PROJECT PROGRESS SUMMARY
3RD YEAR

TITLE OF THE PROJECT: Development and application of a TTI based Safety Monitoring and Assurance System for Chilled Meat Products

PROJECT N° : QLK1-2002-02545
ACRONYM OF THE PROJECT: **TTI-MEAT SAFETY SMAS**

TYPE OF CONTRACT: Research and Technology Development Project
CONTRACT N° : QLK1-2002-02545

TOTAL PROJECT COST (in euro): 2,210,597 €
EU CONTRIBUTION (in euro): 1,416,772 €

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KEYWORDS (5 maximum - Please include specific keywords that best describe the project.): Meat, Safety, Chill chain management, TTI

World wide web address: **http://smas.chemeng.ntua.gr**

List of Participants:

1 National Technical University of Athens, Greece
2 Swedish Institute for Food & Biotechnology, Sweden
3 Agricultural University of Athens, Greece
4 National Food Center, Ireland
5 TNO Quality of Life, The Netherlands
6 Institute of Food Research, UK
7 Creta Farm SA, Latzimas, Greece

Period covered by the progress summary: 1-1-2005 to 31-12-2005
Commencement DATE : 1-1-2003 DURATION : 36 months

Project funded by the European Commision under the 'Quality of life and management of living resources'

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Objectives:

The main tangible goal of the SMAS project is to develop a reliable and practical decision and management tool for an optimized handling of meat products in terms of both safety and quality The aim of this research project is to study reliable and practical Time Temperature Integrator (TTI) systems. The project will and expand on the scientific state of the art approach of mathematical modelling of dominating meat pathogens and translate this knowledge to TTI. TTIs will be applied as quality and safety monitors of meat products from manufacture to consumption.

The major expected achievements of the project are:

- Accurate, validated mathematical models for safety and quality related microorganisms of ready to cook meat products. They will provide the meat industry with a tool for product development and safety assurance. The European authorities will have quantitative means for meat product risk evaluation.
- The development and study of Time Temperature Integrators (TTI) suitable for meat safety monitoring. These TTI will provide the meat industry and retail business with tools to monitor the chill chain.
- Improved distribution logistics and management of the meat chill chain from the application the ***Safety Monitoring and Assurance System (SMAS)***. SMAS could replace the current "First In First Out" (FIFO) practice and lead to risk minimization and quality optimization.
- Increased ability of the meat sector to control its weak link, the chill chain
- Fulfilment of consumer expectations that extra efforts and state of the art technology, represented by the use of TTI active labels and SMAS, have been employed to guarantee him low risk-high quality meat products.

Wide availability of state of the art information, from the project and other reliable sources for Risk Assessment of specific meat products, through the establishment of an effective Internet site

Results and Milestones:

Modelling and model validation for growth of pathogenic bacteria incident to meat was systematically carried out with a series of experiments on meat products. These included pork, beef and lamb products. Based on an expanded version of Combase, the wide microbial data base that is worked out by a Participant of the project, new models were developed for the effects of temperature and CO_2 on the specific growth rate of major meat pathogens. Weaknesses of these models were resolved with the experimental work. The growth of the targeted pathogenic bacteria *Listeria monocytogenes*, *Salmonella enteriditis*, and *E. coli* O157:H7 on different meat products, with or without natural microflora, stored under aerobic or modified atmosphere packaging, was studied and modelled at different temperature conditions from 0 to 20 ^{o}C. Growth models of meat spoilage bacteria (pseudomonads, *Brochothrix thermosphacta*, lactic acid bacteria and *Enterobacteriaceae*) and shelf life models were also established and validated within the project, as a basis for correlation with the response of the TTI and the chill chain management system. The effect of spoilage microflora on the rate of the potential pathogen growth was an important issue that was systematically studied.

The work on the chill chain conditions was completed by building a valuable database from Greece and Netherlands. Data showed the importance of retail and domestic level.
All the aspects of building a risk assessment algorithm for meat products were studied and significant sources of uncertainty were resolved by use of the appropriate input data, accurate predictive models and effective statistical tools. The established Meat Microbial Risk Assessment Site, that was established and is constantly updated, serves as a practical tool for the scientific community, meat industry, regulators, inspection authorities but also non-specialist laboratories, SME's and consumers. MIRAM contains published material relevant to Microbial Risk Assessment and material resulted from the SMAS project(http://smas.chemeng.ntua.gr/MIRAM).
Development, evaluation and modelling of TTI devices that have the required response characteristics and accuracy to serve as monitors of temperature history and controllers of quality state and microbiological safety of meat products, was carried out. Different designs of enzymatic Time Temperature Integrators of various kinetic characteristics were kinetically modelled and validated under variable temperature conditions. A new tricolour configuration(green-yellow-red) was developed. The TTI temperature sensitivity ranged in terms of activation energy values from 50 to 200 kJ/mol covering the range of kinetic behaviour of bacteria growth in meat products. The user friendly TTI software, TTISLC v2.0, that correlates TTI response to meat quality was updated.
The SMAS algorithm was built into software SMAS Decision Maker (SDM v1.0) for use for chill chain management with TTI.
The applicability and effectiveness of SMAS was validated in real and simulated chill chain field studies in different European countries. The obtained benefit from the SMAS intervention in the management of the products in the chill chain was clearly demonstrated. Both the spoilage profile and the risk distribution at the time of final use was significantly improved in comparison to the non SMAS conventional FIFO approach. Also SMAS was communicated and feedback was received from potential end users of SMAS (food industry, retailers) in different European markets in the form of a comprehensive questionnaire on TTI labeling and SMAS and their potential use. The aim of the questionnaire was to inform the industry and food retailers about chill chain management using TTI and evaluate the users' attitude. High scores were reported on the advantages from the potential TTI use. The information given about the TTI cost, reliability, applicability, liability and consumer acceptance from the SMAS project alleviated the reservations of a majority of the respondents.
Through a consumer study, in Greece, Ireland, Netherlands and Sweden, about freshness and labelling of fresh packaged meat, with or without TTI, it was concluded that the respondents are well aware of the importance of freshness of fresh packaged meat. Information of freshness is needed and wanted. Despite some differences between the participating countries, a majority of the consumers are positive to TTI labelling.
Overall, work during the three years of the project progressed satisfactorily and in line with the targeted milestones. All deliverables were achieved.

Benefits and Beneficiaries:

The SMAS project and the achieved progress and obtained results will benefit meat industry,regulators, inspection authorities but also non-specialist laboratories, SME's and consumers.

Future Actions :

Research work within the SMAS project was completed, however activities for the dissemination of results will continue.