

The Use of a Miniature Bioreactor as Research Tool for Biotechnology Process Development

Authors : Muhammad Zainuddin Arriafdi, Hamudah Hakimah Abdullah, Mohd Helmi Sani, Wan Azlina Ahmad, Muhd Nazrul Hisham Zainal Alam

Abstract : The biotechnology process development demands numerous experimental works. In laboratory environment, this is typically carried out using a shake flask platform. This paper presents the design and fabrication of a miniature bioreactor system as an alternative research tool for bioprocessing. The working volume of the reactor is 100 ml, and it is made of plastic. The main features of the reactor included stirring control, temperature control via the electrical heater, aeration strategy through a miniature air compressor, and online optical cell density (OD) sensing. All sensors and actuators integrated into the reactor was controlled using an Arduino microcontroller platform. In order to demonstrate the functionality of such miniature bioreactor concept, series of batch *Saccharomyces cerevisiae* fermentation experiments were performed under various glucose concentrations. Results attained from the fermentation experiments were utilized to solve the Monod equation constants, namely the saturation constant, K_s , and cells maximum growth rate, μ_{max} as to further highlight the usefulness of the device. The mixing capacity of the reactor was also evaluated. It was found that the results attained from the miniature bioreactor prototype were comparable to results achieved using a shake flask. The unique features of the device as compared to shake flask platform is that the reactor mixing condition is much more comparable to a lab-scale bioreactor setup. The prototype is also integrated with an online OD sensor, and as such, no sampling was needed to monitor the progress of the reaction performed. Operating cost and medium consumption are also low and thus, making it much more economical to be utilized for biotechnology process development compared to lab-scale bioreactors.

Keywords : biotechnology, miniature bioreactor, research tools, *Saccharomyces cerevisiae*

Conference Title : ICABBBE 2020 : International Conference on Agricultural, Biotechnology, Biological and Biosystems Engineering

Conference Location : Bali, Indonesia

Conference Dates : July 16-17, 2020