FACTORIAL STUDIES ON THE MORPHOLOGY, GROWTH AND LACTIC ACID PRODUCTION KINETICS OF A LOCALLY ISOLATED FILAMENTOUS FUNGUS IN SUBMERGED CULTURES

By

VILAS SULANG AGAS

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Abstract

15 different isolates of filamentous fungi were isolated from various sources. The 15 isolates were screened for their capacity for saccharifying starch and producing lactic acid. From the screening process, a strain TPH was selected for further studies. A resolution III fractional factorial experiment (conducted with shake flasks) was designed to create a series of linear models to evaluate the performance of morphology (based on filament ratio), specific substrate uptake rate, maximum specific growth rate and lactic acid yield. The five factors and their respective levels are: Inoculation size (1000 vs. 5000 spores/ml), degree of saccharified starch (0 vs. 100%), temperature (30 vs. 35°C), C/N ratio (1 vs. 4) and initial amount of carbon (0.185 vs. 0.555 M).

Experiments showed that maximum specific growth rate, filament ratio and specific substrate uptake rate were well represented by their respective linear models but not filament ratio and yield values. The model describing yield had to be transformed in order to show better model fit. After transforming procedures, the R² value of the model increased from 71.94% to 80.93%. There were also vast improvements in the residual values of the model.

Another experiment in a bench bioreactor was conducted to evaluate whether the constructed models were still usable when scale was increased. However experiments showed that the models performed poorly at that scale. This was likely due to the differences in mixing and aeration dynamics between shake-flasks and the bioreactor. Therefore the use of shake-flask experiments may not be ideal in evaluating TPH performance.
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List of abbreviations and symbols.

CDW  
Cell dry weight (mg/L).

FED  
Factorial experimental design.

FR  
Filament ratio.

LA  
Lactic acid.

MS  
Mean square.

SS  
Sum of squares

SSF  
Simultaneous saccharification and fermentation.

α  
Growth associated constant.

β  
non-growth associated constant.

µ\text{max}  
Maximum specific growth rate (h\(^{-1}\)).

\(\frac{dP}{dt}\)  
Rate of lactic acid production (mg L\(^{-1}\) h\(^{-1}\))

\(\frac{dX}{dt}\)  
Rate of biomass increase (mg L\(^{-1}\) h\(^{-1}\))

P\(_0\)  
Lactic acid concentration at time of inoculation (mg/L).

P\(_{\text{f}}\)  
Peak lactic acid concentration (mg/L).

q_P  
Specific rate of product formation (h\(^{-1}\)).

q_s  
Specific substrate uptake rate (h\(^{-1}\)).

r_s  
Volumetric rate of substrate uptake(h\(^{-1}\)).

S\(_0\)  
Substrate concentration at time of inoculation (mg/L).

S\(_{\text{f}}\)  
Substrate concentration at peak product concentration (mg/L).

\(t\)  
Time (h).

X  
Biomass values (mg/L).

X\(_0\)  
Amount of initial biomass (mg/L).

X\(_{\text{max}}\)  
Carrying capacity of fungal biomass in the fermentation (mg/L).

Y_{p/s}  
Yield of lactic acid (mg lactic acid/ g glucose).