Abstract
Photoautotrophic cultivation of Euglena gracilis results in cells with high α-tocopherol content but the final cell concentration is usually very low due to the difficulty of supplying light efficiently to the photobioreactor. On the other hand, Euglena grows heterotrophically to high cell concentrations, using various organic carbon sources, but the α-tocopherol contents of heterotrophically grown cells are usually very low. Sequential heterotrophic/photoautotrophic cultivation, by which cells are grown heterotrophically to high cell concentrations and then transferred to photoautotrophic culture for accumulation of α-tocopherol was therefore investigated for efficient α-tocopherol production. In batch culture, using glucose as the organic carbon source, the cellular α-tocopherol content increased from 120 μg g− 1 at the end of heterotrophic phase to more than 400 lag μg g− 1 at the end of the photoautotrophic phase. By using ethanol as the organic carbon source during the heterotrophic phase, adding corn steep liquor as a nitrogen source and optimizing light supply during the photoautotrophic phase, the α-tocopherol content of the cells at the end of the photoautotrophic phase increased to 1700 μg g− 1. A system consisting of a mini-jar fermentor (for the heterotrophic phase) and an internally illuminated photobioreactor (for the photoautotrophic phase) was then constructed for continuous sequential heterotrophic/photoautotrophic cultivation. The cells were continuously cultivated heterotrophically in the mini-jar fermentor and the effluent was continuously passed through the photobioreactor for α-tocopherol accumulation. In this way, it was possible to produce 7 gmf l− 1 cells containing about 1100 μg α-tocopherol per g-cell continuously for more than 420 h. The continuous process resulted in α-tocopherol productivity of 100 lag μg l− 1 h− 1 which is about 9.5 and 4.6 times higher than those obtained in batch photoautotrophic culture and batch heterotrophic cultures, respectively.