

New research on consumer attitudes to beef

Pillar 5 of the ProSafeBeef project is responsible for investigating consumer perceptions, attitudes and expectations with respect to beef safety, novel processing methods and new beef products. This will be achieved through a consumer programme that will include qualitative focus group discussions and quantitative experimental consumer research. Initial research from one such focus group is described here.

In May 2008 eight focus groups, each with seven to nine participants, were conducted in the capital cities of Germany, Spain, France and the United Kingdom. Participants (65 in total) were beef eaters (consuming beef at least

once a week) between the ages of 19 and 60 years. Opinions were sought on a range of topics including safety and health perceptions, and acceptance of quality guarantee, technology, GM and cloning.

Safety perceptions

Consumers stated it was difficult for them to know how safe a beef product is, with factors such as the occurrence of international food scares and the attendant media attention being particularly problematic. Concern also existed over issues such as a lack of knowledge about beef safety, and there was a general distrust from consumers of players in the beef production chain. Consumers reported using information cues or beef attributes to identify if a beef product is safe. Origin or quality labels, brands, as well as appearance and whether the beef is fresh or frozen were all considered. Consumers often identified unsafe beef as that which has an expired expiry data, is of foreign origin, is minced or offal, is further



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processed, as well as that which is too cheap. Overall, consumer trust in beef safety was relatively high, despite distrust in particular actors like intermediaries, slaughterhouses, meat processing industries and beef packaging companies.

Health perceptions

Meat was considered to be an important component of a healthy diet, namely due to its role in providing protein and iron. However consumers acknowledged that beef should not be consumed on a daily basis. Healthy beef was initially associated with basic production processes, with a bias towards the traditional farm encompassing grass-fed beef. Cattle fed with natural food and raised outdoors were seen as healthy. Healthy beef was also expected to be as natural as possible, and not have been treated with additives or hormones. A perceived reduction in health was associated with an increase in the amount of processing. Most consumers considered lean beef as the healthiest option. Specific concerns were raised towards marinated meat, with consumers preferring to marinate meat themselves at home to avoid incorporation of any unhealthy material. For most consumers, the final responsibility for beef healthiness resided with the government, both local and European.

Quality guarantee acceptance

The development of a grading and guarantee system for beef eating quality was mostly well accepted by European beef consumers. Consumers acknowledged the opportunity to purchase beef with guaranteed tenderness. However they expressed some reservations related to the possible upgrading of lower value cuts, too high a degree of standardisation, and the fact that tenderness is to some extent subjective. They further required the

system to be simple and independent-party controlled. It is hoped that increasing consumer satisfaction with beef products could lead to higher consumption rates and increased industry profitability.

Technology acceptance

Technology innovations were accepted where they related to convenience, as well as to help feed the ever growing world population. Processing technologies that claim to increase shelf life were not seen as positive, as consumers believed that industries use such technology to increase their own profit, by actually offering products that are 'not fresh' for consumers. Consumers supported the development of technologies that can provide more healthiness and eating quality, and if such technologies are 'not invasive', the chances of being accepted increased. Excess manipulation and distance from 'the natural' when producing and processing beef products were considered very negative outcomes of technological development. There was a severe criticism about too much intervention

in food and a strong desire to keep food and beef processing as simple as possible.

GM & cloning acceptance

New product developments in the beef industry originating from genetic modification and cloning techniques should be treated with extra care, as consumers were not yet willing to accept these technologies. Even scientists, commonly regarded as trustworthy sources of information regarding technologies, were considered 'suspicious' when it came to biotechnologies. Cloning was accepted by some of the participants if the aim was to preserve endangered species, but ethical concerns and the unknown long term effects were still a concern. However, there was an awareness that the growing world population demands more efficient solutions in food production, and biotechnology was accepted for this purpose. Although consumers stated that they were not willing to buy and pay for such products, they thought it very likely that in the near future GM and cloned beef will be available on supermarket shelves.



An interview with Wim Verbeke, Pillar 5 leader

Wim Verbeke is a Professor in agro-food marketing and consumer behaviour, affiliated with the Department of Agricultural Economics at Ghent University in Belgium. Below, he talks about his work as Pillar 5 leader on the ProSafeBeef project.



Wim Verbeke

What is your background and how did this lead to your involvement in ProSafeBeef?

My background is in bio-science engineering. Whilst studying in this area I gained experience in a wide variety of biological sciences and technologies used in the agri-food production and processing chain. Following this I completed an MBA in marketing management at the Vlerick Management School. I finished my PhD in 1999, which focused upon consumer decision-making in relation to fresh meat, with a major focus on meat image and the impact of negative publicity following the meat safety crises from the second half of the nineties.

