IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

BIOFUEL PRODUCTION BY MICROALGAE AND BACTERIA:A REVIEW

Shipra Mishra,Arvind Kumar Singh,Avshesh Kumar

Institute-Department of Botany,T.D.P.G.College.Jaunpur.Affliated to VBSPU,Jaunpur(U.P)

Abstract- Energy is the engine of economic growth and of paramount importance to humanity and sustainable development. Microalgae and bacteria are an important part of the natural carbon cycle and can efficiently utilize water and soil carbon resources. The ability of microalgae to reduce her CO2 emissions and produce oil with high productivity has been demonstrated. Therefore, this third generation biodiesel should be popularized. This paper describes the basic properties and application areas of bacteria and microalgae. The purpose of this review is to provide useful information to support the future development of efficient and commercially viable microorganisms-based biodiesel production technologies.

Keywords: *microalgae , energy,bacteria and biodiesel*

Introduction-Energy being the driver of economic growth as an utmost importance for mankind and sustainable development (Singh and Singh, 2015). Nowadays, the universal energy system is chiefly based on utilization of fossil fuels viz. coal oil and natural gas (Enshaeieh et al ., 2015). This system has several drawbacks such as:

1. cause local, regional and global pollution
2. While fossil fuel reserves are in short supply, demand for fossil fuels is soaring as population increases, leading to a global energy crisis.
3. Burning fossil fuels produces greenhouse gas emissions (CO2, NOx, SOx) that contribute to global warming and climate change (Barbir, 2009).

The advent of industrialization and inappropriate use of natural resources are deteriorating the global environment (Bazmi, 2011; Zaman et al., 2013). In addition, rising oil prices, projected dwindling global oil reserves, and awareness of the environmental impact of burning fossil fuels have increased researchers' interest in finding alternative transportation fuels (Rottig et al. 2010). ; Rashid et al., 2014. Kiran et al., 2016). Biofuels are therefore an effective alternative to fossil fuels to overcome this dilemma (Kirrolia et al., 2013).

Sustainability of biofuel production therefore needs to focus on bioenergy waste rather than growing bioenergy crops only on arable land and food feed, so as not to compete with crops from non-arable land. I have. Moreover, the use of biofuels, albeit economically less cost-effective, will reduce the global environmental impact compared to conventional fossil fuels (Jefferson, 2008; Bajwa et al., 2016). . Biofuels derived from natural sources are inherently more versatile and are considered sustainable and environmentally friendly compared to conventional fuel sources (Doan et al., 2012).

First Generation Feedstocks - Biofuel-based feedstocks are divided into three generations of biofuels. Jatropha, Coconut, Copra, Peanut, Almond, Barley, Camelina, Okra Seed, Bay Leaf, Oats, Poppy, Sunflower, Sorghum, Rice Bran, Sesame, Karanja Biofuel, Biofuel Produced from Wheat, Soybean, Canola (Balat et al., 2008; Robbins et al., 2012; Kirrolia et al., 2013).

Second Generation Feedstocks – According to Rashid et al. (2014), biofuel production is facing the food vs. fuel dilemma, animal fats and cooking waste (also commonly used for biofuel production). Therefore, it faces strong criticism arising from raw materials alone. Meanwhile, such raw materials are always available to meet the world's future energy needs.

Third Generation Feedstocks – Micro-organisms such as microalgae, bacteria, yeast and fungi that can be used to produce biofuels. These raw materials have advantages over 1st and 2nd generations and also contribute to greenhouse gas reduction (Rashid et al., 2014;).

India consumes more diesel energy than gasoline. As such, India consumes about 450 million barrels of diesel per calendar year. Therefore, there is an urgent need in India to find alternative fuels to meet India's future energy needs (Shakeel et al., 2009).

Biodiesel, a renewable, biodegradable and clean-burning fuel, has been recognized as an ideal alternative to the energy crisis (Li et al., 2011; Chang et al., 2015; Abomohra et al. 2016). Rotting et al. (2010) stated that about 90% of the biofuel market is currently covered by bioethanol and biodiesel. Biodiesel is composed of fatty acid alkyl esters of long-chain fatty acids and short-chain alcohols (mainly methanol and ethanol) and is generally produced by transesterification of triglycerides with alkaline acids or enzymes in vegetable oils or animal fats (Fadil et al., 2016). The transesterification process is a very important step for industrial scale biodiesel production. Homogeneous alkaline catalysts such as potassium hydroxide and sodium hydroxide are used in common industrial practice (Yu et al., 2015). Biological catalysts (lipases) can be used to convert lipids with sufficient free fatty acid content, such as microalgal lipids, a limitation of homogeneous alkaline catalysis. In transesterification reactions, lipases can be used to esterify free fatty acids to alkyl esters. Lipases have the advantage over other catalysts that they do not require excess energy and immobilization of the catalyst facilitates its recovery and recycling (Lopez et al., 2015). The major drawbacks of using biological catalysts are long reaction times and high production costs (Hidalgo et al., 2013).

