

438c Spore Germination and Cell Immobilization of *Rhizopus Oryzae* in a Rotating Fibrous Bed Bioreactor for Controlling Morphology and Improving Lactic Acid Production

Nuttha Thongchul and Shang-Tian Yang

A rotating fibrous bed bioreactor (RFBB) was used to immobilize *Rhizopus oryzae* and to control fungal morphology during fermentation, which resulted in improved mixing, oxygen transfer, and L(+)-lactic acid production from glucose and starch compared to free cell fermentation in a conventional stirred tank bioreactor. In our previous study, byproduct ethanol was observed during the fermentation although high oxygen transfer rate was maintained in the RFBB. This result was consistent with the estimation from an oxygen diffusion model explaining the occurrence of oxygen starvation in the overgrown biofilm attached on the fibrous matrix. Fungal cell growth in the RFBB begins with spore germination and cell immobilization in the fibrous matrix; therefore, controlling growth on the fibrous matrix to prevent internal oxygen limitation can be achieved by control of spore and cell immobilization. To understand the spore and cell immobilization mechanism in the fibrous matrix, spore germination, immobilization, and cell growth in various fibrous matrices under different rotational speeds were studied. The result showed that the rotational speed did not greatly affect spore germination; however, it influenced spore and cell immobilization. Surface property and structure of the fibrous matrix also played important roles in affecting the immobilization mechanism and efficiency. Both woven and nonwoven cotton matrices were able to immobilize all spores and produced a cell-free fermentation broth, whereas only nonwoven polyester matrix at a relative high rotational speed could be effectively used for spore immobilization. Mathematical models for spore germination and cell immobilization will be discussed in this presentation.