Modeling and simulating direct competition among three microorganisms for two supplementary nutrients.

Zerrouak Sadem[*], Borsali Fathi [2]

[1] *Department of Mathematics/ laboratoire de mathématiques (LDM), University of Sidi-Bel-Abbés, Algeria*

[2] *Department of Mathematics / Laboratoire Systèmes Dynamiques et Applications, University of Tlemcen, Algeria*

[*]*(sadem.zerrouak@univ-sba.dz)*

Abstract – In our study, we investigated direct competition among three microorganisms for two supplementary nutrients. This investigation was translated into a mathematical model using a five-dimensional equation. We validated the model's stability and identified equilibrium points through MATLAB simulations. The main finding was competitive exclusion, wherein one or both competitors are excluded during direct competition for the supplementary nutrients. Additionally, the study explored the intricate network of interactions resulting from heightened competition for limited resources. By examining various aspects of this competition, the research aimed to uncover the underlying mechanisms shaping the fate of each participant. The experimental setup allowed for comprehensive analysis of competition intricacies. The findings were supported by rigorous stability analysis, clarifying potential outcomes. MATLAB simulations aimed to replicate real-world scenarios and predict competition dynamics over time. The key insight was the concept of competitive exclusion, where intensified competitive pressures lead to the exclusion of one or both microorganisms from the competition. This underscores the pivotal role of resource availability and competitive strategies in shaping the environmental landscape.

Keywords – Dynamical Systems · Chemostat · Global Stability · Local Stability · Uniform Persistence · Density-Dependence