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Inactivation Kinetics of *Bacillus cereus* spores in peracetic acid for aseptic package sterilization

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Abstract

Peracetic acid (PAA) is a key sterilizing agent for aseptic packaging, critical for maintaining product safety across various industries. This study focuses on developing a method to estimate the effectiveness of PAA against *Bacillus cereus*, a surrogate organism chosen to test sterilization methods. Spores of *B. cereus* were exposed to PAA at concentrations of 300, 1500, 2500, and 3500 ppm and temperatures of 23, 35, 45, and 55 °C, reflecting a range of conditions to ensure the study's relevance to real-world applications. The log-linear and Weibull models were used to create inactivation models for PAA, analyzing its sporicidal activity at these conditions. Parameter estimations were standardized at 50 °C for both models, facilitating comparison. The log-linear model estimated D values at various PAA concentrations were 0.14, 0.04, 0.03, and 0.01 minutes, with z values of 32.65, 33.39, 35.02, and 27.38 °C, respectively. The Weibull model showed δ values with similar trends and z values of 31.89, 33.43, and 35.02 °C for the same PAA concentrations. Root mean square error (RMSE), was used as statistical indicator to evaluate model's performance showing values ranged from 0.66 to 0.71 log CFU/ml, indicating high predictive accuracy. Furthermore, the sum of squares ranging from 30.00 to 45.90 and AIC values between -132.47 and -204.21 validated the models' reliability in describing PAA spore inactivation. These results will help the aseptic industry in enhancing packaging sterilization for industrial applications.