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ProSafeBeef

Advancing Beef Safety and Quality through Research and Innovation

Integrated Project in FP6

Executive Summary

Year 1

Period covered: March 2007 to March 2008

Start date of project: March 2007

Duration: 5 years

Project coordinator name: Declan Troy

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, which is of paramount importance given the serious impact of the 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 and practice to reduce microbiological and chemical contaminants in the beef supply chain through an integrated fork-to-farm framework approach, and develop a

range of novel products that are safe, convenient, of high quality and attractive to the consumer.



Highlights to date

In the first year of *ProSafeBeef* research focused on the safety of beef in relation to both microbial pathogen and chemical residues and on developing innovative beef products and processes

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

- Tools for online detection of faecal contamination on beef hides or carcasses have progressed with the identification of potential indicator faecal microflora for use in a DNA diagnostic test and the identification of chlorophyll metabolites in faeces detectable by spectral imaging.
- Research commenced on characterisation of pathogens (virulence typing, genetic fingerprinting and antibiotic resistance) giving new knowledge of the diversity and human virulence potential of pathogens recovered from different parts of the beef chain and different geographic regions.
- The scope of the microbial risk assessments and the products to be considered were decided and data gathering (literature, baseline surveillance for pathogen numbers and prevalence, environmental factors in the beef chain impacting on pathogens) commenced and is facilitating the development of exposure assessment models for four key pathogens (VTEC, *Salmonella*, *L. monocytogenes* and *Campylobacter*) in the beef chain.
- With the ultimate aim of assessing the risk posed by anti-parasitic drug residues in beef, research focused on developing and validating a method to initially detect six macrocyclic lactone residues in bovine muscle and this method is now being extended to allow detection of 39 anti-parasitic drugs including Benzimidazoles, Flukicides, Levamisole and macrocyclic lactones

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

- Research on anti-microbial packaging systems showing the use of oregano essential oil-based active packaging was capable of extended the shelf life of minced beef. The incorporation of nisin or K-sorbate into sorbitol-caseinate (SC) films was shown to inhibit *L. monocytogenes*,

- Research on Time temperature indicators (TTI) for use in chill chain distribution systems were developed based on the growth and metabolic activity of *Lactobacillus sakei* strains during storage. At all temperatures tested, the pH and color change of the TTI closely mirroring the growth of *L. sakei*.
- Olive oil-based marinades were shown to alter the spoilage pattern of fresh beef with addition of polylysine (0.25%) significantly inhibiting the spoilage flora.
- With a view to developing a hide decontamination system the distribution of background microflora and key pathogens were assessed. The levels of general micro-flora and *E. coli* O157 contamination were highest on the metacarpus>brisket>rump>flank>neck. *E. coli* O157 occurrence correlated with dirtiness of hides, but levels of general microflora did not.
- Research efforts on control of pathogen in the cattle rumen investigated the effect of plant extracts on the survival of pathogens in the rumen using *in vitro* model systems and an essential oil (code CF-SD) was shown to significantly reduce *E. coli* O157. It was also shown that survival of *E. coli* O157:H7 in abomasum fluid was enhanced by prior passage through the rumen suggesting induced acid-resistance mechanisms. Micro-array research showed virulence related genes (encoding type 3 secretion system (TTSS) and ToxB) and nitrogen utilisation gene (*eut*) were over expressed in the cattle intestinal content.

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

- Research on the control of ruminal lipid metabolism showed that red clover feeding may offer a sustainable method to not only reduce rumen lipolysis but also to protect C18 polyunsaturated fatty acids. The causative agent is polyphenol oxidase present in red clover.
- Investigations have shown that injecting whole beef cuts with polyunsaturated fatty acids caused an increase of between 50% and 1000% of long chain PUFA, EPA and DHA in the muscle. Work is continuing to ascertain their shelf-life, stability and the effect of cooling on the fatty acids. Particular attention is being given to the production of a German beef product made from beef raw materials containing various beneficial fatty acid compositions.
- Methodologies to determine the fatty acid composition of products are being developed. The techniques showing most promise are Raman spectroscopy and a RP-HPLX method for fat-soluble vitamins (tocopherols, vitamin A and β -carotene).
- A list of existing and known molecular markers associated with beef palatability has been established. Parallel to this a RT-PCR method to assess some of these key markers is near completion and preliminary tests are in progress to assess the expression level of some of the markers.