In addition to my academic background I am also a butchers son, and have therefore been involved with meat and meat processing since childhood. Since my appointment as professor in agro-food marketing and consumer behaviour at Ghent University, I have been looking for funding opportunities in the domain of meat consumer science, and when the EU FP6 call for a project on beef safety and quality was made, it was just a

matter of linking up with the most competitive consortium and putting together and contributing to a consumer science pillar.

As Pillar 5 leader, what does your job involve?

The main task of Pillar 5 leader involves guiding and coordinating the Pillar's research activities and representing the Pillar on the governing board of the project. Besides this, I am also involved in the research and dissemination activities, which is what interests me the most. Working with the four partners in this Pillar (Aarhus University, Nofima, Agricultural University of Athens and Ghent University) is an enjoyable job, made easier by the dedication shown by all partners and the excellent working relationship between them.

How is this important in terms of the whole ProSafeBeef project?

It was a requirement of the European Commission that consumer science was to be a key part of this research project. We have tried to present a consumer research programme that provides

feedback to the natural sciences Pillars of the project as much as possible. The importance of our activities is to ensure the successful development and implementation of novel beef production and processing techniques, which will be acceptable to consumers.

What do you most enjoy about your involvement with ProSafeBeef?

What I enjoy most is that this project provides me and Pillar 5's consumer science consortium with the opportunity to perform excellent consumer research related to meat, and that we can do this in several European countries at the same time. The interaction with other Pillars is gaining momentum, which provides me with a great opportunity to learn more about natural sciences in this domain, as well as to gain an understanding of the practical implementation of research findings.

How do you think the work of Pillar 5, along with that the whole project, will impact upon the beef industry?

The work in the consumer Pillar should reveal consumers' needs in relation to purchasing beef, as well as the reasons for acceptance or rejection of novel beef processing technologies and novel beef products. We believe this is crucial information for the beef industry when developing new products and designing future marketing and communication strategies.



Professor Verbeke is based at the University of Ghent

Improving the nutritional quality of beef

Pillar 3 of the ProSafeBeef project aims to help produce beef products with enhanced nutritional and eating quality characteristics. A particular focus is on the development of strategies to enhance the concentrations in beef of those fatty acids considered to be of benefit to human health.

While beef is considered to be a good source of protein and a variety of micronutrients (including vitamins A, B₁₂, iron and zinc), there is a perception that beef contains large amounts of fat which is rich in saturated fatty acids (SFA). Although the fat content of beef does actually vary considerably depending on the cut and degree of trimming, and lean beef typically has a low fat content (2-5%), over recent years there has been a move towards trying to change the fatty acid profile of beef to enhance health.

Diets high in saturated fatty acids are believed to be associated with an increase in heart disease risk, whereas replacing dietary SFAs with mono- (MUFAs) and polyunsaturated fatty acids (PUFAs) reduces heart disease risk. Whilst it has been recognised for some time that diets high in the essential omega-6 PUFA are important for reducing the risk of heart disease, in recent years there has been an increasing focus upon the role of long chain omega-3 PUFAs in health and disease. Of note, it has been suggested that they may help to reduce blood pressure and blood triglyceride (fat) levels, and thereby protect against heart disease.

It has been suggested that the ratio of omega-6:omega-3 fatty acids is important in determining heart disease risk. The ideal ratio required for health is thought to be 5:1 (omega-6:omega-3). Currently, dietary intakes of omega-6 PUFAs are within recommendations, however the ratio of omega-6:omega-3 is too high. Therefore, increases in omega-3 intakes are required to shift this ratio of intake to within recommendations suggested for health benefits. Whilst beef is a source of SFAs, it also contains

varying amounts of both MUFAs and PUFAs, including omega-3 PUFAs. It is also a source conjugated linoleic acid (CLA), a group of isomers of linoleic acid (an omega-6 PUFA). The *cis-9, trans-11* form of this isomer represents 70% of the CLA in beef, and has been shown to possess anticarcinogenic and antiarrhythmic effects. It is for these reasons that the ProSafeBeef project is focusing efforts to improve the nutritional quality of beef by increasing the concentrations of the omega-3 PUFAs and CLA.

Manipulating the PUFA content of beef: the current situation

Many factors can have an impact upon the fatty acid profile of beef, including the breed of cattle and growth rate. It is however the diet of cattle that has the greatest impact, and dietary modification is therefore the main tool that has been used to enhance the nutritional profile of beef. However, dietary manipulation is made difficult due to saturation (biohydrogenation) of dietary PUFAs in the rumen of cattle, and altering the diet can lead to increases in MUFA deposition. This should be kept in mind when discussing attempts to modify the fatty acid profile of meat.

