess the potential use of Raman spectroscopy as an on-line tool to measure fat and fatty acid composition of beef in-line and results are very promising
- A number of molecular markers (SNPs and genes differentially expressed) have been compiled and a subset of these markers identified and genotyped in national herds. A large informatics exercise was done compiling data suitable for modelling beef quality. A workshop was organised in France on ontologies of characters to discuss how to define variables present in the data base.

Innovations in processing to develop nutritive, convenient and added-value beef products

- A database has been established with NIR, fluorescence and Raman spectra plus CT images from different muscles and different beef carcasses. This database also contains meat quality parameters measured on the same muscles. The effect of salt, marination, packaging conditions as well as instrument settings have been studied with regard to the ability to detect foreign bodies like metal and cartilage in beef products.
- Several experiments on diffusion processes connected to marination have been conducted, and mathematical models have been developed for the unidirectional migration of protons in model systems. Studies of the mechanical properties of collagen fibres as function of pH and cooking have been performed. Experiments have also been conducted to evaluate and better model the interactions between marination processes, marinade composition and type of muscles, and their impact on end product quality. Studies on how marination affects the formation of heterocyclic aromatic amines are in progress.
- Studies have been conducted aimed at optimising cooked meat qualities: juiciness, colour and tenderness and increasing meat safety by reducing heterocyclic amines (HAs, carcinogens) produced during roasting and grilling. Work progression has been based: (1) on the development of thermal-process-control models, which combine heat-mass transfer models and quality modules, (2) ongoing studies of two specific cooking techniques: microwave and convective oven, and (3) the development of specific thermal process control equipments and devices, applicable on different beef cuts, and which will be used to validate models and to interpret technical results.
- With the objective of optimising packaging conditions for meat safety and quality a literature survey of work on the effect of headspace composition on the quality of MAP packaged beef has been completed and experimental work on the effect of headspace to meat ratio on safety and quality has commenced

Consumer need for beef safety information and acceptability of novel processed beef products

- This research aims to determine the role and impact of beef safety and health information (including risk perception and attitudes to new technologies) on consumer perception, attitude and expectation. Qualitative exploratory focus

group discussions have been conducted in the capital cities of four European countries (UK, France, Germany and Spain). The focus group discussions were led by trained moderators and full transcripts are being used for data analysis and consumer and are yielding interesting data on consumer attitudes to safety and health.

Demonstration Activities

There is a strong focus in this project on demonstration of new and emerging technologies to the beef industry across Europe. To date demonstrations have taken place of Beef Muscle Profiling, OSMOFOOD® for osmotic dehydration of meat, Hot boning and restraining technique to improve safety of beef, High hydrostatic pressure on beef meat products and on detection of foreign bodies / unwanted carcass components



Expected impact

ProSafeBeef will enable the beef industry in Europe to deliver innovative, novel, and improved fresh beef and beef products that are safe, high quality, and consumer-driven for national, regional and global markets thus allowing for a more competitive and sustainable industry. This project will develop a strategically focused beef safety management system based on the principles of quantitative risk assessment and the development of new control and intervention strategies that inspire confidence in the beef chain and is consistent with the wider expectations and needs of European consumers.

The project will satisfy consumer demand for choice and both invigorate and add value to the beef chain (fork-to-farm) by developing innovative beef processing techniques and innovative beef products that are safe, attractive to the customer and of high nutritional quality.

ProSafeBeef is engaging with SMEs, expert collaborators from developing countries and INCO partners with a vested interest in stimulating the beef industry by advancing beef safety through research and innovation. Over the course of the project the research outputs will continue to be delivered to stakeholders through a strategic work plan integrating demonstration, technology transfer, dissemination and training activities.

LIST OF PARTNERS

- Teagasc - The Agriculture and Food Authority (Ireland)
- Institut National de la Recherche Agronomique (France)
- Aberystwyth University (United Kingdom)
- Nofima AS, The Norwegian Food Research Institute (Norway)
- Agricultural University of Athens (Greece)
- Association pour le Développement de l'Institut de la Viande (France)
- Ghent University (Belgium)
- University College Dublin (Ireland)
- University of Bristol (United Kingdom)
- Institute of Farm Animal Biology (Germany)
- Agricultural University of Poznan, Institute of Meat Technology (Poland)
- Aarhus School of Business (Denmark)
- Aristotle University of Thessaloniki (Greece)
- University of Veterinary Medicine (Austria)
- National Veterinary Research Institute (Poland)
- Danish Meat Research Institute (Denmark)
- University of Novi Sad (Serbia & Montenegro)
- Organización de Consumidores y Usuarios (Spain)
- RIKILT, Institute of Food Safety (The Netherlands)
- University College Cork (Ireland)
- Queen's University Belfast (United Kingdom)
- International Atomic Energy Agency (Austria)
- British Nutrition Foundation (United Kingdom)
- Institute of Agro-Food Research and Technology (Spain)
- Universidade Federal de São Paulo (Brazil)
- Universidade de São Paulo (Brazil)
- Macrobióticos (Brazil)
- Greifenfleisch GmbH (Germany)
- Ensors Abattoir Limited (United Kingdom)
- Celtic Pride Limited (United Kingdom)
- Union Nationale des Cooperatives d'Elevage et d'Insémination Animale (France)
- Josef Strobel und Sohne (Austria)
- Apostolos Papadopoulos & Sia OE (Greece)
- Ecofarm Peloponessos SA (Greece)
- Furuset Slakteri AS (Norway)
- Prima Jæren AS (Norway)
- Institute of Environmental Science and Research Ltd (New Zealand)
- Co-operative Research Centre, Cattle and Beef Quality (Australia)
- Prof. John Sofos (USA)
- USDA, Western Regional Research Centre (USA)
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