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PATHOGEN COMBAT

Preventing future pathogens throughout the food chain

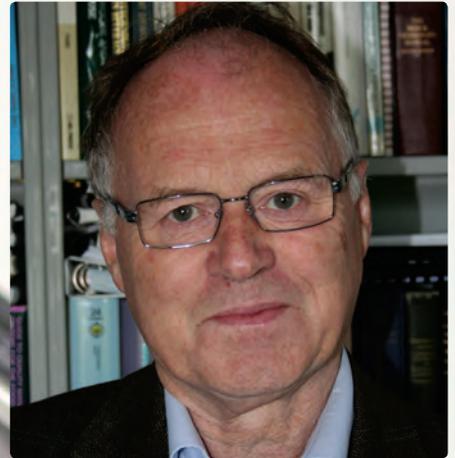
VEG-I-TRADE

Governing a supply chain of uncompromised food sovereignty



Welcome approach to safer foods

Professor Mogens Jakobsen, project coordinator of the PathogenCombat project, explains the aims behind the fight for food free from pathogens



Can you explain a little about the background of your research project, its aim and where the concept came from?

PathogenCombat is a FP6 EU IP project about fighting pathogens to reduce and control food-borne disease. The full title of the project is: 'Control and prevention of emerging and future pathogens at cellular and molecular level throughout the food chain'.

Considering food safety, combating of pathogens is of utmost importance to the consumer and of huge significance to the food industry and economy, as impact on trade and competitiveness is substantial. Despite significant investment, the incidence of food derived disease is still too high in the EU. Further, there is no sign of a reduction in the number of incidences. In order to approach the omnipresent threats from new and emerging pathogens, PathogenCombat aims at fighting pathogens across the entire food chain. The concept of the project is that the food industry should be provided with means and methods to produce food free from pathogens.

What are the most common pathogens in food-borne diseases?

According to (EFSA) *Campylobacter* and *Salmonella* (both Gram-negative bacteria) are still the main causes of bacterial food borne disease in Europe. Based upon the number of incidences recorded the real number is estimated to exceed several million per year – number illustrating the huge cost involved.

How have the project developed functional cell models to replace laboratory animals, and why was this necessary?

It is our Slovenian Partner at University of Maribor who has developed the three functional cell models we are working with in the project. The cell models have been derived from respectively the pig, the ruminant and the chicken intestinal tract. It is the wish of all scientists to have access to novel tools in risk assessment and at the same time spare the

lives of as many laboratory animals as possible, both for ethical and financial reasons. Using cell models is a win-win situation.

What is the new approach to estimating viability and virulence of pathogens through the food chain?

Protocols for PCR-DGGE (Denaturing Gradient Gel Electrophoresis) and FISH (Fluorescence in-situ Hybridisation) have been developed and used for direct profiling of bacterial populations in food. RT-PCR, Q-PCR, multiplex PCR, specific nested PCR and Padlock systems have successfully developed and validated for detection of the pathogens included in PathogenCombat. Together with development of enrichment broths, "rapid" methods are made available, allowing detection of the pathogens in food after short enrichment periods i.e. 6-24 hours. These achievements are important as they make new faster methods for detection and quantification of pathogens available to the food industry. Compared to the conventional methods, which still are the officially approved "state of the art" methods, they offer significant advantages. They are faster, more specific and more informative as they provide information not only on numbers of cells but also on the presence of virulence genes and expression of functions relevant to virulence and persistence in the food chain. The detailed protocols are available on our website along with a number of scientific publications. Further detailed protocols were made available to the public as NewsFlash No5 issued on 22 April 2009 (www.pathogencombat.com / Newsflash archive). Use of the protocols in SMEs is being explored in collaborations between the SMEs and the Partners developing the protocols.

How do you expect the European food industry to react to any findings - and how quickly?

The food industry highly welcomes cost effective approaches to secure safe foods. No

food producer wants a food scandal. However it could take some time for the industry to become aware of the new findings this project has produced. It is also a matter of informing the regulatory agencies. Only through their acknowledgement of a need for altered or new techniques can the achievements of the projects be a success.

Why have dairy and meat products been targeted for emerging pathogens?

Dairy and meat products are in the project used as model systems, however the techniques and systems developed can be applied to all food products and could be used by all food producing companies.

