

Dynamics of Predator-Prey Interactions in Continuous Cultures

K. Alhumazi, A. Ajbar*

King Saud University, Department of Chemical Engineering
P.O. Box 800, Riyadh 11421, Saudi Arabia

email: A. Ajbar (aaibar@ksu.edu.sa)

This paper studies the behavior of a general unstructured kinetic model for continuous bioreactors involving interactions between predator, prey and a limiting substrate. The analysis carried out in this paper shows how closed analytical conditions for arbitrary growth rates can be derived that describe the conditions for the existence of the interacting species in an oscillatory behavior. It is also demonstrated how practical diagrams in terms of operating and kinetic parameters can be constructed that classify the different behavior predicted by the model. Applications of these general results to a number of experimentally validated models have revealed that the saturation model always predicts hard oscillations for a certain range of dilution rates, for any values of model parameters. Bifurcation diagrams in the operating parameter space permitted the delineation of regions of hard oscillations, regions of static coexistence, regions of predator washout and regions of total washout. The analysis of the double saturation model has proven its ability to predict two Hopf points. Hard oscillations are therefore expected within the dilution rates corresponding to the two Hopf points. Practical diagrams were also constructed to delineate the boundaries separating hard oscillations from static coexistence and washout conditions.