Developing biomarkers using omics technology to improve pork quality in the chain

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Newsletter

Q-PORK CHAINS

March 2010 - Number 6

Q-PorkChains
newsletter sixth edition

The Q-PorkChains Newsletter is published biannually on the public project homepage - **www. q-porkchains.org**. The objective of the newsletter is to disseminate news and new knowledge in the field of pig and pork production obtained from the Q-PorkChains project to stakeholders at all levels. The newsletter is divided into different sections specifically directed towards different target groups, i.e. Pig production, Industry, Consumer, Teaching & training and Science. Subscribe the notification at the homepage and receive the newsletter in your mailbox.

In this newsletter you can read about

- 220 experts present at the mid-term conference in Bonn.
- Evaluation of the sustainability of 15 contrasted pork production systems.
- New pilot and demonstration chains.
- Module V: Developing biomarkers using omics technology to improve pork quality in the chain.
- Ripening of fermented sausages by an advanced controller.
- New learning resource in the field of product development: From idea to commercialisation.
- Microbial risk assessment within Q-PorkChains.
- Alignment between chain quality management and chain governance in EU pork chains: A transaction-cost-economics perspective

New product development workshop in Poland

The overall topic of the training event in Poland is product development. First of all, the EU market trends for pork products will be specified. With regard to the target group which consists of polish meat industry representatives, the problems and challenges of the polish market will be presented by two polish scientists. By integration of the E-learning material, a concept on strategic product development will be used to work in an interactive way. In the run-up of the event the learning resource has been edited and adopted in collaboration with Module B, Module I and the University of Warsaw. Aspects like the features of the focused market, the working area, as well as the education level will be considered. For an interactive exchange of experiences, several discussion rounds are planned. Here the participants can ask questions and discuss the topics, as well as state their own opinion and experiences. The University of Warsaw is in this context represented by two advanced and experienced experts that are well known in the polish meat sector. These experts are also responsible for the establishment of the contacts with the participants.

READ MORE AT PAGE 11

Upcoming events:

May 26-28:
International Conference: Food Chains and Network Management (WICaNeM)
In Wageningen, The Netherlands.
Info: Contact Jacques Trienekens
See www.q-porkchains.org

Q-PorkChains is funded by 6th Framework Programme

220 experts present at the mid-term conference in Bonn

By Birger Pedersen

The international Q-PorkChains mid-term conference "Improving the quality of pork for the consumer" in Bonn on November 18th last year became a success. About 220 experts from 23 countries attended the conference, which was part of the 1st international "Meat Week" with events, workshops and seminars for experts from the meat industry and scientific community.

The conference was organized by GIQS and the foodnetcenter of the University of Bonn.

Chairwoman of GIQS, Brigitte Petersen, welcomed all the participants and emphasized the aim of the conference: Focus on three main topics a) chain to consumer, b) pork quality and novel convenient products and c) new breeding technology and sustainable farming.

Prior to presentation of the 13 speakers, coordinator of Q-PorkChains, Prof. Anders H. Karlsson from University of Copenhagen, informed, that 13 new partners from six different countries has joined the project during the last six months. Alltogether 62 partners now participates in Q-PorkChains. He also emphasized, that at present 46 procent of all meat consumed comes from pigs, and that the overall aim of the 5-year research programme is, that both the consumers and the industrial demands shall be fulfilled by means of the scientific work in Q-PorkChains.

Chairwoman Brigitte Petersen (University of Bonn and GIQS), Detert Brinkmann, (University of Bonn), and participants of the Bonn conference.

In this newsletter you can read the present state of research in different research areas.

Short papers from the conference can be downloaded from www.q-porkchains.org

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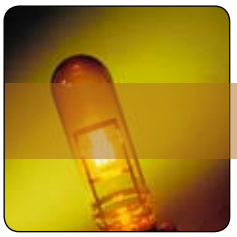


Scientific key activities

Research on consumer and citizen roles focuses on developing new tools for marketing and development of porkbased products.

Under primary production, the diversity, flexibility and sustainability (environment, economy, societal demand) of farm level production systems are explored.

Quality control focuses on development and application of new and appropriate molecular control tools in pork production.

