ASIA-PACIFIC JOURNAL OF CHEMICAL ENGINEERING
Asia-Pac. J. Chem. Eng. 2015; **10**: 65–74
Published online 4 September 2014 in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/apj.1846

Curtin University

Research article

Effects of dual impeller system of Rushton turbine, concave disk turbine and their combinations on the performance of kojic acid fermentation by *Aspergillus flavus* Link 44-1

Nurashikin Suhaili,[1,3] *Joo Shun Tan,*[2,4] *Mohd-Shamzi Mohamed,*[1,4] *Murni Halim*[1,4] *and A.B. Ariff*[1,2,4]*

[1]*Department of Bioprocess Technology, Faculty of Biotechnology and Biomolecular Sciences, Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor, Malaysia*
[2]*Institute of Bioscience, Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor, Malaysia*
[3]*Department of Molecular Biology, Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300, Kota Samarahan, Sarawak, Malaysia*
[4]*Bioprocessing and Biomanufacturing Research Center, Faculty of Biotechnology and Biomolecular Sciences, Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor, Malaysia*

Received 17 February 2014; Revised 24 July 2014; Accepted 6 August 2014

ABSTRACT: In the present work, the effects of dual impeller configurations comprising of Rushton turbine (RT) and Concave-bladed disk turbine (CD-6) on the oxygen transfer profile and fermentation performance of kojic acid production by *Aspergillus flavus* Link 44-1 was investigated. Batch cultivations of *A. flavus* Link 44-1 were performed in 2 L stirred tank bioreactor. The fermentations were conducted using different dual impeller systems; (1) RT-RT, (2) CD6-CD6, (3) RT-CD6, and (4) CD6-RT (bottom-top impeller). It was perceived that dual CD-6 system was able to improve oxygen transfer rate by about 25–45% over the hybrids of RT and CD-6 and the typically configured dual RT system. While no substantial disparity could be seen on the fungal growth rate by the manipulation of the impeller, high concentration of kojic acid (44.93 g L^{-1}) was attained with the use of dual CD-6 as the mixer. Efficient agitating system that can facilitate good gas dispersion capability is crucially required in order to counteract the problem of oxygen solubility limitation faced in such viscous fungal fermentation broth. The results from this work suggested the promising capability of dual CD-6 configuration in enhancing productivity of kojic acid fermentation in stirred tank bioreactor. © 2014 Curtin University of Technology and John Wiley & Sons, Ltd.

KEYWORDS: concave disk turbine; Rushton turbine; dual impeller system; kojic acid; oxygen transfer; volumetric mass transfer coefficient

INTRODUCTION

The significance of kojic acid, a fungal metabolite produced by *Aspergillus* spp., *Penicillium* spp. and *Acetobacter* spp., was reported extensively in the literature due to its interesting and diverse industrial applications. The enormous industrial capabilities of kojic acid present a fascinating field for research, creating an interest among the researchers to develop the most optimal way of its production, particularly for large scale applications. Industrially, kojic acid is produced via submerged fermentation in stirred tank bioreactor. A number of issues related to the strain and process development for kojic acid fermentation in stirred tank bioreactor have been addressed and reported.[1–3] However, new knowledge and information are progressively needed for further improvement of large scale kojic acid production.

One of the important issues that require great consideration in kojic acid fermentation is the improvement of the oxygen transfer in the culture. As oxygen transfer represents the rate limiting step for an aerobic bioprocesses,[4] its importance in contributing to the process productivity could not be neglected. A report by Ariff and his coworkers[3] revealed that two-phase dissolved oxygen tension (DOT) control strategy was necessary for the enhancement of kojic acid production by *A. flavus*. During active growth phase, high DOT level (80% saturation) should be maintained to increase the secretion of cell-bound enzymes which are accountable for the conversion of glucose to kojic acid. On the other hand, low DOT level (30% saturation) was needed during the production phase to prevent kojic acid from being extremely degraded to other compounds. Oxygen transfer is associated with several affecting factors and one of the

**Correspondence to*: Arbakariya B. Ariff, Department of Bioprocess Technology, Faculty of Biotechnology and Biomolecular Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia. E-mail: arbarif@upm.edu.my