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Mathematical model of biotechnology process to produce a recombinant protein

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The aim of this research is to develop a mathematical model to describe the production of human antibody fragments of small size as ScFv, Fab, F(ab'), through fermentation of *Escherichia coli* BW25113 (ara). The fermentations are conducted in a fermenter (Chemap Ag) with a mechanical agitation. The entire phase of fermentation is monitored on-line using a data acquisition system MFCS/WIN. A kinetic and stochiometric models are developed. The stochiometric model describes the biological process of biomass growth. The kinetic analysis of experimental data about fermentation of *E. coli* is carried out for batch and fed-batch phase for the production process. The batch analysis is described by material balances of substrate and biomass with Monod and Pirt equations. The fed-batch phase is modeled using the material balances on biomass, substrate and product and analyzing the variation on volume during the time. Runge and Kutta algorithm is used to resolve the system equations. Result show that the equation that describe the growth of biomass is: $C_6H_{12}O_6+3.56O_2+0.52ONH_3 \rightarrow 2.13CH_1,92O0,3N0,24+3,87CO_2+4,74H_2O$. For the Monod and Pirt law the following parameters are found by regression of experimental data during the batch phase: μmax is 0.55 h-1, Ks is 0.10 g/L, Yx/s is 0.35. The kinetics parameters that describe the fed-batch phase are the following: μmax is 0.24 h-1, Ks is 1.5 g/L, Yx/s is 0.34, m is 0.02, α is 0.00043, β is 0.00007, Yp/s is 0.00084. A sensitivity analysis is carried out to verify the efficiency of the mathematical model, varying the values of parameters about ±10%: Evident variations are not present so the model is robust and stable. The realized mathematical models can be used to optimize the pilot plant and for the planning of the laboratory tests.

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