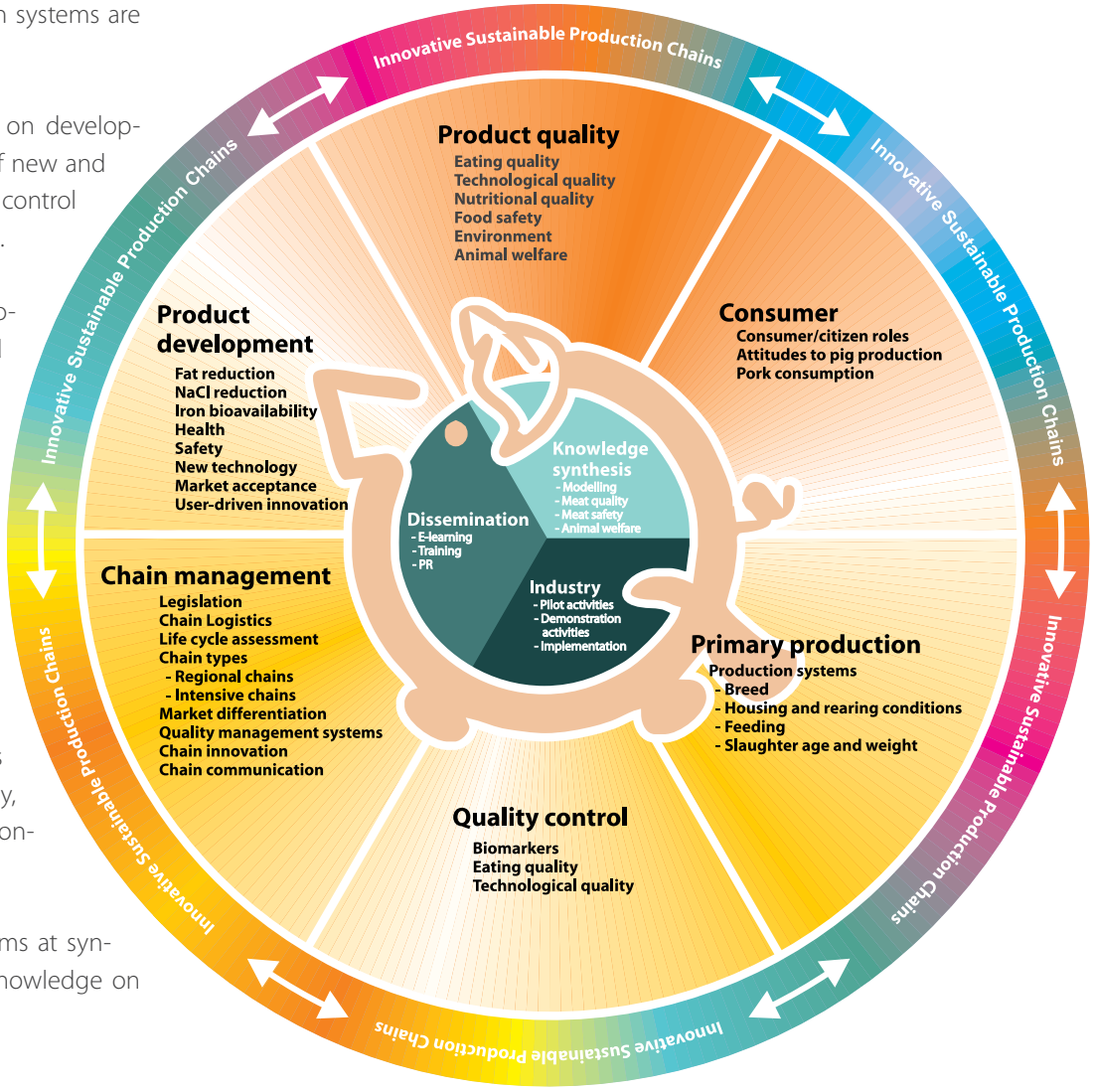
Chain management focuses on integrated quality management and logistic and sustainable network optimization.

Product development focuses on innovative technologies for improved pork products, which match consumer demands with regard to quality, safety, nutrition, and convenience.

Knowledge synthesis aims at synthesising the existing knowledge on pork quality, pork safety and animal welfare into prediction models.

The topic "Industry" aims at facilitating cooperation with Small and Medium Enterprises (SMEs) on pilot research and demonstration activities.

Dissemination of Q-PorkChains activities is undertaken via development of E-learning resources, training activities and general PR. An Open Learning Platform (OLP) containing a wiki on pig and pork production.



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Evaluation of the sustainability of 15 contrasted pork production systems

By Michel Bonneau

A group of scientists, led by Michel Bonneau from INRA in France has within Module II of Q-PorkChains begun research for assessing the sustainability of 15 contrasted pork production systems at farm level. This work is complementary to the studies on pork production chains that have been, and are currently being, developed within the module IV of Q-PorkChains. The aim is to increase knowledge on the strengths and weaknesses of the variety of pork production systems existing in Europe and to derive opportunities and possibilities for future development taking into account all the relevant issues of sustainability, namely economy, society and environment.

The 15 contrasted production systems are presented in Figure 1. In each of the 5 participating countries, 2 differentiated systems (differentiation is based on one or several claims, the main one being presented in Figure 1) are ▶

