

E-coli Growth and Mutation in Batch Culture

A New Mathematical Model

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When an isogenic culture of e-coli bacteria is inoculated into glycerol minimal medium and kept in *batch culture* at 37°C , it experiences a number of different phases culminating in what is known as the *long-term stationary phase*. In this phase, which can last up to 5 years, the population is under very stressed conditions. Only sterile distilled water is ever added to the system, so all of the nutrients have been depleted. The population survives by a process of *crossfeeding* where dead cells break down and provide nutrients to the living cells. The name ‘stationary’ refers to the fact that the total population remains roughly constant. There is evidence, however, that this phase is anything but stationary. Indeed, it is characterized by rapid mutations and genetic diversity. New strains continually appear that are better adapted to the environment. These take over and the old ones die out until an even fitter strain appears.

We have developed a mathematical model for an isogenic culture of bacteria in the long-term stationary phase. The model is a stochastic two-stage growth/death model based on a modified Ricker equation. Simulations of the model compare very favorably with laboratory data taken over 3 years. In this talk we will develop the model and discuss how we have estimated the parameters.