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Algal Biomethanation Generate with Organic Amendments

Taumudeen Arek*

Department of Biotech Engineering, California State University, California, USA

Abstract

Microalgae may be a viable alternative to fossil fuels that have a negative environmental impact. Higher quality biogas can be produced by combining microalgae with other substrates. This type of biogas is regarded as one of the most promising solutions for mitigating climate change. The study included new research into biogas yield in a three-stage bioreactor (TSB) during the anaerobic digestion of Cladophora glomeration microalgae with inoculants from cattle manure and sewage sludge at different organic loading rates (OLR). The goal of selecting the optimal OLR in this manner was to increase the energy potential of biomass. The study was carried out at OLRs of 2.87, 4.06, and 8.13 Kg VS/m3 d. The highest biogas yield was determined after extensive research.

Keywords: Cladophora • Bioreactor • Sewage • Sludge

Introduction

When the OLR was 2.87 Kg VS/m3 d. The average biogas yield was 439.0 4.0 L/Kg Sodded with this OLR, and the methane yield was 306.5 9.2 L CH4/Kg Sodded. The yield of biogas and methane decreased by 1.55 times after increasing the OLR to 4.06 and 8.13 Kg VS/m3 d, respectively. When the OLR was 2.87 Kg VS/m3 d, the higher yield was due to better decomposition of elements C, N, H, and S during the fermentation process. Methane concentrations remained high at all OLRs, ranging from 68% to 80%. When the OLR was 2.87 Kg VS/m3 d, the highest biomass energy potential was determined, with a value of 3.05 kWh/Kg Sodded. The high biogas yield and biomass energy potential determined this biomass energy potential [1].

One of the most promising areas of renewable energy is biofuel production using renewable natural resources. To increase biofuel production, technologies capable of producing large amounts of renewable natural resources in a short period of time must be developed. Biofuel production from biomass is the fourth highest in the world. This demonstrates that the use of biomass in the application of various technologies is becoming increasingly important. The desire to use macroalgae for biofuel production promotes reductions in carbon dioxide (CO2), nitrogen oxides (NOx), sulphur dioxide (SO2), and particulate matter (PM) emissions into the atmosphere. According to a review of the literature, algae is regarded as one of the most promising raw materials for the production of bioenergy [2].

One of the primary bioreactor parameters that determines biogas yield is the organic loading rate (OLR). The use of macroalgae, which grow in bodies of water and are high in organic matter, for biogas production appears to be promising. Algae are a great way to replace high-energy crops like Miscanthus silage in anaerobic digestion. Mixing algae with Miscanthus silage at an OLR of 2.0 g VS/L d resulted in a biogas yield of 628.0 mL/g VS. One of the factors influencing substrate fermentation stabilisation is OLR. Water blooms are becoming an increasingly pressing issue as the climate warms. Increasing amounts of nitrogen and phosphorus compounds enter water bodies as a result of intensive human activity in both the industrial and agricultural sectors [3].

***Address for Correspondence:** Taumudeen Arek, Department of Biotech Engineering, California State University, California, USA, E-mail: taumudeenarek3@gmail.com*

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Literature Review

Aquatic biomass has an advantage over other plants in that it does not compete for arable land with food crops. Algae produce a significant increase in biomass, and when collected from water bodies, the condition and quality of those bodies improve. Biogas production does not necessitate any additional macroalgae processing. Depending on the environmental conditions and type of macroalgae, macroalgae have high concentrations of carbohydrates (up to 60%), proteins (10-47%), and fats (1-3%), making them suitable as an energy source for microorganisms. Anaerobic digestion of algae from carbohydrates and fats produced the highest concentration of hydrogen required for energy extraction. Furthermore, even when algal biomass is mixed with other substrates, the methanogenesis process continues [4].

By using biomass resources wisely, greenhouse gas emissions can be reduced. As a result, it's important to find biomass sources that satisfy both ecological and economic requirements. The environment would become more polluted as a result of improper management of biomass resources, which can have detrimental effects on both people and the environment. The supply and cost of food would be negatively impacted by improper land use. According to studies, using macroalgae to extract energy is a practical substitute for traditional energy crops.In this study, we looked at the biogas and methane production from the anaerobic digestion of the green macroalga Cladophora glomerata using sewage sludge and cattle manure as inoculants. During the research, yields of biogas and methane at various OLRs were noted [5].

This study found that the OLR of 2.87 Kg VS/m3 d produced the highest biogas yield. At this OLR, methane concentration was 80%, biogas yield was 439.0 4.0 L/Kg VSadded, and methane yield was 306.5 9.2 L CH4/Kg VSadded. The biogas yield fell to 198.7 2.2 L/Kg VSadded after raising the OLR to 8.13 Kg VS/m3 d. The yield of biogas and methane at various stages of substrate supply to TSB was also determined by this research. This study demonstrated that the biogas yield decreased by 1.55 times when the OLR was raised from 2.87 Kg VS/m3 d to 8.13 Kg VS/m3 d. At various OLRs, methane concentrations were high, ranging from 68% to 80% [6].

Discussion

The biogas yield in this study was 2.7 times lower. The organic materials are converted into biogas by using sugar waste. Biogas can be produced from up to 90% of the mass of biodegradable waste. Biogas's energy value (methane concentration and content) is influenced by both the amount of organic matter present and the microbiological processes taking place.

Researchers discovered that the cultivation of algae like Ulva sp. lowers the levels of volatile fatty acids and thereby enhances the quality of the biogas. In this study, the lower VS breakdown and conversion to biogas was the cause of the lower biogas yield. Other researchers used macrocystis in a variety of biogas yield studies. Researchers fermented M. pyrifera and obtained a biogas yield of 282 mL/g VS to 383 mL/g [7].

Conclusion

The novel aspect of this work is the investigation of the biogas yield in a three-stage bioreactor using Cladophora glomerata macroalgae inoculated with sewage sludge and cattle manure under various OLRs.When green macroalgae with inoculants from cattle manure and sewage sludge are used in TSB, the anaerobic digestion process is dependent on the substrate OLR and significantly affects the biogas yield. The production of biogas from green macroalgae is a practical substitute for fossil fuels. The findings of this study demonstrate that an efficient and sustainable method for energy extraction is a mixture of Cladophora glomerata and inoculants at optimal OLR.

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Conflict of Interest

There is no conflict of interest by author.

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