Forages such as grass and clover contain a high proportion (50-75%) of the



omega-3 fatty acid linolenic acid. Feeding fresh grass therefore results in higher concentrations of omega-3 PUFAs in meat. Both the proportion of grass in the diet, as well as the length of time grazing, lead to beneficial changes in the fatty acid profile of beef. Further attempts to improve the omega-3 profile of meat have seen the inclusion of fish oil (a very good source of the essential fatty acid) in sunflower oil-based supplements for grazing cattle, which also increases the CLA content of meat. Whilst the main source of supplementary fatty acids are plant oils, oilseed and fish oils, the amount that can be included in the diet of cattle is limited, due to problems of impaired ruminant function. To avoid such problems, supplementation with liquids protected from rumen biohydrogenation is now being investigated. Infusing omega-3 PUFAs into the small intestine raises the possibility of being able to markedly increase the concentration of omega-3 PUFAs in beef. A variety of different processes have been used to attempt to do this, including using intact oilseeds, heat/chemical treatment of intact processed oilseeds, chemical treatment of oils to form calcium soaps or amides, and emulsification/encapsulation of oils with protein and subsequent chemical protection. Using this latter method, it has been shown that a protected plant oil supplement is able to favourably shift the omega-6:omega-3 ratio in the direction of increasing omega-3 intake, whilst maintaining a high MUFA:SFA ratio.

Manipulating the CLA content of beef: the current situation

CLA is formed during the biohydrogenation of linoleic acid in the rumen, and therefore ruminants are the only 'natural' source of CLA. The primary source of CLA is endogenous synthesis from vaccenic acid, and therefore maximising vaccenic acid in the diet is the main route by which to increase

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CLA. Diets containing a high proportion of grass increase CLA concentration in meat, as does adding oils seeds, vegetable oils and fish oil to the diet. Whilst the amount of CLA in meat is still relatively small, clarification of the daily requirement for human health benefits is an area currently under active investigation.

ProSafeBeef

Whilst progress is being made to enhance the nutritional quality of beef products, it is important to use a multidisciplinary approach to take into account other factors associated with these new technological developments. For example, increasing PUFAs in beef may compromise animal health, and may also lead to the potential development of unhealthy oxidative products and reduced colour stability. These factors in turn may lead to an undesirable reduction in shelf-life, with associated economic losses.

Fundamental information on ruminal lipid metabolism and on the control and/or prevention of ruminal hydrogenation of dietary lipids arising from research within *ProSafeBeef* will facilitate the production of beef with a greater enrichment of "healthy" fatty acids. The project hopes to define strategies for industry on how to optimise nutritional, sensory properties and oxidative quality of beef products, by combining enhancement made in the live animal together with target levels of functional ingredients to be added during processing. This will enable beef to compete more effectively with other parts of the food industry where healthier, more convenient, value-added options are commonplace.

References

This information is a summary of an article published in *Nutrition Bulletin*. For further information, please see: Molony AP, Scollan ND & Miles L (2008) Enrichment of *n*-3 fatty acids and conjugated linoleic acid in beef. *ProSafeBeef. Nutrition Bulletin* 33(4): 374-381



The ICOMST ProSafeBeef symposium: Advancing beef safety and quality through research and innovation

On Friday 21st August 2009 a half-day ProSafeBeef symposium was held as a satellite session to the ICOMST 2009 conference. The symposium, held in Copenhagen, Denmark, brought together key scientists from each of the Pillars, to present their work on the project so far and findings to date. Delegates were able to hear about a broad range of topics on the day, with sessions covering consumer research, beef safety and emerging developments and innovation in healthy beef.

Mr Declan Troy, Project Co-ordinator from Ashtown Food Research Centre, opened the symposium, by presenting an overview of the project. Mr Troy began by summing up the background and motivation for this project, including highlighting the importance of beef to the EU, before going on to stress the challenges faced by the beef industry. The beef industry is one that is highly sensitive, commodity driven, and there must be an increasing focus on innovation and added value in order to remain competitive. The *ProSafeBeef* project has outlined a number of objectives which must be achieved over the next five years in order to help overcome some of these obstacles, which include contributing to the sustainable development and competitiveness of the sector, and trying to improve consumer confidence in the area.

Session one opened with a talk from Dr Geraldine Duffy, Pillar 1 leader. She discussed the well-recognised

problem of bovine to human transmission of micro-organisms, some of which may be pathogenic and cause illness (eg. E.coli 0157). Using newly developed Quantitative Risk Assessment Models, the project is hoping to be able to assess the current level of risk posed, the impact of novel intervention on overall reduction of microbial risk, and for setting performance objectives in the beef chain.

