531a Controlling *Rhizopus Oryzae* Biofilm Growth and Lactic Acid Production in a Rotating Fibrous Bed Bioreactor

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 as compared to free cell fermentations in conventional stirred tank bioreactors. Our previous study showed that oxygen was one critical factor affecting lactic acid production by *R. oryzae*. Lack of oxygen resulted in low lactic acid production because of the pathway shunted to ethanol production and eventually led to loss in fungal activity and cell death. In this work, it was found that maintaining a high level of dissolved oxygen (DO) in the RFBB did not improve lactic acid production, whereas increasing oxygen transfer rate led to an increase in lactic acid productivity. Ethanol production was found although a high oxygen transfer rate in the fermentation medium was maintained, indicating an anoxic condition occurring in the biofilm on the rotating fibrous matrix. This finding was consistent with estimation from an oxygen diffusion model, which could explain the occurrence of oxygen starvation in the overgrown biofilm attached on the fibrous matrix. Controlling the thickness of biofilm on the fibrous matrix to prevent oxygen diffusion limitation could be achieved by shaving off the fungal hyphae at the outer region or limiting the concentration of nitrogen source in the medium. The tensile strength of fungal mycelia plays roles in controlling shaving mechanism. Shaving occurs only when the shear stress is higher than the mycelial tensile strength and the shaving rate is proportional to the specific energy dissipation rate, which is in turn affected by the rotational speed of the fibrous matrix. Besides mechanical hyphal shaving-off, the growth and metabolic pathway of immobilized *R. oryzae* on the fibrous matrix also could be controlled by manipulating the medium composition. Nitrogen is the key composition controlling fungal growth and activity. To limit growth and maintain fungal activity in the production phase, fermentations with various urea concentrations were studied. The effect of urea concentration on fungal cell growth and lactic acid production was determined.