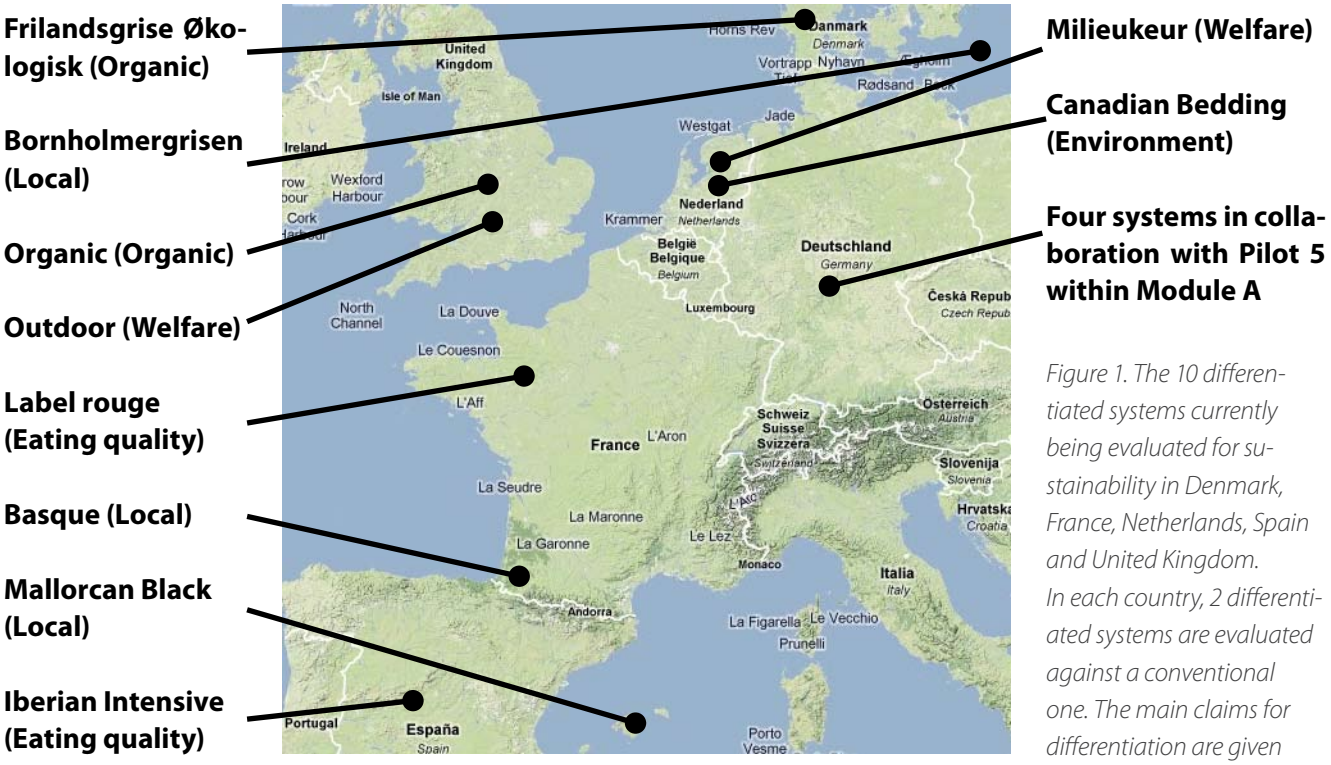

Figure 1. The 10 differentiated systems currently being evaluated for sustainability in Denmark, France, Netherlands, Spain and United Kingdom. In each country, 2 differentiated systems are evaluated against a conventional one. The main claims for differentiation are given between brackets

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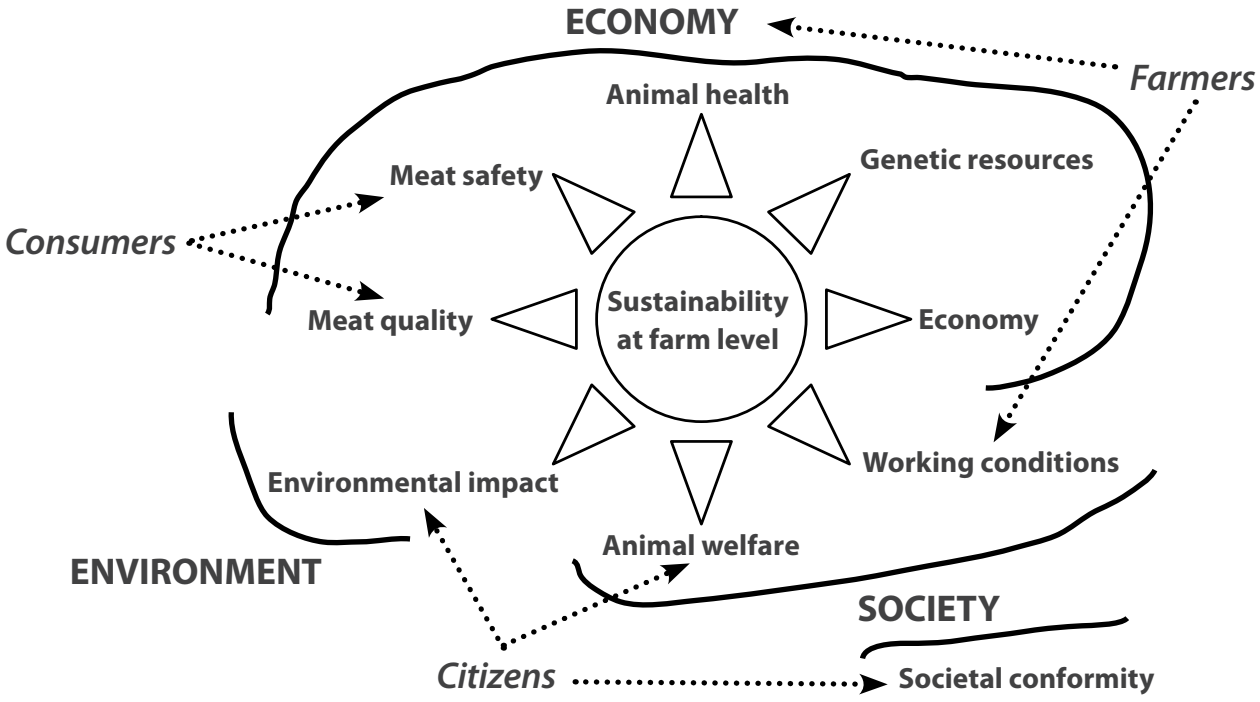
Pig production

