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Analyzing Recent Research on Packed Bed Bioreactors for Solid State Fermentation: A Critical Review

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Introduction

Since forced aeration provides O_2 and removes metabolic heat from the bed, packed-bed bioreactors are frequently used for aerobic solid-state fermentation. We review studies on packed-bed bioreactors carried out over the past ten years, evaluating the insights these studies provide into how large-scale packed beds should be designed and operated. This review was motivated by the potential for applications in biorefineries. Numerous studies have low superficial air velocities and preferential airflow, which prevents proper aeration of some areas of the bed. Additionally, some studies have suggested ineffective tactics like switching the airflow's direction or adding air through perforated pipes inside the bed. Numerous studies have also utilised narrow water-jacketed packed-bed bioreactors, but these bioreactors do not reflect heat removal in wide large-scale packed [1]. Beds, where the side walls' contribution to heat removal is minimal. Finally, we draw the conclusion that although some attention has been paid to characterising substrate beds' porosities, water sorption isotherms, and volumetric heat and mass transfer coefficients, this work needs to be expanded to cover a wider range of solid substrates, and work needs to be done to characterise how these bed properties change as a result of microbial growth.

This review focuses on packed-bed bioreactor-based aerobic solid-state fermentation. Microorganisms are grown in a bed of solid particles with a continuous gas phase in the spaces between the particles in aerobic solid-state fermentation (SSF) systems. Although some free water may be present as a thin film at the particle surface and there may be a few water droplets held within the interparticle spaces, the majority of the water in the system is sorbed within the solid particles or held within the microbial biomass [2]. For centuries, especially in Asia, aerobic SSF has been used to create a variety of traditional fermented foods. It has also attracted increasing attention over the last few decades for the production of a wide range of biotechnological products and is especially. Algal biomass is particularly appealing for use in third-generation biorefineries that convert algal biomass, as well as second-generation biorefineries that convert lignocellulosic biomass. SSF is the best technology for producing metabolites from residual organic solids produced within the biorefinery because it allows for high solids loadings and lower water demands when compared to submerged liquid fermentation. SSF has the potential to help make large-scale biorefineries economically and practically feasible. Tray bioreactors, packed-bed bioreactors, rotating-drum bioreactors, and continuously agitated bioreactors are just a few of the bioreactor types that can be used for SSF processes. These various types of bioreactors' general design and operation principles have been described in great detail. Due to its simplicity of use in the utilisation and conversion of lignocellulosic biomass, the packed-bed bioreactor has drawn the most attention among these different types of bioreactors [3].

Description

Packed-bed bioreactors are bioreactors in which air is blown into the bioreactor and is forced to flow through the interparticle spaces (or "void Use of a highly porous bed is one method for addressing the issue of uneven airflow. In a 20 L bioreactor, van Breukelen, et al. produced conidia of Metarhizium anisopliae using hemp that had been impregnated with a nutrient solution. In an earlier study, the initial bed porosity was 0.48, and 1 kg of dry hemp could hold 7.2 kg of water. Despite the fact that they did not measure the porosity, it is known that hemp fibres have a high water-holding capacity and give porous beds that do not shrink. In an effort to regulate the outlet air temperature, van Breukelen et al. varied the airflow in response to the measured O_2 uptake rate; VZ ranged from 2.7 to 8.0 cm s1. When the porous medium and these high-resolutionspaces") of the bed in order to reach the air outlet. The bed of substrate particles remains static during the fermentation in packed-bed bioreactors. As the name implies, it is also possible to have "intermittently mixed packed-bed bioreactors." Rare occasions of mixing do occur [4,5].

Conclusion

Mixing events can help the bed become more uniform, enable the addition of water, or reseat the bed if preferential flow paths have developed within it. Packed-bed bioreactors are particularly well suited for the cultivation of filamentous fungi because they frequently cannot tolerate continuous or frequent mixing because of the excessive harm it causes to the developing hyphae. However, unicellular microorganisms have also been used in packed-bed bioreactors. In pilot- and large-scale packed-bed bioreactors, bed-wall heat transfer can be encouraged. In the Zymotis bioreactor, which was developed 30 years ago, the bed is divided by vertical heat transfer plates that are spaced roughly 5 cm apart. Although a patent application was made for a modified version of this design, which was first demonstrated with 40 kg of moist solids of lignocellulosic biomass, it has not recently attracted much attention. This could be because it's challenging to maintain uniform airflow through the bed; if preferential airflow paths form as a result of bed shrinkage, it would be difficult to reseat the bed by agitating the tightly spaced heat transfer plates. It is still a promising bioreactor design for massive biomass conversion, though, if this issue can be solved.

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Conflict of Interest

There is no conflict of interest by author.

References

1. Mitchell, David Alexander, Héctor A. Ruiz and Nadia Krieger. "A critical evaluation of recent studies on packed-bed bioreactors for solid-state fermentation." *Processes* 11 (2023): 872.
2. Mitchell, David A., Ashok Pandey, Penjit Sangsurasak and Nadia Krieger. "Scale-up strategies for packed-bed bioreactors for solid-state fermentation." *Process Biochem* 35 (1999): 167-178.
3. Behera, Sudhanshu S. and Ramesh C. Ray. "Solid state fermentation for production of microbial cellulases: Recent advances and improvement strategies." *Int J Biol Macromol* 86 (2016): 656-669.
4. Thomas, Leya, Christian Larroche and Ashok Pandey. "Current developments in

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solid-state fermentation." *Biochem Eng J* 81 (2013): 146-161.

5. Casciatori, Fernanda Perpétua, Andreas Bück, João Cláudio Thoméo and Evangelos Tsotsas. "Two-phase and two-dimensional model describing heat and water transfer during solid-state fermentation within a packed-bed bioreactor." *J Chem Eng* 287 (2016): 103-116.

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