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Dynamic between biomass, pH and acid lactic by microorganisms in fermentation of fresh milk

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In this research a mathematical model composed by a set of Ordinary Differential Equations (ODEs) is formulated in order to describe the dynamics between biomass concentration (UFC), pH variation and acid lactic (aL) produced by a strain of microorganisms during a batch fermentation of fresh milk under specific culture conditions. Our mathematical model was constructed with a modelling software called Eureqa, it was based on the logistic equation, the law of mass action and some biological suppositions. The design considered that all three populations do not grow exponentially, they must have biological feasible limits and are described by non-negative numbers, biomass tends to zero at large time if and only if the medium is not contaminated and the temperature is constant. Positivity of the system was verified through the Leenheer and Aeyels theorem to determine positivity for non-linear systems. In order to analyze its global dynamics, the method of compact invariant sets proposed by Krishchenko was applied to calculate upper and lower bounds of the localizing domain. Further, the structure and dynamics of the proposed model is consistent with the literature regarding behavior of its solutions. Therefore, it is expected that the ODE system will become a support tool for standardization of fermented milk production as well as the behavior prediction of variables (UFC, pH, aL) will ensure the quality of fermented milk products. Further research is focused to carry out the analysis of existence and uniqueness, moreover establish a control variable that allows to bring the system to a desired state.