- evaluated against a conventional one. The 15 systems were selected from an inventory of pork production systems existing in Europe that was conducted in 2008. In parallel to the inventory, a comprehensive survey of the available tools was performed under the supervision of Sandra Edwards, from the University of Newcastle (UK). This was finalised into a handbook of tools for the assessment of the sustainability of pork production systems at farm level which is currently being used for the evaluation of the above-mentioned 15 systems. The evaluation is multidisciplinary, as presented in Figure 2.

Further to the 15 systems selected from the inventory, three systems developed by a German farmer organisation will be evaluated, using the same tools, in close collaboration with Pilot chain 5 within Q-PorkChains Module A.

Data collection started in the autumn of 2009 and should be finished by March 2010. Data will be analysed in 2010, starting with dimension-wise analyses. A fully integrated analysis will then be conducted at the end of 2010.

Figure 2. The **dimensions** *evaluated in the handbook of tools and the corresponding* **ISSUES** *and most involved* ***stakeholders***



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New pilot and demonstration chains

By Christina Gawron

In Q-PorkChains newsletter no. 5 we informed about the selection of new industrial partners through a competitive call (March – May 2009). As the result of the decision process four new pilot and two new demo chains have been implemented in the project. The following table describes the content and the partners of the new pilot and demonstration chains:

Co-author: Maren Bruns

No.	Objectives	Description	Actors
Pilot 5 2010-2011	Implementation of sustainability aspects in the quality pork program of a regional chain.	The implementation of an innovative pig production system based on integrated sustainability criteria or sustainable breeding strategies ist he content of this pilot chain. Criteria - from the in Module II developed sustainability handbook – will be used to extend quality programme at farm level. Sustainability aspects are for example animal health and welfare, environmental impacts, genetic resources, human working conditions, meat quality, social conformity etc. The developed system in this pilot chain could be applied by other companies in the agricultural sector.	BESH, BDSH, INRA, Univarsity of Newcastle, GIQS e.V.
Pilot 6 2010-2011	Development of non invasive technologies for assessment of fat content in order to select good meat quality.	On-line, non-destructive technologies are in the focus in order to assess fat content of fresh loins and green hams from different genetic lines and carcass weights. The information about the fat content is very important regarding the amount of added salt, diffusion mechanisms, processing weight losses and the degree of salt concentration in the final product e.g. technical and nutritional topics. Therefore the results provided by the pilot chain are important for several companies within the pork processing sector, especially at abattoir or dry-cured meat industry.	Italcarni, SSICA, CRPA, Jamones Segovia, University of Bologna, IRTA, GIQS e.V.

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Pilot 7 2010-2011	Implementation of regional pork chain concepts and new pork product concepts.	The overall aim of the pilot chain ist o implement and evaluate new pork production concepts, as well as to identify key success factors of a regional production chain. The geographical aspects are from major relevance in the pilot chain. The partners in Germany and Greece will focus on the creation of innovative products such as souvlaki and gyros in Greece or sausages from a special regional German breed. Focussing on the communication of non-material characteristics (e.g. quality programmes) towards the customers is additionally very important.	Chiropal LTO, Gefsitexnia G.P., Iason SA, BESH, Nofima Mat, Wageningen University, University of Athens, GIQS e.V.
Pilot 8 2010-2011	Implementation of cold chain management to improve quality and safety of pork products.	Expected results of this ppilot chain are, on the one hand, the application of innovative temperature monitoring solutions based on the RFID technology by using wireless communication. On the other hand, optimal settings of cooling parameters during all cooling steps should be established and, besides this, guidelines fort he efficient and effective implementation of temperature monitoring systems in the meat supply chains will be developed to improve food quality and safety. With the help of these results, companies can optimize the cooling down of pork carcasses and, therefore, estimate the effect of cooling parameters during the process on remaining shelf life of the products.	GLS, Verdict System, University of Bonn, Wageningen University, GIQS e.V.

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Demo 1 2010-2011	Demonstration of a concept for harmonization of veterinary findings in centralized databases.	The harmonisation of veterinary findings should be the main result oft he demonstration chain. This will be achieved by creating standardised veterinary codes and thereby making veterinary findings comparable beyond individual slaughterhouses and regions. Official meat-hygiene supervision personnel will be supported be a software programme to collect and forward information most efficiently. By standardizing the databases structures, an improvement of data quality, as well as a consistent data management can be achieved to support all in the value-added chain involved parties.	H+P, University of Bonn, GIQS e.V.
Demo 2 2010-2011	Demonstration of biological markers as meat quality control tools.	The results of Module V „Molecular quality control" should be demonstrated tot he industry. Module V is identifying biomarkers associated with different expressions of genes (mRNA) and proteins that predict meat quality traits e.g. water holding capacity etc. Demonstration events on these biological markers will be organized with the aim to encourage SMEs to use Q-PorkChains results for further development or the implementation into the market (e.g. development of a rapid test based on biological markers to predict pork quality traits).	Aarhus University, Wageningen Universtiy, GIQS e.V.