Can you tell us if you faced any major challenges over the duration of the project?

Dissemination of the results to the food industry has been and still is a major challenge. Many SMEs are very small companies "who have produced their products the same way always" and it can be difficult to change their behaviour and attitude.

After five years of this project, what difference do you expect to make towards European food safety?

The project has obtained new information and new results as to how pathogens behave in the food chain and how they can be detected by rapid and specific methods, not only in reporting numbers, but also in their virulence. Together with other achievements like closing the gap between technology and hygiene it is becoming increasingly clear that PathogenCombat contributes substantially towards improving effectiveness and uniformity in reducing the prevalence of food-borne pathogens in European food and creates an important foundation for scientifically based food safety management in Europe.

Preventing spread of food-borne pathogens

PathogenCombat has addressed the widespread problem of diseases spread by food and food handling in a wide variety of novel ways. International Innovation found out more about an issue that affects us all

THE FEAR OF catching a dose of swine flu has, in recent months, focused minds across the world on basic-but-essential personal hygiene. Notices to wash hands have been placed in many workplaces, and those who come into direct contact with the public in all walks of life are making sure they keep regular supplies of bacterial wipes handy.

All this is very admirable, but it doesn't hide the fact that we are all at risk from pathogens every day – and not just from the ones that attract the most attention in the media. Food-borne diseases are prevalent across the world, and it is only stringent controls – particularly in Europe – that prevents recurring and widespread outbreaks of such diseases as caused by *Campylobacter*, *Salmonella*, *E. coli*, *Listeria* and various other pathogens, including viruses. That said, in the UK alone about 3.5 million people are affected by food-borne diseases each year, and across the world many millions, particularly in developing countries, face similar problems, quite often with fatal outcomes.

The EU 6th Framework Programme funded project PathogenCombat aims to make food safer and strengthen consumer trust by monitoring

and preventing future pathogens throughout the food chain. More specific objectives have included an improvement in detection methods and prediction of pathogens in the food chain, the development of functional cell models to replace experimental animals, hygienic design to close the present gap between technology and hygiene and implementation of new and improved food safety management systems and communication strategies for consumers, the food industry and regulatory agencies.

During the life of the project, which comes to an end next year, PathogenCombat has had to address some difficult questions in order to pursue its aims with the greatest efficiency. Which pathogens pose the biggest threat? How can they best be combated? What can industry do to prevent such risks and keep pathogens out of food? What do consumers know about the possible risks, where do they get their information, and how should this information be presented so that they can understand it? To find the answers, PathogenCombat harnessed the expertise and skills of researchers and industry members from 16 European states and Australia. Scientists from 24 reputed

universities, institutes and other research facilities, three industrial partners and 17 small and medium-sized enterprises (SMEs) worked across national borders in multidisciplinary co-operation and partnership.

Researchers were confronted with a myriad of reasons for the spread of pathogens from food to humans; an apparent gap between technology and hygiene, lack of precise and rapid methods for monitoring and understanding the behaviour of pathogens in the food chain, a need for novel methods for breaking the transmission of pathogens along the food chain and a lack of



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INTELLIGENCE

PATHOGENCOMBAT

CONTROL AND PREVENTION OF EMERGING AND FUTURE PATHOGENS AT CELLULAR AND MOLECULAR LEVEL THROUGHOUT THE FOOD CHAIN

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efficient food safety management systems which also address the role of human behaviour in the food chain.

In order to identify and eliminate pathogens through the food chain, researchers and partners from industry had to solve a considerable number of tasks. Anyone who wants to combat food-borne pathogens effectively has to know more about them and be aware of which factors in the food chain control their viability, persistence and virulence. They have to develop or improve fast and highly specific tests for detecting pathogens and assessing not only the number of pathogens, but also their virulence in good time. As mentioned, one important task was to develop functional cell models which would enable the replacement of some of today's controversial animal experiments to understand how pathogens interact with humans and farm animals. Of particular interest to industry is the development of hygienic design and new processing technologies to prevent settling and spreading within the food chain.

One interesting outcome of the research was a questionnaire aimed at basic good kitchen practice, and while it has long been suspected that food poisoning is picked up from poor hygiene in restaurants and take-aways, in many cases, it is actually linked to our own behaviour in domestic kitchens. A survey was carried out in the UK, Denmark, Spain and Poland to determine what constitutes good hygiene in different countries, finding out how meat is stored and cooked and how utensils are cleaned, among many other questions.

