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Influence of Infrared Radiation on the Growth Rate of Microalgae Chlorella sorokiniana

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Abstract : Nowadays, the progressive decrease of primary natural resources and ongoing upward trend in terms of energy demand, have resulted in development of new generation technological processes which are focused on step-wise production and residues utilization. Thus, microalgae-based 3rd generation bioeconomy is considered one of the most promising approaches that allow production of value-added products and sophisticated utilization of residues biomass. In comparison to conventional biomass, microalgae can be cultivated in wide range of conditions without compromising food and feed production, and thus, addressing issues associated with negative social and environmental impacts. However, one of the most challenging tasks is to undergo seasonal variations and to achieve optimal growing conditions for indoor closed systems that can cover further demand for material and energetic utilization of microalgae. For instance, outdoor cultivation in St. Petersburg (Russia) is only suitable within rather narrow time frame (from mid-May to mid-September). At earlier and later periods, insufficient sunlight and heat for the growth of microalgae were detected. On the other hand, without additional physical effects, the biomass increment in summer is 3-5 times per week, depending on the solar radiation and the ambient temperature. In order to increase biomass production, scientists from all over the world have proposed various technical solutions for cultivators and have been studying the influence of various physical factors affecting biomass growth namely: magnetic field, radiation impact, and electric field, etc. In this paper, the influence of infrared radiation (IR) and fluorescent light on the growth rate of microalgae Chlorella sorokiniana has been studied. The cultivation of Chlorella sorokiniana was carried out in 500 ml cylindrical glass vessels, which were constantly aerated. To accelerate the cultivation process, the mixture was stirred for 15 minutes at 500 rpm following 120 minutes of rest time. At the same time, the metabolic needs in nutrients were provided by the addition of micro- and macro-nutrients in the microalgae growing medium. Lighting was provided by fluorescent lamps with the intensity of 2500 ± 300 lx. The influence of IR was determined using IR lamps with a voltage of 220 V, power of 250 W, in order to achieve the intensity of 13 600 ± 500 lx. The obtained results show that under the influence of fluorescent lamps along with the combined effect of active aeration and variable mixing, the biomass increment on the 2nd day was three times, and on the 7th day, it was eight-fold. The growth rate of microalgae under the influence of IR radiation was lower and has reached 22.6·10⁶ cells·mL⁻¹. However, application of IR lamps for the biomass growth allows maintaining the optimal temperature of microalgae suspension at approximately 25-28°C, which might especially be beneficial during the cold season in extreme climate zones.

Keywords : biomass, fluorescent lamp, infrared radiation, microalgae
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