IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Specialized Technologies, Including Nanotechnology (8)

Author: Prof.Dr. Akira Takahashi
University of Tokushima, Japan

DEVELOPMENT OF UVA STERILIZATION TECHNOLOGIES THAT CAN BE USED IN SPACE PLANT FACTORIES

Abstract

The establishment of food production systems that produce safe food is a big concern in space as well as on earth. The number of factories that are devoted to artificial cultivation of plants has been increasing in recent years. Many of these factories use hydroponics, in which circulating nutrient solutions instead of soil are used to grow plants in an artificial environment to provide a steady supply of high quality plant materials for food. However, contamination of hydroponic nutrient solutions by pathogens that can propagate and spread throughout a plant factory is a significant problem. The use of treated wastewater for irrigation is increasing, especially in those areas where water resources are limited. Thus, strategies for effective disinfection of hydroponic nutrient solutions are needed. In this study, we developed a new disinfection device equipped with an ultraviolet A (UVA) light emitting diode (LED) that can be used to disinfect hydroponic nutrient solutions in plant factories. We first evaluated the basic disinfection capability of the device and then estimated its bactericidal effect in a small scale model system. The log survival ratio was related to UVA irradiation fluence and the volume of nutrient solution. From the assay results, we devised a kinetics equation to describe the relationship between nutrient solution volume, log survival ratio, and UVA fluence. Together our results show that UVA irradiation could be used to disinfect hydroponic nutrient solutions, and the derived kinetics equations can be used to determine optimal conditions, such as nutrient solution volume, UVA irradiation, and killing activity, to develop devices that disinfect hydroponic nutrient solutions. If a desired log survival ratio goal is defined, the equations we derived can be used to estimate the required UVA fluence. Using these results, similar devices could be customized for installation in plant factories to achieve economical disinfection of hydroponic nutrient solutions without chemicals or generation of hazardous waste. Moreover, this device could be incorporated into existing plant factories without disturbing production lines. This system may be applicable to food production in plant factory in space.