QUANTITATIVE RISK ASSESSMENT MODELS FOR FOOD PATHOGENS

A. Handan Baysal & Sevcan Ünlütürk
Izmir Institute of Technology, Gülbahçe, Urla, Izmir, Turkey

Risk assessment (RA) which is a holistic approach involves hazard identification, exposure assessment, dose-response assessment, and risk characterization (Oscar, 2004). Microbiological risk assessments (MRAs) have been subdivided into four steps, which comprise, hazard identification, hazard characterization, exposure assessment and risk characterization. RAs are well developed for chemical hazards, and much effort has been put into the application of this type analysis to microbial food safety risks, especially for human foodborne diseases. The methods used for MRA, as well as the underlying concepts for evaluating risk derived from foodborne organisms and the effects of control measures on reducing risk are still new to many countries including developing countries. It is important to demonstrate examples of practical data generation and modelling even if they are limited in data size.

The typical approach taken is to construct a quantitative risk assessment model (QRAM) in a computer spreadsheet using probability distributions to model the variability and uncertainty of important risk factors, such as time, temperature and pathogen density. The QRAM is then simulated using a spreadsheet add-in program that randomly samples the probability distributions and uses the random numbers generated to perform calculations and penetrate output distributions.

Many researchers have discussed the importance of modelling growth, survival, and inactivation of pathogens, thereby developing the concept of “predictive microbiology” in regard to food safety. Others have utilized more comprehensive techniques, such as Monte Carlo simulation, to develop QRAMs to describe large processes with multiple interaction steps, including growth and inactivation models.

QRAM for food pathogens using this approach and which are published in the scientific literature includes *S. enteritidis* (pasteurized liquid eggs, shell eggs), *E. coli*

O157:H7 (ground beef hamburgers, raw fermented sausages, apples, ground beef, beef burgers, beef trimmings, unpasteurized milk), *Salmonella* spp. (cooked poultry patty, whole chicken, turkey cordon bleu, almond), *Bacillus cereus* (Chinese-style rice, pasteurized & chilled courgette purees), *L. monocytogenes* (smoked salmon & trout, cold smoked salmon), *S. aureus* (Unripened cheese) and pathogens (sprout).

Monte Carlo simulation utilizes probability distribution functions such as the normal distribution as input variables in a set of governing equations in order to calculate likely distributions of defined outputs. A random number generator is used to populate the input function in a series of iterations or trials that represent different values of the input (incoming concentration of bacteria of an infected beef trimming) relative to the desired output (prevalence and concentration of the bacteria in the finished product).

QRA Modelling is a holistic approach that has a great potential as a decision analysis tool for the food industry. The advantage of QRAM over other approaches such as in-plant HACCP, is that post processing risk factors, such as food-handling practices and consumer demographics are considered in the evaluation of the microbial safety of food. More basic research is needed in assessment to support development of models that address the complex effects for the interacting microbial populations in foods. Extension of the body of scientific knowledge of predictive microbiology in foods will support improvements in risk assessment modelling and management of foodborne risks.