Microalgal biodiesel appears to be the most promising renewable biofuel with the potential to fully replace petroleum-based transportation fuels (Lang et al., 2016). Microalgae have several advantages over other biofuel feedstocks, including: B. High lipid production capacity, no seasonal variation, low water and land requirements, and good photosynthetic efficiency are ecologically important (Sharma et al., 2015). India's tropical environment is also favorable for the maintenance and growth of algae species, which is a major advantage over other countries. India is a country with a rich microbial biodiversity, including about 841 species of seaweed, but fewer than 100 species have been investigated for biodiesel production. In the photosynthetic state, microalgae convert CO2 into various forms of products such as polysaccharides, proteins, lipids and hydrocarbons. Half of the biomass contains triglycerides, resulting in final productivity of over 10,000 gal/cre, making them highly petroleum efficient and highly valuable for bioenergy production (Prajapati et al., 2014). The following algal species are considered for bio mass- oil production such as *Scenedesmus dimorphus, Neochloris oleoabundans, Nannochloropsis salina, Nannochlorisoculata, Nannochloris sp ., Euglena gracilis, Phaeodactylum tricornutum, Pleurochry- siscarterae, Prymnesiumparvum, Tetraselmis chui, Tetraslm is suecica, Isochrysis galbana, Botryococcus braunii, Dunaliella tertiolecta* and *Spirulina* species (Kiran et al ., 2016). Genus Nannochloropsis is the most enchanting microalgae for the production of biodiesel. It can accumulate large amounts of lipids in the form of triglycerol and can be easily cultivated on an industrial scale. microalga *Scenedesmus obliquus* is considered promising for industrial-scale biodiesel production because it increases biomass, lipid content and fatty acid productivity. In addition, large-scale production of microalgal biodiesel for industrial applications needs to solve several ecological, economic and technical problems, and the productivity of microalgal oil per hectare is higher than that of synthetic It can be improved by learning Biology techniques and improving the light system. Archelvam and Nirmalakandan, 2013).). In addition, in the field of biodiesel, not only algae biofuels, which are traditional energy sources, but also microbial oils are attracting great attention as a new type of oil source. Bacterial lipids have found applications related to the production of renewable fuels and biobased oleochemicals. In addition, it has many advantages such as: B. Short life cycle, low labor, easy seasons and climate, and easy cultivation (Hidalgo et al., 2013). Additionally, excess microbial biomass after lipid extraction can be used as fertilizer for crop cultivation . According to Papanikolaou and Aggelis (2011), microorganisms capable of accumulating more than 20–25% of their dry cellular biomass as oil are called oleaginous, and the oil is called protozoan, protozoan, or microbial oil. In addition, certain bacterial groups belonging to the Actinobacteria (such as Streptomyces, Nocardia, Rhodococcus, Mycobacterium, Dietzia or Gordonia) are able to store lipids intracellularly and within TAGs under nitrogen-limited conditions. Yes (Zhang et al., 2011). In addition, under certain growth-restricted conditions, oleaginous unicellular bacteria that can form storage lipids also contain special proteins such as poly-3-hydroxybutyric acid (PHB) and other polyhydroxyalkanoic acids (PHAs) as intracellular inclusion bodies. lipids (Papanikolaou and Aggelis). , 2011). Microbial oils have many future commercial uses as dietary supplements, pharmaceuticals, aquaculture feed ingredients, and raw materials for biodiesel production. The physicochemical properties of biodiesel are evaluated based on the fatty acid profile including saturated, monounsaturated and polyunsaturated fatty acids (Kumar and Chauhan, 2013). Biodiesel parameters, i.e., H. cetane number, iodine number, and oxidative stability, correlated with unsaturated fatty acid levels, and cold filter plugging correlated with long-chain saturated fatty acids. However, a major obstacle to commercialization of microbial oils is the high cost of production. Therefore, in order to commercialize microbial oils on a wide scale, it is necessary to find strategies that can improve oil yields (Christophe et al., 2012). Several studies have shown that carbon exchange increases microalgal biomass and lipid productivity. Co-culturing of sterile Chlorella vulgaris and her four different growth-promoting bacteria revealed a synergistic relationship between each bacterium that could be enhanced by a consortium of bioengineered bacteria (Kouzuma and Watanabe, 2015). Therefore, this idea may open new perspectives for biodiesel research. Therefore, this study focuses on the isolation, screening and characterization of natural oleaginous algae and bacterial strains, as well as the optimization of various physio-biochemical factors for algal growth, bacterial staining and production of oil from oleaginous microorganisms. guessed The algal and bacterial biomass make these strains good candidates for high-efficiency biodiesel production.

