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COMPUTER-BASED ARTIFICIAL INTELLIGENCE STRATEGIES IN MODELING AND OPTIMIZATION OF MICROBIAL BIOPROCESSES OPTIMIZATION CASE OF BIOGAS GENERATION FROM WASTES

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Abstract

Microbial fermentations produce a wide range of valuable foods, fuels and chemicals, most of which are complex to be produced through conventional chemical processes. The industrial viability of such processes requires an optimal combination of physico-chemical process parameters. Traditional modeling and optimization strategies suffer from large computational burden and are unable to consider the interaction effects of the various process parameters.

Emerging Artificial Intelligence (AI) tools such as Artificial Neural Network (ANN), Genetic Algorithm (GA), Fuzzy Logic (FL), Ant Algorithm (AA) and Particle Swarm Optimization (PSO) are being considered in the design of optimal production media and process operating conditions.

In this work, the techniques and procedures of ANN, GA and PSO are detailed. Their application is illustrated by previous findings in: (1) an improvement of 8.64% biogas production form mixed co-substrates of sawdust and others; (2) the minimization of acidification time in yogurt production by *Lactobacillus bulgaricus* and *Streptococcus thermophilus* using a non-linear temperature profile (3) a comparative evaluation of AI strategies with the Response Surface Methodology (RSM) on modeling and optimization of citric acid production by *Aspergillus niger* on seven process parameters, in which the AI optimized process showed an experimental production 6.68 g/L against the RSM predicted 3.35 g/L; (4) an improvement of fermentative biohydrogen production from mixed agrowastes.

ANN coupling GA is a more efficient strategy to navigate the optimization search space for fermentation development, and its prospect is further discussed.