On the use of the Gompertz model to predict microbial inactivation behaviour

M.M. GIL, M. Quintas, T.R.S. Brandão, and C.L.M. Silva**,** Escola Superior de Biotecnologia - Universidade Católica Portuguesa, Rua Dr. António Bernardino de Almeida, 4200-072 Porto, Portugal

The Gompertz equation is commonly applied to describe microbial inactivation behaviour. Besides the proven adequacy of the model in those kinetics descriptions, most of the reported works do not use Gompertz equation in the most convenient form, neglecting the biological meaning of the parameters. Insightful information can be obtained with re-parameterized forms. Microbial survival often presents a lag prior to inactivation, followed by a linear phase (corresponding to a maximum inactivation rate, k_{max}) and a residual population (tail). These phenomena should be model parameters.

Our objective was to modify the original Gompertz model in order to describe inactivation, and test drawbacks/advantages of applying the re-parameterized functions, based on regression analysis of *Listeria innocua* thermal inactivation data.

Two different approaches were studied. The dependent variable was assumed to be the logarithm of the microbial load (logN), and normalized values to the initial load ($\log(N/N_0)$). Based on functions' analytical study (e.g. function limits and derivatives), equations were re-written using parameters with microbiological meaning. The functions were fitted to experimental data of *Listeria innocua* obtained at 52.5, 55, 57.5, 60, 62.5 and 65ºC, used as case study. Model parameters (lag, k_{max}, and tail) were estimated by non-linear regression analysis.

Results showed that the quality of regression and parameters estimation were improved if normalized data was used. Gompertz model allowed accurate predictions of *Listeria innocua* inactivation in the temperature range considered, and parameters were estimated with precision (evaluated by 95% confidence level errors, divided by the estimate). For lag, k_{max} and tail, the errors varied between 16-62%, 7-13% and 14-28%, respectively.

The use of accurate mathematical models is a considerable tool to predict target pathogen's survival within specific environmental conditions. It may also help to determine the extent to which existing thermal processes could be modified in order to obtain major quality retention.