Conclusion- Microalgae can harness natural water and soil carbon resources, and biodiesel, a more sustainable and environmentally friendly alternative to fossil fuels, can be made from microalgae. Bacteria also play an important role in the production of biofuels. However, the long-term stability and technical aspects of hybrid refineries need further research.

Acknowledgement –This review is supported by my supervisor Dr.Arvind Kumar Singh and my Cosupervisor Dr.Avshesh Kumar (Department of Botany T.D.P.G.College,Jaunpur,U.P.).

References-

1. Singh, S. P., & Singh, P. (2015). Effect of temperature and light o n the growth of algae species: a review. Renewable and Sustainable Energy Reviews , 50 , 431 - 444.
2. Enshaeieh, M., Abdoli, A., & Madani, M. (2015). Single Cell Oil (SCO) Production by
3. Rhodotorula mucilaginosa and its environmental benefits. Journal of Agricultural Science and Technology, 17 (2), 387 - 400.
4. Barbir, F.(2009). Transition to renewable energy systems with hydrogen as an energy carrier, Energy, 34 : 308 – 312
5. Bazmi, A. A., Zahedi, G., & Hashim, H. (2011). Progress and challenges in utilization of palm oil biomass as fuel for decentralized electricity generation. Renewable and Sustainable Energy Reviews , 15 (1), 574- 583.
6. Zaman, K., Khan, M. M., & Ahmad, M.(2013). Factors affecting commercial energy consumption in Pakistan: Progress in energy. Renewable and Sustainable EnergyReviews , 19 (3), 107 - 135.
7. Rötting, A., Wenning, L., Bröker, D., & Steinbüchel, A. (2010). Fatty acid alkyl esters: perspectives for production of alternative biofuels. Applied microbiology and biotechnology , 85

(6), 1713 - 1733.

8. Rashid, N., Rehman, M. S. U., Sadiq, M., Mahmood, T., & Han, J. I. (2014). Current status, issues and developments in microalgae derived biodiesel producti on. Renewable and sustainable energy reviews, 40, 760 -778.

9. Kiran, B., Pathak, K., Kumar, R., Deshmukh, D., & Rani, N. (2016). Influence of varying nitrogen levels on lipid accumulation in Chlorella sp . International Journal of Environmental Science and Technology, 13 (7), 1 - 10.

10. Kirrolia, A., Bishnoi, N. R., & Singh, R. (2013). Microalgae as a boon for sustain able energy production and its future research & development aspects. Renewable and Sustainable Energy Reviews, 20, 642 -656.

11. Jefferson, M. (2008). Accelerating the transition to sustainable energy systems. Energy Policy, 36 (11), 4116 - 4125.

12. Bajwa, K., & Bishnoi, N. R. (2016). Single cell oil of bacterial strains as a new source of high -value biodiesel! Isolation and screening for storage lipids in cytoplasm. Annals of Biology. 32 (1):1 – 6

13. Doan, Q. C., Moheimani, N. R., Mastrangelo, A. J., & Lewis, D. M. (2012). Microalgal biomass for bioethanol fermentation: Implications for hypersaline systems with an industrial focus. Biomass and Bioenergy , 46, 79 - 88.

14. Balat, M., Balat, H., & Öz, C. (2008). Progress in bioethanol processing. Progress in energy and combustion science, 34 (5), 551 - 573.

15. Robbins, M. P., Evans, G., Valentine, J., Donnison, I. S., & Allison, G. G. (2012). New opportunities for the exploitation of energy crops by thermochemical conversion in Northern Europe and the UK. Progress in energy and combustion science , 38 (2), 138 -155.

16. Kirrolia, A., Bishnoi, N. R., & Singh, R. (2013). Microalgae as a boon for sustain able energy production and its future research & development aspects. Renewable and Sustainable Energy Reviews, 20, 642 -656.

17. Rashid, N., Rehman, M. S. U., Sadiq, M., Mahmood, T., & Han, J. I. (2014). Current status,issues and developments in microalgae derived biodiesel producti on. Renewable and sustainable energy reviews, 40, 760 -778.

