INTEGRATION OF STATISTICS AND FOOD PROCESS ENGINEERING: ASSESSING THE UNCERTAINTY OF THERMAL PROCESSING AND SHELF-LIFE ESTIMATIONS

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SUMMARY

In response to recent requirements in food regulations, new procedures are now necessary to evaluate the impact of the variability in the parameters of food engineering models used for decisions of safe processing, packaging, storage and distribution conditions. The variability of these parameters generates an uncertainty in the estimations of product safety and quality submitted by food processors to regulatory agencies. Also, consumers and processors want to know the time that products will retain the quality desired and safety expected. This type of problems depends on many factors often described by statistical distributions requiring non-deterministic calculations such as Monte Carlo procedures. A combined predictive microbiology and Monte Carlo procedure were used to determine the shelf-life uncertainty and thus reduce the risk of reaching consumers with unsafe or spoiled products. These benefits are not possible to identify when using conventional estimation methods of shelf-life.

The high probability that thermal processing protocols determined using average values for the parameters in the model are not safe was confirmed. That is why, in the commercial sterilization and pasteurization of foods, it will be required to provide regulatory agencies with determinations of the confidence level that the pathogen risk has been reduced to an acceptable probability level. This can be achieved using the Monte Carlo methodology described in this work. Estimations of the reduction in process time achievable by lowering the statistical variability of process design parameters are also demonstrated. Practical applications of the methodologies here shown are presented including approaches to reduce the variability of input parameters to minimize the uncertainty of thermal processing times. This uncertainty reduction results in more moderate thermal treatments with clear benefits for both processors and consumers.