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Module V: Developing biomarkers using omics technology to improve pork quality in the chain

By Marinus Te Pas

Q-PorkChains aims to improve the quality of pork taking the whole pork production chain into account. Dedicated modules investigate defined parts of the chain such as farm management, chain management, etc. Module V is a high technology module using omics technology. Omics research helps to understand the expression of the genome in cells from various tissues or organs under various physiological situations. In Q-PorkChains, the omics technology is used to improve the quality of food products through a better understanding of its biological bases. Our research first aims to find out relationships between genes expression level in muscle and fat tissues and subsequent pork eating and technological quality, and identify biomarkers of pork quality. Then, control tools (tests) will be developed to evaluate pig carcasses and pork quality in the industries.

Module V aims at relating gene expression at both RNA and protein levels to pork quality and using this knowledge to develop biomarkers that can be used to improve pork quality. Biomarkers may be used at any point in the pork production chain. Biomarkers may be specific for a single pork production chain or be useable in many chains.
What is a biomarker? A biomarker may be defined as a gene (mRNA or protein) with variation in expression that is related to variation in a trait (growth, pork quality, etc), and with a known relationship between expression and the phenotype of the trait: for example, pork drip loss, sensory tenderness etc.

The present status of the research in Module V

We started by taking samples from two experimental pork chains and several commercial pork chains. The experimental pork chains included one experiment aiming at investigating the effect and differential times of rest following stress on pork quality, and the other on different pig production systems in two contrasted genotypes on pork quality. The commercial pork chains included specific local and more conventional pork chains from Spain, Germany, Poland, and China. The mRNA or proteomics expression levels of these chains were investigated. These data resulted in several potential biomarkers.

What remains to be done to reach the goal

The biomarkers have been found (often) using one technology and one pork production chain. Thus, the results need first verification using another methodology, and then validation with more samples of the same and other pork production chains.
These experiments are ongoing.
Thus, if a biomarker is validated, a test need to be developed that can be used in an industrial setting. It needs to be fast and cheap, and the interpretation should be possible without specific scientific knowledge. It is important that we receive a pilot project enabling us to involve specific companies with specialized knowledge on this point. So, the final aim of Module V is that within two years the industry will have several tests to evaluate and thereby improve pork quality as the output of omics research.

Co-authors: M. Benedicte and Niels Oksbjerg

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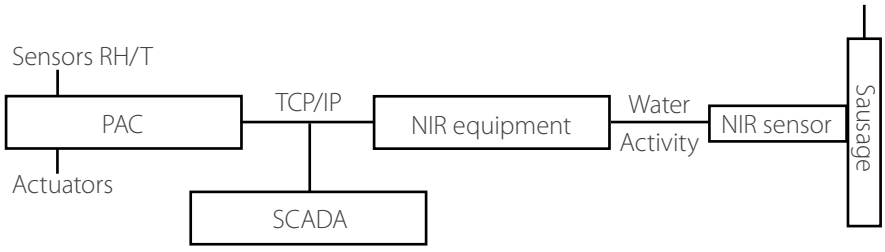
Ripening of fermented sausages by an advanced controller

By Jacint Arnau

Drying of fermented sausages requires the supervision of an expert who manually readjusts air temperature (T) and relative humidity (RH) set-point of the drying process, allowing obtaining the final desired meat product. An increase in T and a decrease in RH helps, among other factors, to accelerate the drying process, but there is a critical point at which an unwanted surface crust can develop due to the higher drying rate of the surface compared to the drying rate of the inner part of the product. In the Q-PorkChains project an on-line instrumental measurement of parameters related to the expert evaluation, which would be useful for the improvement of the control system to avoid crust formation has been studied. One of the most promising technologies for on-line product evaluation is near-infrared spectroscopy (NIR). It enables a rapid, simple, and simultaneous on-line determination of different meat properties on the surface, like moisture content and water activity (aW). An advanced controller, which processes information from the sausages Near-Infrared spectra (NIR) and from the drying air humidity and temperature probes, allowing calculating and modifying air relative humidity set-points during the drying process of the fermented sausages has been developed. The controller allows maintaining the required superficial water activity of fermented sausages and its proper drying process.



Figur 1: Scheme of the control system

Temperature and relative humidity sensors on the dryer

NIR measuring aW on the product

Sausages in the dryer

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New learning resource in the field of product development

From idea to commercialisation

By Anne Algers,

A new electronic learning resource that can be used for students and business has been developed and uploaded at the teaching and training platform www.porktraining.org

Strategic new product development (NPD) is central for the survival of many companies and gives direction to future innovation activities. Based on the research in Module I, a learning resource has been developed together with PhD student Jens Kügler from MAPP (Centre for Research on Customer Relations in the Food Sector). The learning resource focuses on the process from idea generation to product commercialisation. It also describes how NPD ideally combines both marketing strategy and technical development and how this process can be controlled.

Pork product quality is important for consumers. Their quality expectations are based on cues such as price, brand, taste, healthiness, convenience and information about production and process attributes. Today's consumer pays much attention to healthiness, convenience, sustainability and ethics. Q-PorkChains conduct research on every of these attributes and consequently, they are included as case studies in the learning resource "Strategic New Product Development".