- The compiling of a large database detailing age, breed, muscle type, etc of about 4000 animals is near completion. This informatics work programme can be interrogated by many of the scientists involved in *ProSafeBeef* through filtered access.

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

- Beef muscle profile of 39 different muscle types using existing data sets confirmed large variations between muscles when analysed by multivariate statistical analyses.
- The diffusion process during marinating of beef muscles was modelled according to different parameters such as water activity, pH, small molecules and ion content. Marination effected tenderness, juiciness and colour intensity of beef and there was a large variance in the reaction of different muscle types and marinate. Pilot plant scale equipment has been calibrated and the models will be validated at this level.
- Development of thermal process control models in order to optimise cooking conditions for enhanced tenderness, juiciness, colour as well as to negate the formation of heterocyclic amines have commenced. The kinetics of colour parameters have been measured during cooling of beef at different temperatures. Temperature had a greater effect on protein denaturation than the length of time of cooking. This work is now scaled up to include commercial ovens.

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

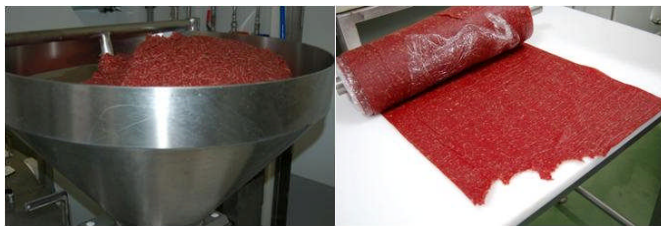
- In order to determine the role and impact of beef safety information on consumer perception, attitude and expectation, two qualitative focus group discussions in four European countries are planned. These consumer focus groups have now been defined in terms of countries (UK, France, Greece and Spain), participant selection criteria, structure and content
- The scope of the discussion groups have been altered to also include emerging issues such as animal cloning and genetic modification in discussions with the EC.
- A review of the literature on the consumption of beef and other meats has taken place.
- Input by the scientific and technological focused pillars has taken place so that emerging technologies can be incorporated into the focus group discussions by defining the topic guide and recruitment criteria.

Demonstration, Training, Technology Transfer and Dissemination

- Demonstration actions: two completed and two more planned for the next 6 months:
 - a. **Muscle Profiling:** Demonstration of Beef Muscle Profiling at Matforsk, Norway, May 24th 2007: This demonstration involved a practical demonstration of beef muscle profiling activities in *ProSafeBeef*, a discussion about practical aspects of muscle profiling and value addition of beef products.



- b. **OsmoFood** A practical demonstration of new technology: OSMOFOOD® Osmotic dehydration of meat on the 27th of February 2008 in ADIV, France. This demonstration was aimed solely at the SME's, meat companies and professional institutions.



- A “Commercial Task Force” (or Core Team) of judicially selected, experienced technologists from ProSafeBeef participants has been formed. The Task Force will promote and disseminate new technologies emanating from the RTD activities of *ProSafeBeef*.
- A training plan has been developed and is being implemented on an ongoing basis throughout the project. The training programme has two main objectives: to enable early stage researchers and scientists to advance their scientific understanding and expertise and to promote the transfer of knowledge and technology by training the “Core Team” of scientists and technological trainers to disseminate and communicate to industry.
A student/early stage researcher exchange programme has been completed and is currently open for candidates to submit proposals.
- The development of national and EU level networks of SMEs and CEO has begun. The database has over 200 members currently.
- The *ProSafeBeef* website (www.prosafebeef.eu) is established and serves as a portal for public and private use. When fully developed, it will serve as a central area for the dissemination of information to the public, SMEs and stakeholders.
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- *ProSafeBeef* brochure has been published and distributed through dissemination activities and through the networks above.



- The first issue of the E-newsletter is set for release in April 2008 to all the network members discussed above.



- There are also a significant number of other technical and scientific publications, presentations and published papers even at this early stage.

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 will engage 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. The research outputs will 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)
- Institute of Grassland and Environmental Research (United Kingdom)
- Matforsk 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'Élevage 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)
- Canadian Research Institute, University of Guelph (Canada)

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