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Computational fluid mechanics in biomanufacturing

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Gloriosa superba is a commercial source of the pharmaceutical colchicine. Colchicine is one of the primary sources of treatment for gout. The balloon type bubble reactor (BTBR) has been successfully used to biomanufacture bioactive small molecules. Colchicine production can be improved by understanding the fluid mechanics inside this reactor, which primarily depends on several parameters such as reactor working volumes, diameter of the sparger, flow rate, viscosity, surface tension, density of the fluids, and nutrient volume fractions. Our initial bioimaging study suggests that in 4L BTBR at low air injection rate the flow ascends up a fairly straight vertical path, concentrating mostly toward the center of the reactor. However, at higher injection rates, a more chaotic flow forms. The post processed images reveal that the flow patterns inside the reactor vary, as positive and negative vorticity zones. We will present the clockwise/counter-clockwise directions of the dimensionless mapping of fluid dynamics data. This analysis will not only address the geometric patterns of mixing, but will also apply to the nature of liquids, solutions, and injection gases with various combinations of density, viscosity, and surface tension that will eventually improve the colchicine biomanufacturing design process.

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