Respondents were also asked whether they had heard of 11 micro-organisms, including some of the most commonly known, and those least talked about. In the UK, respondents' knowledge of such micro-organisms was generally limited to three main pathogens, namely, *Salmonella*, *E. coli* and *Listeria*. However, those in the three other countries could only define one pathogen each, indicating that much better knowledge of pathogens through various levels of advice and information is vital for the maintenance

and development of high levels of food safety. Interestingly, the Poles and the Spanish put greater trust in small, independent food shops to provide them with safe food than the proportion who trust supermarkets to do so, while the Danes and the British demonstrate a reasonably high level of trust in food producers, processors, retailers and regulators of all types.

PathogenCombat was keen to get small and medium-sized (SMEs) companies involved in the project, not only because SMEs represent 99 per cent of the total number of companies in the EU but also because the vast majority of suppliers along the food chain are of such description. The project aimed to set up a network among SMEs which would disseminate results and information which, it is hoped, would help a wide range of European businesses to produce food with no, or acceptably low, levels of pathogens, so giving SME food producers and processors an economic advantage. The SME network will also link with regulatory agencies in Member States and the European Food Safety Authority (EFSA), and the exchange of experience and information will be supported on the project's website, www.pathogencombat.com

As demonstrated above, the project's strong practical relevance and orientation is undoubtedly one of its outstanding merits. For example, the researchers have not only gained new insight into food-borne pathogens and their prevention, detection and specific combat but have also put great effort into enabling this newly acquired knowledge to be implemented quickly within the food industry.

After nearly five years of hard work, a multitude of results is gradually being put together like a mosaic to form a complete picture, a harmonious whole. It is becoming increasingly clear that PathogenCombat contributes substantially towards improving effectiveness and uniformity in reducing the prevalence of food-borne pathogens in European food and creates an important foundation for scientifically based food safety management in Europe.



PathogenCombat
for safe food



Fresh produce puts safety first

Dr Mieke Uyttendaele discusses her latest project, which has been set up to assess the impact of climate change and globalisation on safety of fresh food products

With the aid of Liesbeth Jacxsens, Imca Sampers and Pieterneel Luning

Firstly, could you explain the main aims and objectives of VEG-i-TRADE?

The demand for convenient, healthy and tasty food has grown. Global trade with stakeholders in many different countries makes the management of food safety more difficult. Concerns have emerged with regard to the safety of fresh produce in response to recent disease outbreaks and emerging risks linked to fresh produce and derived food products. In addition, climate change and associated extreme weather events may affect global sourcing and logistics and pose new food safety challenges. This highlights the need for timely scientific advice to guide risk management decisions. VEG-i-TRADE will provide the first comprehensive integrated impact assessments of farm to fork systems and food safety for different scenarios of climate change.

In what way will the project output help to establish a discussion forum for stakeholders in the global food chain, and what issues is this likely to reflect on?

Factors such as consumer pressure, protection of brand image, more strict food regulations, and outbreaks that demonstrate the vulnerability of the fresh produce chain to microbial and chemical hazards, have all culminated in the introduction of strict food safety standards that put pressure on the actors in the fresh produce chain.

Assistance to those involved is focused on strengthening capacities in knowledge and skills, enabling them to respond in accordance to their own contextual factors, such as proper culture, infrastructure, climate, making implementation of food safety demands difficult. One objective of the VEG-i-TRADE project is to strengthen international collaboration through scientific cooperation to encourage useful recommendations on good practices and quality assurance in the fresh produce supply chain and thus encourage exchange of information to enhance dialogue between trade partners in the global food market.

Who is set to benefit from the information and platforms VEG-i-TRADE provide? Could policy makers and governments be interested in the assessments you offer?

