

Advancing beef safety and quality through research and innovation ProSafeBeef

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Beef production within the EU region is an activity of major economic importance, valued at over €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, the E.U. Framework Integrated project *ProSafeBeef* is examining new scientific approaches of reducing contaminants in the beef chain from 'farm to fork' as well as enhancing quality, healthiness, choice and diversity of its fresh and processed products.

The 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.

In the first year of *ProSafeBeef* research focused on:

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

- 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.
- Research commenced on characterisation of key pathogens (virulence typing, genetic fingerprinting and antibiotic resistance) recovered from different parts of the beef chain and different geographic regions giving new knowledge of their diversity and human virulence potential
- 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.
- With the ultimate aim of assessing the risk posed by anti-parasitic drug residues in beef, research focused on developing and validating an LC MS / MS 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 is being 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 mirrors the growth of *L. sakei*.
- Olive oil-based marinades were shown to alter the spoilage pattern of fresh beef with addition of polylysin (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 using *in vitro* model systems showed that an essential oil could significantly reduce the level of *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 feeding animals red clover may offer a sustainable method not only to 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 ongoing 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.

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

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

discussions in four European countries were planned and consumer focus groups have now been defined in terms of countries participant selection criteria, structure and content

Demonstration Activities

A demonstration of **Beef Muscle Profiling** took place at Matforsk, Norway, May 24th 2007 which involved a practical demonstration of beef muscle profiling and discussion about practical aspects of muscle profiling and value addition of beef products. A demonstration of **OSMOFOOD®** for osmotic dehydration of meat took place on 27th February 2008 in ADIV, France and was attended by SME's, meat companies and professional institutions.

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. If you would like more information and participate in our planned events please visit our website at www.prosafebeef.eu.