Within the Q-PorkChains project several training and demonstration activities take place in order to disseminate the research results of Q-PorkChains. In the first training round, all in all, 10 activities in 5 different countries were performed. Results from module I-V and from pilot chain 1-4, as well as e-Learning material from Module B were integrated in the training activities.

To illustrate how such trainings look like, the upcoming event in Poland is explained in more detail:

Date: Summer 2010	*Location:* University of Warsaw
Type of activity: Lecture session/workshop	*Q-PorkChains research input:* Module I
Collaboration: University of Warsaw (external Q-PorkChains collaboration)	*Content:* Product development
Contact establishment: Danish Meat Trade College (DMTC)	*eLearning:* Learning Resource on "Strategic product development"

Download the leaflet from www.q-porkchains.org

By Christina Gawron

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Microbial risk assessment within Q-PorkChains

By Francis Butler

Within the Q-PorkChains project there is a small but active group working on microbial risk assessment of pork and pork projects. The project team consists of Biosystems Engineering, University College Dublin and Teagasc, Ashtown Food Research Institute, Dublin. The group carried out three separate risk assessments for Salmonella in the pork chain – a farm level risk assessment, an assessment of the slaughter / processing of pork and finally the group considered the risk from consumption of typical UK/ Irish fresh pork sausages.

This product was considered, according to Professor Butler, the leader of the risk assessment group, as it is a comminuted product so consequently the pathogen is potentially distributed right through the sausage and there is also a risk of undercooking by the consumer with the accompanying risk of illness from ingesting *Salmonella*.

While three separate risk assessments were developed within the Q-PorkChains project, this article focuses on the outcomes of the farm level risk assessment. The approach adopted in this risk assessment was a novel dynamic model using existing data from published literature that describes the dynamics of *Salmonella Typhimurium* in modern intensive pig farms. The study is the first approach so far to build a dynamic model for *Salmonella Typhimurium* at the compartment level of the pig farm based on sets of differential equations in order to predict the prevalence of different risk groups of pigs at the slaughterhouse, given the different load of the pathogen in the compartment. The basic concept of the model is shown in Figure 1.

Pigs are initially free of *Salmonella* (susceptible) but if exposed to the pathogen can become infected, either as high shedding pigs (high infectious) or low shedding (low infectious) depending on the environmental conditions. After being infectious for a period of time, the pigs stop shedding the organism but become carriers. Thereafter they become immune with antibody protection and finally they can become susceptible again when the immunity wears off.

By modelling this disease cycle, the model can predict the percentage of animals in each of the different categories at different stages in the pig

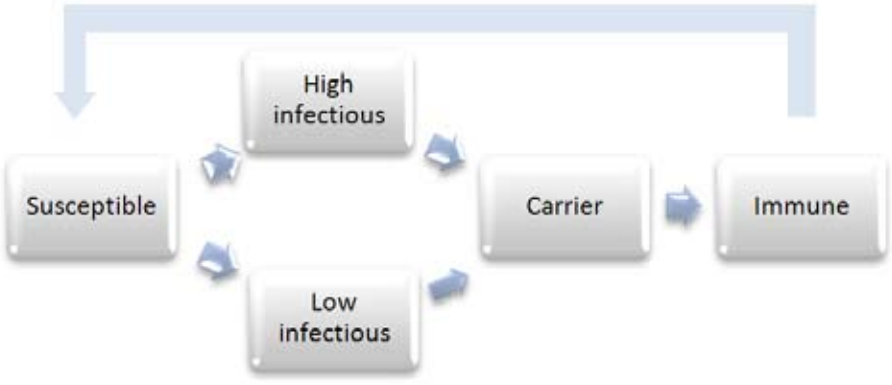

Figure 1: Conceptual representation of the farm Salmonella model

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production cycle. An example of the outputs of the model is shown in Figure 2 where the variation in the percentages of animals in the different categories with time is shown. Commenting on the outcomes from the risk assessment models, Professor Butler from University College Dublin concluded that it was important that good risk assessment models be made available through the Q-PorkChains project to risk managers so that they can objectively quantify the risk and, as important, properly assess the effectiveness of intervention strategies at key points in the pork food chain.

Salmonella is a pathogen of significant public health concern. A total of 190,000 cases of human salmonellosis were reported by 25 Member States in 2004 and the overall incidence in the EU was approximately 40 per 100,000 population. Pork, after eggs and poultry meat, is a major source of human foodborne salmonellosis in the European Union (EU). Consequently there is ongoing concern by the pork industry, regulatory authorities and other stakeholders to control *Salmonella* throughout the full pork food chain. EFSA is currently considering the risk of *Salmonella* in pork and it is opportune that the Q-PorkChains project has developed quantitative risk assessments of *Salmonella* in pork at separate stages in the food chain to allow a informed debate take place on the level of the risk and the role of intervention strategies at various stages in the chain to control the pathogen.