New analytical methodology to be developed for biological and chemical hazards can be taken up by competent authorities for monitoring and surveillance. The diagnostic tool to be developed for performance measurement and

identification of bottle necks in food safety management schemes as well as the risk based sampling plans may serve the food business operators including processors, retailers or trade organisations. Data collection of handling practices in fresh produce and water used for production or processing in several regions of the world may serve as a baseline to help set guidelines of 'best practice'. Risk assessments will provide a scientific basis for development and adoption of food safety standards by food policy makers. These risk assessment models may be used for scenario analysis of trade flows and climate change and thus allow an a priori assessment of the effect of intervention measures or adaptation scenarios to be evaluated by food policy makers. Finally, research on best practice for risk communication to the consumer is foreseen and strengthened dialogue with the consumers and stakeholders will result in improved awareness of potential emerging hazards associated with fresh produce whilst also highlighting improved strategies and efforts in place for assuring the safety in the food chain.

With much of Europe's food coming from developing countries, how can both local and foreign producers work side by side whilst maintaining the concept of 'food sovereignty'?

As global trade continues to expand, developing countries have embarked on seizing the thriving opportunities in the fresh produce market. However, this has implications for food safety within countries importing these products as safeguarding the quality of Europe's food is a commitment to consumer health. Guaranteeing food supplies of unprecedented quality and safety is an investment in the local and global economy and takes advantage of emerging trading opportunities in the global fresh produce market. This should be combined with enhancing benefits to the developing countries' national agricultural policies and improving access to safe, nutritious and culturally appropriate food in sufficient quantity and quality for domestic consumption. In the concept of 'food sovereignty' food imports must not displace local production nor depress prices and work. The diversity of products, practices and problem solving strategies internationally provides a robust setting to develop adaptation scenarios, overcome global change and keep the fresh supply chain both safe and profitable. The ethical management of VEG-i-TRADE will keep this principle at the fore and will lead discussions with the scientists throughout the research work.



Safer fresh produce for a healthier world

By encouraging global collaboration in studies of safety standards for fresh produce, the new EU research project **VEG-i-TRADE** seeks to create and govern a supply chain of uncompromised food sovereignty

WITH THE RAPID growth in recent years of diet related illnesses such as diabetes, western societies have become increasingly aware of the importance of eating a balanced diet that includes a high level of fresh fruit and vegetables. This has necessarily led to a greater demand for good quality fresh food products. However, due to recent disease outbreaks attributed to fresh produce, international, European and national concerns have begun to emerge about the current safety guidelines regarding such produce.

In June of this year, the VEG-i-TRADE project, coordinated by Dr Mieke Uyttendaele, was launched to address such concerns by proactively investing in problem-solving technologies for safe produce. Previous research has indicated that more advanced food safety management systems (FSMS) are required in order to realise a good safety output. In addition, the complexity of the international food supply chain, constraints in national and international food legislation, the unpredictability of climate conditions, and the conflicting interests of industrial and governmental stakeholders, entail demands on the horticultural safety management systems (HSMS) that operate in a global context.

VEG-i-TRADE therefore seeks to develop a diagnostic instrument to assess the performance of FSMS in operation. Application of this new tool will provide insight into the strengths and weaknesses of current HSMS of different actors within the fresh produce chain. This knowledge will be used to develop strategies for improvement specific to the different subjects in order to realise a sustainable assurance of food safety. With the involvement of multiple non-

EU partners, there is heavy emphasis within the project objectives for global collaboration at all levels, as Uyttendaele explains: "The diagnostic instrument in the VEG-i-TRADE project will be dedicated to all actors in the fresh produce chain and will also address factors that will prevail when considering the global situation".

ASSESSMENT AND APPLICATION

The overall objective of VEG-i-TRADE is to identify and monitor anticipated risks related to bacteria and viruses, mycotoxins and the issue of pesticide residues in the fresh produce chain. It aims to develop adaptation scenarios and control measures of a managerial and technological nature to assure safety in the food chain.

The systematic assessment of the performance of current farm/company specific HSMS, using a diagnostic instrument, will provide input on the riskiness and the variability in product and process characteristics, organisational, and contextual aspects in various climate regions. This includes observational studies and analytical lab testing for data collection. Field studies will be undertaken to examine relationships between pre- and post-harvesting technological interventions such as packaging concepts, water treatment and production practices and their impact on plant physiology, microbial ecology and related food safety issues. To provide the link between hazard control and consumer risk, the team will use risk assessments which will be undertaken for defined case studies for both selected microbial and chemical hazards. Proactive model development and integration is undertaken and this is the basis for simulation of adaptation scenarios.

