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Use of an instrumented bioreactor for the production of biomass-degrading multienzymes under solid state fermentation of soybean meal

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Biomass-degrading enzymes are one of the most costly inputs to impact on the economic viability of the biochemical route for biomass conversion into biofuels. Therefore, there is a need for the development of technologies for improving enzyme production. Solid-state fermentation (SSF) is an attractive process to produce enzymes economically due to its lower capital investment and higher productivity. However, the limitation of SSF is the control of the operating variables that affect microbial growth. This work evaluates the effects of operational conditions on biomass-degrading multienzyme production by a selected strain of Aspergillus niger cultivated under solid state fermentation of soybean meal using an instrumented lab-scale bioreactor equipped with an on-line automated monitoring and control system. The effects of air flow rate, inlet air relative humidity and substrate initial moisture on multienzyme production (FPase, endoglucanase and xylanase) were evaluated using a statistical design methodology. Higher productions of FPase (0.55 FPU/g), endoglucanase (35.1 IU/g), and xylanase (47.7 IU/g) were achieved for cultivation under a selected condition of substrate initial moisture of 84%, air inlet humidity of 70%, and flow rate of 24 mL/min. The enzymatic complex was then used to hydrolyze a lignocellulosic biomass, releasing 4.4 g/L of glucose after 36 hours of saccharification of 50 g/L pretreated sugar cane bagasse. The methodology employed here was very effective in estimating enzyme production under different SSF process conditions, showing the potential of using SSF as an alternative to contribute in the economics of converting biomass into ethanol.

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