Abstract
Reduction in the cost of microalgae oil requires improvement in the growth rate, oil content of the cells, and reduced cost of construction and operation of bioreactors. Photosynthetic microorganisms have been mainly cultivated under photoautotrophic conditions, using inorganic carbon as the carbon source and light as the source of energy. However, photoautotrophic cultures have several limitations which include low growth rates and low biomass concentrations due to poor light distribution inside the photobioreactors, especially at high cell densities. The requirement for light is the most import factor limiting productivities of photoautotrophic cultures. It is very difficult to achieve homogenous distribution of light within the photobioreactors, especially in large scale closed systems at high cell densities due to self-shading by the cells. Due to heterogeneous distribution of light, light limitation and photoinhibition can be taking place simultaneously inside the same photobioreactor. In order to reduce the cost of production, open air photobioreactors have been extensively used for commercial cultivation of microalgae. However, the biomass concentrations are usually very low, making harvesting laborious, costly, and very inefficient. It is also very difficult to control culture conditions in open air systems. Many parts of the world are not suitable for outdoor photoautotrophic cultures because of the extreme temperatures and low levels of insolation for most part of the year. Furthermore, maintaining monocultures in open air systems is also very difficult. Thus, use of open ponds has been limited to strains that can grow under selective conditions such as high pH (e.g., Spirulina spp.), high salinity (e.g., Dunaliella spp.), or that can grow very rapidly (e.g., Chlorella spp.). At this time, unfortunately, most of the oil-producing strains do not have selective growth conditions.