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## Modeling and Dynamic Optimization of protein and spore production by *Bacillus thuringiensis* (WP2-2)

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**Background and aim:** Dynamic optimization of proteins and spore production by *B. thuringiensis* needs to use robust models coupled to control strategies. In this work, two models were proposed to describe proteins and spores production using *B. thuringiensis*. Models were calibrated and the parameters obtained were in the literature range. The best model was selected to implement two control strategies, for a Fed-batch culture and a Sequential Batch culture.

**Methods:** Two dynamic model were used to optimize proteins and spores production using three *B. thuringiensis* strains.

**Results:** The experimental simulations developed in the present study, on *B. thuringiensis* culture made it possible to analyze their behavior and to adjust two models to the experimental data sets. The calibration of both models allows calculate the kinetic parameters of the culture and the experimental data presented a good fit. Additionally, although the BLB strain showed the highest maximum specific growth rate ( $\mu_{max}$ ), the HD strain presented the highest yield Biomass/substrate yield coefficient values (Y1). The LIP strain presented the lowest values for this yield. As for the production of proteins, which are mainly used for insecticidal effects, the BLB strain presented the highest concentration and the proteins/substrate yield coefficient (Y2) was the highest of all the strains, while the LIP strain showed the lowest values for this yield.

In order to study the performance of the control strategies, three different cases were considered, batch without optimization and with initial Substrate equal to 25g/L, fed-batch strategy and sequential batch. It was found that the optimization of proteins and spores productions depicted an increasing profile for glucose feeding until the upper limit of volume was achieved. Fed-batch strategy had the best proteins and spores' productivity with high biomass productivity.

**Conclusion:** Two models were proposed in this work. One model was chosen to compare two approaches of dynamical optimization. The results demonstrated that the model based on control strategy allowed maximizing proteins and spores productivity. An experimental validation of the control law will be performed to prove the correct proteins and spore productivity.

**Keywords:** Model optimization, Proteins and Spores optimization, Fed-batch fermentation, Sequential batch fermentation.

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