Individual Based Modelling of Bacterial Cultures. A Lag Phase Study.

C. Prats, A. Giró, D. López, J. Valls
Departament de Física I Enginyeria Nuclear
Escola Superior d'Agrobiologia de Barcelona
Universitat Politècnica de Catalunya
Urgell, 187. 08036 Barcelona
clara.prats@upc.es

INDISIM is a program based on an IBM (Individual Based Model). INDISIM enables the study of the evolution of a bacterial culture based in the individual behaviour of the bacteria, over a period of time in a specific environment, in which space and time are discrete. "Eigen experiments" controlling all the elements of the system can be done [5]. It is an interesting methodology to study the temporal evolution of complex systems. In particular, it is a good tool to study the lag phase in microbiological systems. The study of lag phenomena is specially important in food microbiology [5].

The lag phase is the initial growth phase of a bacterial culture after inoculation, during which cell numbers increase relatively constant prior to exponential growth but total biomass increases [4]. During this period of time bacterial cells modify their metabolism in order to take advantage of the new environment and initiate exponential growth.

In this work it has been considered that the lag phase can be caused by:

- the need to reach a certain mean cellular biomass and mass distribution
- the metabolism adaptation to a new medium by means of synthesizing new enzymes according to that

These cases have been studied separately with INDISIM.

DISTANCES DEFINITION
Two distances have been defined in order to study the evolution of the mean mass and the mass distribution, and their relationship with λ parameter. The third one takes into account both of them.

The bacteria need to synthesize enzymes in order to grow and reproduce. With an asynchronous culture, and with an initial mean biomass corresponding to exponential growth, it has been tested the relationship between Relative Mean Enzyme Biosynthesis Rate and Lag parameter, as you can see below.

INDISIM allows the improvement of the knowledge of the microbial cultures behaviour. It has been proven that IBM is a good tool to study lag phase phenomena.