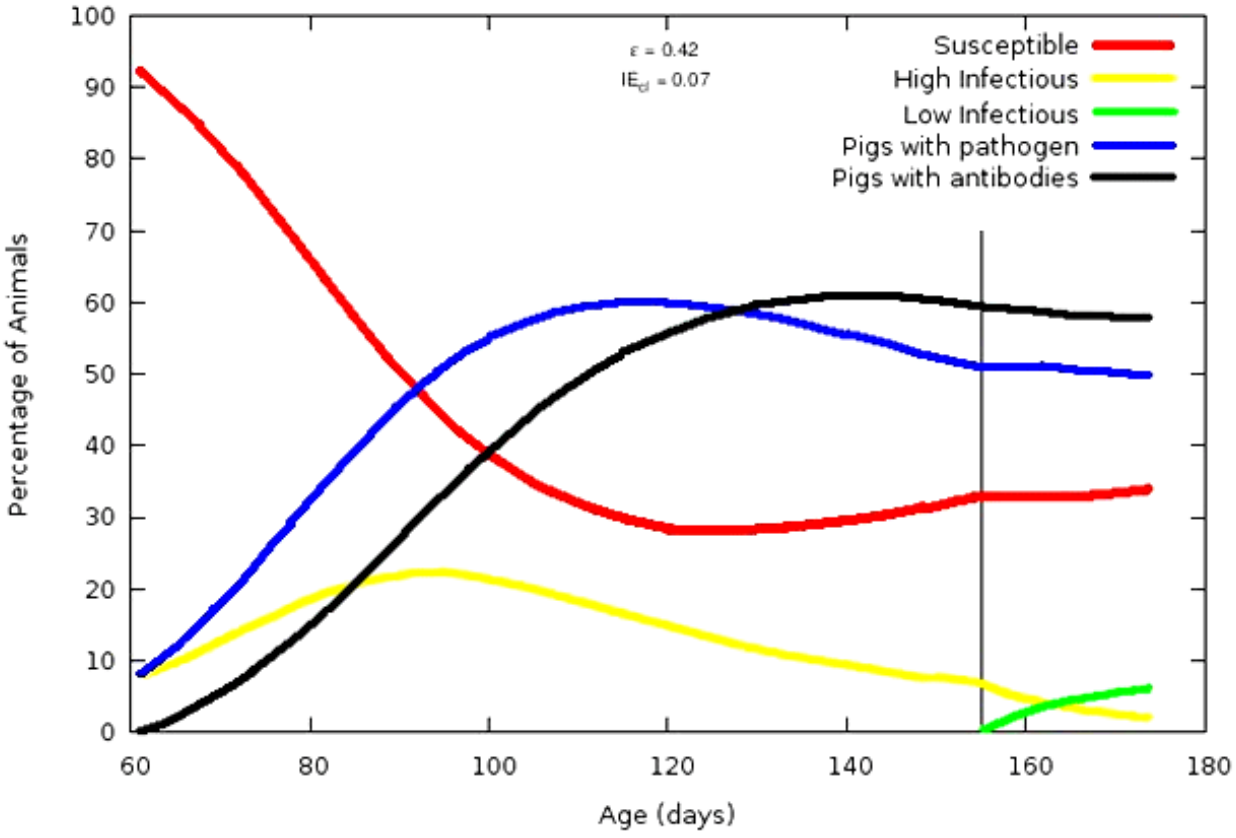

Figure 2: Typical output from the farm model showing the propagation of Salmonella Typhiminurum in a 'compartment' in a pig farm in a 'highly' contaminated environment

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Alignment between chain quality management and chain governance in EU pork chains

A transaction-cost-economics perspective

By Mark Wever

Inter-firm coordination of quality management systems is increasingly important for meeting end-consumer demands in agri-food chains. The governance structures needed to coordinate quality management systems, especially those applying to two or more stages of food supply chains, are not well studied, though. This work was performed to fill this gap, because proper alignment between governance structures (GS) and quality management systems (QMS) is expected to positively impact supply chain performance and lower transaction costs.

A peer-reviewed article was recently published (Wever et al. (2010), Meat Science, 84, 228-237) in which the relation between QMSs and GSs is empirically examined for pork supply chains. Transaction-cost-economic theory is used to develop propositions about the relation between three aspects of QMSs – ownership, vertical scope and scale of adoption – and the use of different types of GSs from market type structures to hierarchies. To validate the propositions seven cases are examined from four different countries.

Different choices of GS-QMS relationships

It appears that different circumstances require different choices of GS - QMS relationships. In Northern Europe we find mostly private chain-wide QMSs, like IKB (Integrated Chain management), QS (Quality Standards –

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German Qualität und Sicherheit), VPF (French Pork meat) and GQS (Danish quality management system) combined with market-type GSs. These chain-wide systems can be considered as industry standards that have been adopted by the largest part of actors in pork supply chains in the respective countries. Such supply chains also tend to be very large with mostly intensive farming. In Southern Europe, on the other hand, we find more integrated GSs for the intensive supply chain without a chain-wide QMS. For example, the upstream part of the fresh meat supply chain in Spain is coordinated by the feed company. Several QMSs can be found, covering different parts of the supply chain.

