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# Case Study on Innovative Aquatic-Based Bioeconomy for Chlorella sorokiniana

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**Abstract :** Over the last decade due to climate change and a strategy of natural resources preservation, the interest for the aquatic biomass has dramatically increased. Along with mitigation of the environmental pressure and connection of waste streams (including CO<sub>2</sub> and heat emissions), microalgae bioeconomy can supply food, feed, as well as the pharmaceutical and power industry with number of value-added products. Furthermore, in comparison to conventional biomass, microalgae can be cultivated in wide range of conditions without compromising food and feed production, thus addressing issues associated with negative social and the environmental impacts. This paper presents the state-of-the art technology for microalgae bioeconomy from cultivation process to production of valuable components and by-streams. Microalgae <em>Chlorella sorokiniana</em> were cultivated in the pilot-scale innovation concept in Hamburg (Germany) using different systems such as race way pond (5000 L) and flat panel reactors (8 x 180 L). In order to achieve the optimum growth conditions along with suitable cellular composition for the further extraction of the value-added components, process parameters such as light intensity, temperature and pH are continuously being monitored. On the other hand, metabolic needs in nutrients were provided by addition of micro- and macro-nutrients into a medium to ensure autotrophic growth conditions of microalgae. The cultivation was further followed by downstream process and extraction of lipids, proteins and saccharides. Lipids extraction is conducted in repeated-batch semi-automatic mode using hot extraction method according to Randall. As solvents hexane and ethanol are used at different ratio of 9:1 and 1:9, respectively. Depending on cell disruption method along with solvents ratio, the total lipids content showed significant variations between 8.1% and 13.9 %. The highest percentage of extracted biomass was reached with a sample pretreated with microwave digestion using 90% of hexane and 10% of ethanol as solvents. Proteins content in microalgae was determined by two different methods, namely: Total Kejadahl Nitrogen (TKN), which further was converted to protein content, as well as Bradford method using Brilliant Blue G-250 dye. Obtained results, showed a good correlation between both methods with protein content being in the range of 39.8–47.1%. Characterization of neutral and acid saccharides from microalgae was conducted by phenol-sulfuric acid method at two wavelengths of 480 nm and 490 nm. The average concentration of neutral and acid saccharides under the optimal cultivation conditions was 19.5% and 26.1%, respectively. Subsequently, biomass residues are used as substrate for anaerobic digestion on the laboratory-scale. The methane concentration, which was measured on the daily bases, showed some variations for different samples after extraction steps but was in the range between 48% and 55%. CO<sub>2</sub> which is formed during the fermentation process and after the combustion in the Combined Heat and Power unit can potentially be used within the cultivation process as a carbon source for the photoautotrophic synthesis of biomass.

**Keywords :** bioeconomy, lipids, microalgae, proteins, saccharides
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