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Determining the Oil Content of Seaweed Native to Connecticut for Biofuel Production

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Presently, many of the environmental challenges facing the world are energy-related and concerned with sustainability. These issues have increased the need for cleaner alternative fuels, such as biofuels. Although biofuels have been in existence since several years ago, e.g., burning of wood for heat, they are now widely researched, as they make up a larger percentage of alternative fuels. An increased interest in green fuels calls for the development of the renewable energy sector, causing many developed countries to create a vision of switching away from petroleum usage by 2050 (i.e., The Go-Green Movement). The emergence of renewable energy options is crucial to combatting global warming and healing the environment.

The potential of biofuels is based on the characteristics of the plants they are extracted from. These plants mostly contain vegetable oil, fats, sugar, or cellulosic materials. For this research, we focused on seaweed, also known as macroalgae. Algae-based biofuels are third generation-based biofuels, which are ideal for biofuel production and are generated from specific algae species that utilize carbon dioxide. They grow fast, even in locations unsuitable for crops, absorb carbon dioxide during the process, and can be coupled to wastewater treatment (Hannon, M. et al, 2010). However, there have been arguments about the economic viability of this fuel. According to Milledge, although they have a remarkably high potential as a source of sustainable biofuels, there has been no feasible commercial-scale extraction of fuel from them (John, J. Milledge, et al, 2014).

Therefore, our research purpose was to determine the oil content of some of the local seaweeds in the state by comparing the yield of each species collected to determine which has the highest potential. The Soxhlet extraction method was employed for this research as we dealt with dried seaweed. The collected seaweeds (Fucus distichus (Rockweed), Monostroma Grevillei (Sea Cellophane), and Ulva Linza (Mini Sea Lettuce)) from the Silver Sands State Park in Milford were dried with the tray drier. Oil was extracted by continuously heating a solvent until bio-oil was extracted completely from the seaweed. The solvent was evaporated from the mixture using a rotary evaporator, leaving the extract. Table 1 provides a summary of the results obtained from each extraction.

Based on the results obtained, the Sea Cellophane gave a 6.64% which is the highest yield, compared with the other extractions. This is due to its large surface area. On the other hand, sea lettuce gave the lowest yield at 3.62%. Based on the small size and narrow shape of the sea lettuce, the result is unsurprising. Due to the region where seaweed is collected, low oil yields were obtained. Going further into the seawater, past the shoreline will increase the chances of collecting fresh seaweed with higher oil content. However, further research and additional oil extractions on fresh seaweed need to be performed to determine if higher yields can be achieved. Overall, this data shows some potential for the use of native Connecticut seaweed as a green fuel source.

Table 1. Extraction Data from Seaweed Species

Soxhlet Extraction of Seaweed Date	Date: 06/27/2022	Date: 07/01/2022	Date: 07/08/2022
Type of Seaweed	*Fucus Distichus* (Rockweed)	*Monostroma Grevillei* (Sea Cellophane)	*Ulva Linza* (Mini Sea Lettuce)
Weight of Seaweed	8.02 g	8.28 g	8.01 g
Volume of Hexanes	233 ml	300 ml	300 ml
Weight of Extracted Oil	0.38 g	0.55 g	0.29 g
Number of Cycles	12	10	8
Time Taken	1 h 46 min	1 h 19 min	1 h 2 min
% Yield	4.74%	6.64%	3.62%

Works Cited

1. Hannon, M.; et al. "Biofuels from Algae: Challenges and Potential." *Biofuels*, vol 1, Sept. 2010, pp 763-784. US National Library of Medicine, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3152439.
2. John, J. Milledge, et al. "Macroalgae-Derived Biofuel: A Review of Methods of Energy Extraction from Seaweed Biomass." *Energies*, vol 7, 7 November 2014, pp 7194-7222. ResearchGate, doi:10.3390/en7117194.