In Europe, also public chain-wide systems can be found, like PDO (Protected Designation of Origin) and PGI (Protected Geographical Indicator) systems. PDO and PGI systems are QMSs that are based on EU legislation and approved by EU government. Such systems require contracts with a coordinating board in which both government and supply chain actors are represented. only part of the supply chain, often only two stages. An example of such QMSs is the Guijelo PDO supply chain of Iberian Ham in Spain.

Finally we have found small specialty chains with a private chain-wide QMS on top of the industry standard. An example of such a chain is the Eichenhof chain in Germany. The GS is characterized by long-term commitment by the chain actors, while the quality level is claimed to be very high. There is a coordinating agent in this chain, which is the farmers' organization. The retailers or butchers are not comprised in the quality system arrangements.

The aim of the research

With the research we aim to develop new theory on GS-QMS relationships that apply to different contexts and their impact on supply chain performance. In addition, we aim to develop advice for policy makers and industry for facilitating public and private investments, improving performance management and adaptation of quality management systems when quality demands change.

Co-authors: Nel Wognum, Jacques Trienekens, Onno Omta

Q-PorkChains is funded by 6th Framework Programme

Q-PorkChains in short

Q-PorkChains includes 62 partners, from 19 different countries including Europe, Brazil, China, South Africa and USA. The total budget is 20.7 million €. The EU grant is 14.5 million €. Q-PorkChains is an integrated project under the EU´s sixth framework programme. The full title of the project is "Improving quality of pork and pork products for the consumer: Development of innovative, integrated, and sustainable food production chains of high quality pork products matching consumer demands". Q-PorkChains is composed of nine modules. The six research modules include consumer and market analysis (Module I), on-farm sustainable production systems (Module II), product development (Module III), integration and sustainable management of the production chain (Module IV), molecular biology in pork quality control (Module V) and synthesis of existing knowledge on pork quality, safety and welfare (Module VI). Two horizontal modules (A and B) aims at incorporating new knowledge into pilot and demonstration chains and disseminate Q-PorkChains results to stakeholders at all levels.

1. University of Copenhagen (KU), Denmark
2. University of Aarhus (AU), Denmark
3. Wageningen University (WU), Netherlands
4. University of Bonn (UB), Germany
5. Swedish University of Agricultural Sciences (SLU), Sweden
6. Agricultural University of Athens (AUA), Greece
7. University Gent (UGent), Belgium
8. University of Newcastle (UNEW), United Kingdom
9. Technical University of Lodz (TUL), Poland
10. Politechnic University of Madrid (UPM), Spain
11. LaSalle Beauvais Polytechnic Institute (LB), France
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21. Chinese Academy of Ag. Science (CAAS), China
22. Kansas State University (KSU), United States of America
23. Polish Academy of Science (PAS), Poland
24. Norwegian Food Research Institute (Matforsk), Norway
25. Danish Meat Research Institute (DMRI), Denmark
26. Teagasc, Ashtown Food Research Centre (AFRC), Ireland
27. Institut de la Filière Porcine (IFIP), France
28. Centro Ricerche Produzioni Animali SPA (CRPA SPA), Italy
29. ASG Veehouderij BV (ASGV), Netherlands
30. Institute of Food Safety (RIKILT), Netherlands
31. Central Food Research Institute (CFRI), Hungary
32. Nutreco, Swine Research Centre (SRC), Netherlands
33. Agrotechnology & Food Sciences group (AFSG), Netherlands
34. Association of Meat Processors in Bulgaria (AMB), Bulgaria
35. Grenzüberschreitende Integrierte Qualitätssicherung (GIQS), Germany
36. Zentralverband der Deutschen Schweineproduction (ZDS), Germany
37. Gesellschaft für Lebensmittelsicherheit (GLS), Germany
38. Inst. for Food and Agricultural Research and Technology (IRTA), Spain
39. French National Institute for Agricultural Research (INRA), France
40. Chambre Régionale d'Agriculture de Bretagne (CRAB), France
41. The Danish Meat Trade College (DMTC), Denmark
42. Danish Crown (DC), Denmark
43. Vion Food Group (VFG), Netherlands
44. Pigchamp Pro (PP), Spain
45. Pig Improvement Company UK Limited (PIC), United Kingdom
46. Casademont (CS), Spain
47. Esteban Espuña (EE), Spain
48. Glon Group (GG), France
49. Erzeugergemeinschaft Osnabrueck (EGO), Germany
50. France Hybrides (FH), France
51. Chainfood (CHF), Netherlands
52. Qualitype (QT), Germany
53. Italcarni Società Cooperativa Agricola (ITAL), Italy
54. Verdict Systems BV (VS), Netherlands
55. Jamones Segovia S.A. (Jamsa), Spain
56. Stazione Sperimentale per l'industria delle conserve alimentari (SSICA), Italy
57. Zentralverband der Deutschen Schweineproduction (ZDS), Germany
58. Landwirtschaftlicher Beratungsdienst Schwäbisch Hall e.V. (BDSC), Germany
59. D. Didangelos Bros, El. Ar. Papasika (CHIR), Greece
60. D. Didangelos Bros, N. Exarchos SA (IASON), Greece
61. Didangelos Iason - Giannakos Andreas General Partnership (GEF), Greece
62. Bäuerliche Erzeugergemeinschaft Schwäbisch Hall w.V. (BESH), Germany
63. European Commission, Belgium

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