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Microalgae in Modern Agriculture - A Green Technological Approach

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Green technology is applied to mitigate the devastation that mankind inflict on the environment. When executed correctly, they will nourish the world's population and propagate valuable cultivation techniques to the forthcoming generation. Because they lessen environmental harm, produce fewer fossil fuel byproducts, and support the development of sustainable agriculture, green technology is essential for the agricultural industry. Sustainable agriculture depends on renewable energy sources. A natural resource that can replenish itself after being used up is called renewable. There is no end to the renewable resource. Currently, the majority of agricultural equipment uses fossil fuels, which contribute to climate change by releasing greenhouse gas emissions into the environment. If we adopt renewable energy sources and associated technology, we could reduce this environmental harm. Renewable energy and agriculture go well together since these natural resources can be harvested indefinitely. These may provide farmers with a steady stream of income. Microalgae in agriculture are one of the promising green technologies. It can be used for producing biofuels, treating wastewater, reducing pollution, and resource recovery systems. The primary energy source for human activity today is biofuel. The research of microalgae-based biofuel has successfully demonstrated how it is feasible to attain the sustainable growth and clean energy sources. Microalgae-based green technology advancements added value as animal feed and biofertilizer in addition to environmental benefits (Yap *et al.*, 2021).

WHAT ARE MICROALGAE?

Luckily, the invention of microalgae-based biofuel has shown that it is possible to accomplish the goal of using environmentally-friendly and clean energy sources. These microbes carry out green synthesis and a crucial natural process that lowers the atmospheric CO_2 concentration. Microalgae are also distinguished by a brief generation period and exponential growth in the presence of a favorable environment.

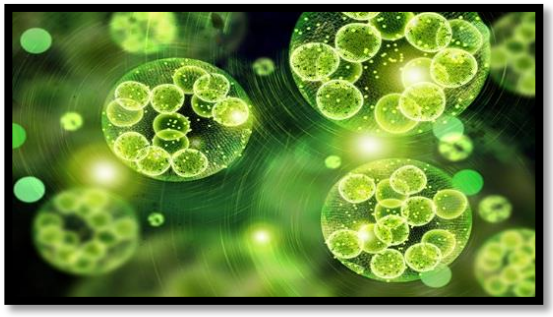

Figure 1. Image of Microalgae

MICROALGAE IN BIOFUEL PRODUCTION

One of the renewable energy sources is bioenergy, which is created from organic or biological origins, such as vegetation, livestock or their byproducts. Another name for bioenergy is "clean, sustainable energy." Fuel must be burned in order to be converted to energy, but burning fossil fuels releases carbon dioxide, and the amount of carbon dioxide produced depends on the type of fuel being burned. CO_2 is a major source of greenhouse gases at the same time. Fuel combustion is a major contributor to carbon dioxide emissions. However, the amounts of carbon dioxide produced by various fuels vary slightly. The statistics on carbon dioxide emissions from fuel combustion are as the main role of coal combustion is to produce the thermal energy which may be employed in a diverse range of ways, depending on the amount of carbon dioxide emitted per million British thermal units. (US Department, 2021).

MICROALGAE IN POLLUTION REDUCTION

Since 1980, managing hazardous materials and the environmental harm they produce has received a lot of focus. Many techniques, including physical filtration, evaporation, and even chemical reactions, have been devised to remove such pollutants (Rajasulochana and Preethy, 2016). For instance, the chemical precipitation technique produces a lot of sludge and is comparatively ineffective at removing heavy metals at low concentrations. As a result, scientists are very interested in using biological agents to combat environmental contamination.

MICROALGAE IN RESOURCE RECOVERY SYSTEMS

Microalgal and cyanobacterial resource recovery systems have the ability to significantly enhance nutrient recovery from wastewater by delivering effluent nitrogen (N) and phosphorus (P) rates below the modern technological limit. However, for the successful application of phytoplankton, process models must be established that efficiently reconcile verisimilitude and simplicity to estimate dynamic performance in response to environmental variables. Excellent water resource recovery models using microalgae were created by the scientists. (Shoener *et al*., 2019).

MICROALGAE AS ANIMAL FEED

For domestic livestock and poultry production, new sources of high-nutrient feedstocks must be found right away. This is necessary to meet the world's expanding food demand as well as to create functional meals made from microalgae that have many positive health effects. To supplement current feedstock, many species of microalgae and cyanobacteria are employed. Since microalgae contain large amounts of proteins, carbs, lipids, minerals, vitamins, and other high-value compounds, they have been identified as a possible feedstock for domestic animals. The physiological outcomes of animals given microalgal biomass are incredibly favorable. Many economic trade-offs must be taken into account when growing microalgae on a large scale for use as feed, including the choice of strains with desirable nutritional characteristics, cultivation methods, and processes for downstream processing. Further investigations needed to reduce the overall costs of cultivation.

MICROALGAE AS BIO-FERTILIZER

Two common forms of photosynthetic microalgae are prokaryotic blue algae and eukaryotic green algae. They have a ton of potential to be used as biological resources in the creation of goods like food, fuel, and health care items, among other things. These fascinating organisms can also be used in modern agriculture because of their ability to increase soil nutrient absorption and macro- and micronutrient intake. In addition to improving soil fertility and quality, microalgae can produce plant growth hormones, polysaccharides, antibacterial compounds, and other metabolites that assist plant growth. The advantages of cyanobacteria and green algae as bio-fertilizers for improving soil fertility and quality and promoting plant development are widely relied upon in modern agriculture (Guo *et al.,* 2020).

CONCLUSION

Microalgae hold great promise for the use of green technology. It can be applied to a variety of green technologies, including those for producing biofuels, treating wastewater, reducing pollution, and resource recovery systems. The primary energy source for human activity today is biofuel. While the discovery of biofuels did raise the standard of living for people, it also had negative effects on the environment, such as global warming. Sustainable energy sources are always the main worry when it comes to barriers to green technologies. Fortunately, the advancement of biofuel based on microalgae has demonstrated the ability to realize the goal of sustainable and clean energy sources. Microalgae-based green technology advancements added value as animal feed and bio-fertilizer in addition to environmental benefits. Although more research is being done on the connection between microalgae and green technology, more work and investigation are still needed. Researchers in this sector have an excellent opportunity to investigate additional potential uses for increasing the value-added commodities that can be obtained from microalgae and boosting the variability of biomass resources.

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