Analysis to evaluate food safety of imported products which are overall safe and thus show low prevalence of hazards is costly. Consequently, sampling plans will be risk-based, aim for a maximum cost to benefit ratio and will consider the shift of risks due to these changes in supply chain and climate.

Based on expertise gathered in VEG-i-TRADE, risk-based sampling schemes will be constructed based on all relevant factors: toxicological properties of the hazard; type of crop; consumption data; and vulnerability to food safety hazards. Before risk-based sampling plans can be developed, knowledge about the behaviour of the hazards in the logistic chain, and possible interference of packaging techniques of fresh produce, needs to be established. This will also help decide which hazards should be analysed and at what stage in the supply chain.

Water quality has a significant impact on the quality and safety of fresh produce. Data collection on the source and the quality of various types of irrigation water and water used in processing will serve as a basis for scientific recommendations on standards for water in the fresh produce chain. The main objective is to examine existing and innovative technologies serving as intervention strategies to improve the quality of water at both pre-harvest and post-harvest stage. From this research, a tool will be developed to provide guidance on the appropriate technology for treatment of water in the fresh produce chain.

GLOBAL COLLABORATION

VEG-i-TRADE comprises a well-balanced spectrum of 23 partners from universities,



research institutes, SMEs and industrial partners. Amongst the latter are players that cover the whole spectrum of the fresh food industry: growing; sourcing; marketing; distribution as well as multiple water treatment technology providers. They provide a network for field studies and input on practical experience on current practices, food safety issues and logistics in the world wide supply chain. They confront the researchers involved with the challenges and bottlenecks associated with global trade, the complexity of legislation and food safety standards and the effect of climate change on business. Furthermore, the partners provide a broad network and a continuous flow of research. Public workshops, dissemination activities and networking at events, as well as dedicated training programmes, such as summer schools organised in collaboration with other funding agencies, serve to further encourage the integration of individual business or organisations and stakeholders in the VEG-i-TRADE story.

Europe is currently the largest importer and exporter of food products in the world, so ensuring their food safety is a top priority for the EU. Thus, the project which benefits from funding by the EU's Seventh Framework Programme is thinking ahead to ensure food safety in an ever-changing world. Demonstrably forward thinking, VEG-i-TRADE is the first project that brings together experts from the fields of food safety and climate change. It is a multifaceted project combining exact and social sciences and careful integration between different disciplines. Essential to the project is its focus on strong international cooperation and the involvement of all stakeholders, supporting a coordinated but pragmatic approach of research.

As Uyttendaele indicates, the large European collaborative research framework is essential in order to provide solutions: "These issues cannot be tackled by individual research groups or regional funding alone. International cooperation is essential in dialogue and problem solving strategies need to take heed of cultural feasibility context to accomplish results".

CHALLENGES AND EXPECTATIONS

Once the scientific research is complete, the intention for VEG-i-TRADE is to identify risks in the fresh produce supply chain due to global changes and then to produce intervention strategies to tackle them. The challenge lies in encouraging scientists to work openly together in the approach for integrating scenarios of risk assessment, taking into account the various disciplines of food science, management and logistics, and climate change.

Another goal is to understand the variability of the fresh food production, processing and consumption patterns between all trade partners in the global economy. A further understanding of unexplored mechanisms of the contextual situation affecting the performance of control measures – and assurance activities in quality management systems – is essential in order to work on accepted and feasible recommendations to guarantee food safety throughout the global supply chain.

The intention is that VEG-i-TRADE will boost further research through the acquisition of personal mandates for PhD students from non EU countries from various funding agencies, and also act as a contact point on food safety in the fresh supply chain for stakeholders, international organisations and food policy makers.

The diversity of products, practices and problem solving strategies internationally provides a robust setting to develop adaptation scenarios, overcome global change and keep the fresh supply chain safe and profitable

INTELLIGENCE

VEG-i-TRADE

GOVERNING A SUPPLY CHAIN OF UNCOMPROMISED FOOD SOVEREIGNTY

OBJECTIVES

VEG-i-TRADE provides platforms to identify impacts of anticipated climate change and globalisation on food safety, microbiological and chemical hazards, of fresh produce and derived food products. Control measures of a managerial and technological nature will be developed in the supply chain of crop production, post-harvest processing and logistics to minimise food safety risks.

PARTNERS

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FUNDING

VEG-i-TRADE is funded under the EU Seventh Framework Programme

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