Food Refrigeration & Process Engineering Research Centre

THE GRIMSBY INSTITUTE of Further & Higher Education

Bugdeath - Predicting microbial death kinetics

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Partners

frperc at the University of Bristol

ESB at the Universidada Católica Portuguesa

Katholieke Universiteit Leuven

Teagasc - Irish Agriculture and Food Development Authority

CCFRA - Campden and Chorleywood Food Research Association

UWE - University of the West of England

ENITIAA - Ecole Nationale d'Ingénieurs des Techniques des Industries Agricoles et Alimentaires

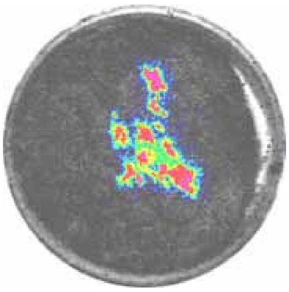
INRA - Institut National de la Recherche Agronomique

Background

Food poisoning is increasing throughout the European Union (EU). The majority of outbreaks are associated with meat, fresh fruit and salad vegetables. Most of the contamination by pathogenic and spoilage organisms is present on the surface of foods at the time of harvesting or slaughter, or is transferred to the surfaces during slaughter and processing. Accurate microbial death models are of considerable help to the food industry in the development of surface pasteurisation systems for meat, fruit and vegetables. These will in turn lead to safer foods with improved quality and shelf life.

The prime objective of the project was to produce accurate predictive models of the reductions in microbial numbers that can be achieved on the surface of real foods during surface pasteurisation processes. These models will enable a wide range of food manufacturers to design more effective and efficient surface pasteurisation treatments than can be produced with current microbial death models and data.

Project results

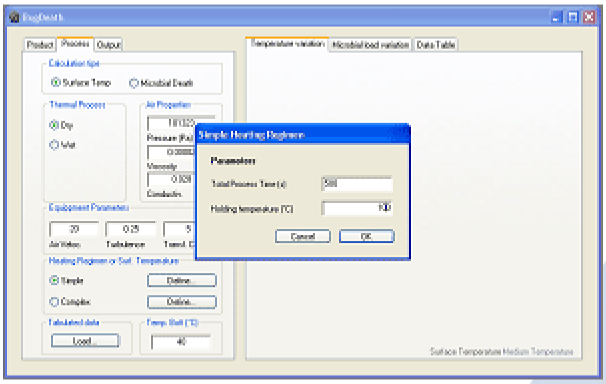


Several pieces of test equipment (see image) were built during the project and delivered to project partners. These could create 'rapid' processes, where surface temperatures were heated from 5 to 100°C in less than 1 minute, held at a set temperature and then cooled rapidly. Slower heating and cooling processes could also be carried out to compare the effects of heating and cooling times of bacterial death. Both dry (hot air) and wet (steam) heating streams could be applied to the product surface.

Each partner carrying out microbiological trials used the test equipment to determine bacterial death as a result of the treatments. This was measured both by more traditional viable count techniques and by specialist techniques, including use of bacteria tagged with lux genes that made them glow (bioluminescence).

The bioluminescent organisms were inoculated onto the food surfaces, which were then treated while the light levels were monitored using a low-light-level camera. Since the bacteria glow brightly when healthy, fade when expiring and stop glowing when they stop metabolising, the effectiveness of the process can be rapidly determined in real time (see image).

While the traditional viable count techniques provided the quantitative data that was used for creating the microbial death models, using bioluminescent organisms proved very useful for obtaining more qualitative information, such as whether the treatments are even over the product surface or whether the bacteria move from their original inoculation positions as a result of the treatments. This kind of information would require far more experimentation and a great deal more time to obtain using traditional microbiological techniques.



A user-friendly heat transfer and microbial death model was created and validated against both published data and data provided by the partners using the pieces of apparatus provided to them. The software application was developed in Real Basic© 5.2 (see example screenshot in the image). The program simulates inactivation kinetics of microorganisms on food surfaces during both dry and wet pasteurisation treatments under both constant and time-varying temperature conditions. A heating regime can be selected in the program, which then calculates food surface temperatures and the resulting microbial numbers during the simulated process. Input data and simulated values can be visualised in graphics and data tables.

The data can be printed, exported to other applications and saved in data files. The program can simulate processes on two foods (beef and potato) and contains data on their thermal properties. It contains data on two microorganisms (Listeria monocytogenes and Salmonella) and their corresponding inactivation kinetic parameters, enabling simulation of a variety of microbial death scenarios.

The software can be used to simulate the effect of pasteurisation treatments. The simulations will be valuable to a wide section of the food industry for developing appropriate and safe processes. The software has also the potential of being exploited for educational purposes.

Contacts

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