Dr Martin Danaher, also of Teagasc, Ashtown Food Research Centre, next discussed the current state of the art technologies used for detecting chemical contaminant residues in beef. Workpackage 1.4 is looking to investigate the risk to consumers posed by anti-parasitic drug residues in beef. Using newly developed multi-residue technology the presence and quantity of these agents in beef can now be identified. Whilst the results have identified closantel as the most

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prevalent residue in beef, residue levels are typically below that which pose a risk to the consumer.

Dr Wim Verbeke, from Ghent University, Belgium, and Pillar 5 leader, gave the final presentation of the first session, on consumer interest in beef safety and safety information. The information he presented is discussed in further detail in this newsletter (see *New research on consumer attitudes to beef*). This work raised considerable interest from conference delegates, and the information generated from such research will no doubt be of use to the work of all Pillars of the project.

Session two began with another discussion regarding European consumers' perception of beef, with findings presented by Dr Marcia Dutra de Barcellos, Aarhus University, Denmark. This presentation again touched upon the focus group research conducted within Pillar 5 of the project, highlighting the fact that consumers often expressed healthy beef as being associated with a bias towards a 'romantic view', a concept of the traditional grass-fed beef, raised

outdoors with natural food. Encouragingly, meat was considered to be a component of a healthy diet by participants in all countries, including being a good source of protein and iron.

Professor Nigel Scollan next discussed the desire shown by an increasing number of health conscious consumers for healthier, more nutritional and more functional food products, with a particular interest in the fat content of foods. Much work is being done in *ProSafeBeef* to alter the fatty acid composition of beef (see *Improving the nutritional quality of beef*). One of the biggest influences on the fatty acid profile of beef is the extensive metabolism of dietary fatty acids in the rumen. In this process polyunsaturated fatty acids (PUFAs) undergo hydrogenation to saturated fatty acids, and this is one of the main explanations for the highly saturated nature of beef fats. It has, however, been noted that feeding cattle the legume clover relative to grass reduces this biohydrogenation process, leading to a higher PUFA content of meat from animals grazing on this. It is hoped that research as part of *ProSafeBeef* can also help to identify other factors which may impact upon

this process in the rumen, to help improve the fatty acid content of beef meat.

Consumer acceptance was again discussed in the penultimate presentation of the day, given by Dr Oydis Ueland of Nofima Food. Research indicates that consumers have a traditional view when it comes to meat consumption, and levels of processing are inversely related to perceived quality and value. A quantitative study using eight focus groups, with a total of 65 beef consumers, was undertaken to evaluate beef meat processing technologies. Participants indicated that they would be likely to reject all beef processing technologies of an invasive nature, and that they believe technologies that seemingly enhanced eating quality of low quality meat were done to increase food industry profitability, and not always to enhance the eating quality for the consumer. However, they did support non-invasive technologies, particularly if the value added is perceived beneficial to the consumer.

The final presentation of the day was given by Dr Alain Kondjoyan from Institut National de la Recherche Agronomique, France. Dr Kondjoyan discussed the role of heterocyclic amines (HA), carcinogens formed in trace amounts in cooked muscle. HA are formed when temperature increases, and meat has been identified as an important source. Work within *ProSafeBeef* aims to be able to give a more accurate prediction of consumer exposure to HAs when eating meat, and also to optimise roasting and grilling to obtain cooked meat pieces which keep the traditional aspect of cooked meat whilst keeping HA production down. After assessing different options of how best to do this, it is thought that the best way to achieve this is to combine the kinetic approach to the prediction of temperature and water activity 'in the crust' which develops at the meats surface during grilling and roasting.



University of Copenhagen

Training Exchange Programme

As part of *ProSafeBeef*, students and early stage researchers working on the *ProSafeBeef* project at the many universities involved in the project are given the opportunity to undertake an exchange placement. Here, two students who have completed this exchange talk about their experiences.

Marcia Dutra de Barcellos

What was your background prior to going on the exchange programme?

I am a Post Doctoral Researcher in Denmark (Aarhus University, MAPP Centre). Originally, I am from Brazil. I have a PhD diploma in Agribusiness. My research areas are food marketing and consumer behaviour.

What is your role in the *ProSafeBeef* project?

I work in Pillar 5 – Consumer Issues. I undertook many activities within Pillar 5 in 2008, including the organisation of the qualitative focus groups. The focus groups discussions with beef consumers were held in the UK, Spain, Germany and France. Data analysis and reporting were also tasks I actively participated in.

Where did you go for your exchange and for how long?

