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Effect of storage temperature on the lag time of *Geobacillus stearothermophilus* individual spores

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ABSTRACT

The lag times (λ) of *Geobacillus stearothermophilus* single spores were studied at different storage temperatures ranging from 45 to 59 °C using the Bioscreen C method. A significant variability of λ was observed among individual spores at all temperatures tested. The storage temperature affected both the position and the spread of the λ distributions. The minimum mean value of λ (i.e. 10.87 h) was observed at 55 °C, while moving away from this temperature resulted in an increase for both the mean and standard deviation of λ. A Cardinal Model with Inflection (CMI) was fitted to the reverse mean λ, and the estimated values for the cardinal parameters T_{min}, T_{max}, T_{opt} and the optimum mean λ of *G. stearothermophilus* were found to be 38.1, 64.2, 53.6 °C and 10.3 h, respectively. To interpret the observations, a probabilistic growth model for *G. stearothermophilus* individual spores, taking into account λ variability, was developed. The model describes the growth of a population, initially consisting of N_0 spores, over time as the sum of cells in each of the N_0 imminent subpopulations originating from a single spore. Growth simulations for different initial contamination levels showed that for low N_0 the number of cells in the population at any time is highly variable. An increase in N_0 to levels exceeding 100 spores results in a significant decrease of the above variability and a shorter λ of the population. Considering that the number of *G. stearothermophilus* surviving spores in the final product is usually very low, the data provided in this work can be used to evaluate the probability distribution of the time-to-spoilage and enable decision-making based on the "acceptable level of risk".