18. Shakeel. A., Khan. R., Mir. Z., Hussain, P.S, & Banerjee, U.L. (2009). Prospects of biodiesel production from microalgae in India. Renew Sustain Energy Rev 13 :2361 - 2372.

19. Li, W., Guo, Y., & Fu, K. (2011). Enclosure experiment for influence on algae growth byshading light. Procedia Environmental Sciences, 10, 1823 - 1828.

20. Chang, K. J. L., Rye, L., Dunstan, G. A., Grant, T., Koutoulis, A., Nichols, P. D., & Blackburn, S. I. (2015). Life cycle assessment: heterotrophic cultivation of Thraustochytrids for biodiesel production. Journal of Applied Phycology , 27 (2), 639-647.

21. Abomohra, A. E. F., Jin, W., Tu, R., Han, S. F., Eid, M., & Eladel, H. (2016). Microalgal b iomass production as a sustainable feedstock for biodiesel: Current status and perspectives.

Renewable and Sustainable Energy Reviews , 64 , 596 -606.

22. Fadhil, A. B., Aziz, A. M., & Al - Tamer, M. H. (2016). Biodiesel production from Silybum marianum L. seed oil with high FFA content using sulfonated carbon catalyst for esterification and base catalyst for transesterification. Energy Conversion andManagement, 108 , 255 -265.

23. Yu, N., Dieu, L. T. J., Harvey, S., & Lee, D. Y. (2015). Optimization of process configuration and strain selection for microalgae - based biodiesel production. Bioresource technology , 193 , 25 - 34.

24. López, B. C., Cerdán, L. E., Medina, A. R., López, E. N., Valverde, L. M., Peña, E. H., &

25. Grima, E. M. (2015). Production of biodiesel from vegetable oil and microalgae by fatty acid extraction and enzymatic esterification. *Journal of bioscience and* bioengineering , 119 (6), 706- 711.

26. Hidalgo, P., Toro, C., & Navia, R. (2013). Advances in direct transesterific ation of microalgal biomass for biodiesel production. *Reviews in Environmental Science and Bio/Technology*, *12* (2), 179 - 199.

27. Lang, I., Hodac, L., Friedl, T., & Feussner, I. (2016). Fatty acid profiles and their distribution patterns in microalgae: a comprehensive analysis o f more than 2000 strains from the SAG culture collection. *BMC Plant Biology* , *124* (11),1 - 16

28. Sharma, A. K., Sahoo, P. K., & Singhal, S.(2015). Screening and optimization of culture media for *Chlorella sp.* as a raw material for biodiesel production.*Int J pharma bio sci*. *6* (3): 251 - 262.

29. Prajapati, S. K., Malik, A., & Vijay, V. K. (2014). Comparative evaluation of biomass production and bioenergy generation potential of *Chlorella sp* . through anaerobic digestion. *Applied Energy, 114* (4) , 790 - 797.

30. Kiran, B., Pathak, K., Kumar, R., Deshmukh, D., & Rani, N. (2016). Influence of varying nitrogen levels on lipid accumulation in Chlorella sp . International Journal of Environmental Science and Technology , 13 (7), 1 - 10.

31. Arudchelvam, Y., & Nirmalakhandan, N. (2013). Energetic optimization of microal gal cultivation in photobioreactors for biodiesel production. *Renewable energy* , *56* , 77 - 84.

32. Papanikolaou, S., & Aggelis, G. (2011). Lipids of oleaginous yeasts. Part I: Biochemistry of single cell oil production. *European Journal of Lipid Science and Technology* , *113* (8),1031 - 1051.

33. Zhang, G., French, W. T., He rnandez, R., Alley, E., & Paraschivescu, M. (2011). Effects of furfural and acetic acid on growth and lipid production from glucose and xylose by *Rhodotorula glutinis* . *biomass and bioenergy* , *35* (1), 734- 740.

34. Kumar, N., & Chauhan, S. R. (2013). Performance and emission characteristics of biodiesel from different origins: a review. *Renewable and Sustainable Energy Reviews* , *21* ,633 -658.

35. Christophe, G., Kumar, V., Nouaille, R., Gaudet, G., Fontanille, P., P andey, A.,& Larroche, C. (2012). Recent developments in microbial oils production: a possible alternative to vegetable oils for biodiesel without competition with human food?. *Brazilian Archives of Biology and Technology*, *55* (1), 29 - 46.

36. Kouzuma, A., & Watanabe, K. (2015). Exploring the potential of algae/bacteria interactions. *Current opinion in biotechnology*, *33*, 125 - 129