I went to Gent, Belgium (Ghent University) for training.

What did you do on your exchange programme? What type of training/techniques did you do? Who did you work with?

The training was with software called NVIVO. The software was used to analyse the qualitative data we obtained through the focus groups. Myself and another colleague from MAPP centre participated.

What did you learn from the programme? How do you feel this will help you in your future career?

The training was fundamental for the completion of the research tasks assigned to our pillar. Consistent results were obtained through the training and knowledge transfer of the participants. It is a very useful software for qualitative research, and I am now able to master it.

Kaye Burgess

What was your background prior to going on the exchange programme?

I did my PhD in the Department of Microbiology at University College Cork where I focused on the molecular characterisation of riboflavin metabolism in lactic acid bacteria. Subsequent to this I have been employed as a Research Officer in the Food Safety Department in the Teagasc Ashtown Food Research Centre (PSB Partner No 1) in Dublin. I participated in the exchange programme as an early stage researcher.

What is your role in the *ProSafeBeef* project?

I am involved in Pillar 1 of the *ProSafeBeef* project. More specifically I am working on Workpackage 1.2 which is focused on the persistence of key microbial pathogens in the beef chain. In particular I am investigating the molecular basis for pathogen virulence and stress adaptation in beef, in order to understand how pathogens survive and adapt to measures put in place to prevent their survival in the food chain. My work is currently focused on verocytotoxigenic *E. coli* (VTEC), a pathogen which can cause severe and life threatening illness in humans and whose main reservoir is cattle.

Where did you go for your exchange and for how long?

I spent four weeks in the Produce Safety and Microbiology Research Unit in the Western Regional Research Center of the United States Department of Agriculture

(USDA) Agricultural Research Service (PSB Partner No 41) in Albany, California.

What did you do on your exchange programme? What type of training/techniques did you do? Who did you work with?

While there I worked with Dr Rob Mandrell, Dr Craig Parker and Mr Steven Huynh. The objective of my exchange was to use whole genome microarrays to investigate genomic diversity among 76 VTEC isolates (*E. coli* O157, O145, O26 and O103) obtained from the Irish beef chain. I was fully trained on the techniques necessary for performing whole genome arrays of *E. coli* O157. This included preparation of the DNA, labelling of the DNA with fluorescent dyes, hybridising the labelled DNA to array slides and subsequent washing of the slides. I also learnt how to scan the slides and analyse the array scans. The information which has been obtained will facilitate the selection of strains with differing gene profiles and isolation points in the beef chain. These strains will be used in subsequent fitness studies to examine the relationship of virulence and stress response.

What did you learn from the programme? How do you feel this will help you in your future career?

As well as the vast amount of information obtained from the experiments I did while on the exchange programme, I also learnt a powerful new technique which I hope to be able to introduce to our own laboratory to further enhance our research capabilities. Further to this I would also hope that the exchange period will pave the way for future collaborations between the partners.

Update on opportunities for new exchange programmes

Proposals for training and exchange programmes within *ProSafeBeef* can now be made at any time. If you would also like to enjoy the benefits of an exchange programme please contact Catherine Souty-Dametto by email (catherine.dametto@adiv.fr) for further details.

Upcoming events: dates for the diary

Forthcoming dissemination activities

Hungary (before the end of 2009): Meat companies.

Subjects proposed: Good practises in slaughterhouses (pillar 1 and 2), muscle profiling and marination (pillar 4).

Upcoming event organised by the Competitiveness Cluster InnoViandes

On the 17th and 18th of November 2009 in Clermont-Ferrand, France, the first bi-annual European innovation conference MEAT'IN, dedicated to the meat and meat products industry, will be held. Participants at this event will mainly be industry representatives and their sub-suppliers and research partners.

The event will feature general conferences, workshops and an exhibition area. Its aim is to highlight meat companies and successful innovation projects, and it will enable exchanges between companies and research partners in order to boost innovation. During this event the European network MEATEAM will give several presentations. The network is composed of members from Spain, Italy, Denmark, Ireland, Norway, Hungary and France.

ProSafeBeef, Advancing Beef Safety and Quality through Research and Innovation: European Framework Programme 6: (FOOD-CT-2006-36241)

More Information

For more information on ProSafeBeef please visit our website at www.prosafebeef.eu or contact Robert Mooney, Project Manager, at robert.mooney@teagasc.ie.

ProSafeBeef is an Integrated Project supported under the 6th Framework Programme of the European Union.

It involves 41 leading research and industrial organisations working in 18 different countries.

ProSafeBeef is a five year project which commenced on March 1st 2007.



Ashtown Food Research Centre

