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ROLE OF MICRO- ALGAE IN SUSTAINABLE BIOFUEL PRODUCTION

Aarti S. Chirwatkar*[1], Dr. Sujata A. Mankar [2] and Anita M. Chandak

[1]*PGTD of Microbiology, RTM Nagpur University, Nagpur, India.*

[2] *Department of Microbiology, Dada Ramchand Bakhru Sindhu Mahavidhyalaya, Nagpur, India.*

*aartichirwatkar@gmail.com, drsujatamankar@gmail.com

ABSTRACT:

World population is outbursting due to which the rising requirement for biofuel and energy is also shoot up. Energy is necessary for development and its demand is increasing on each coming days due to extravagant life style, mall culture, industrial activity and transportation in every strata of modern society. The growing requirement for energy, the reliance on traditional fuels and the worry about world population promote the search of alternative energy resources. The alternative energy sources like biofuels are sustainable, biodegradable option, supposed to have a significant role in the coming energy change and are encouraged by developed countries. The excessive use of petrochemical fuel and coal fuel price hikes, energy safety has turn out to be one of the main concerns and as such there is a requirement of a sustainable alternative energy source (Hammond et al., 2008). Fossil fuels from the leftovers fossils and it is blaze to let go energy for further utilization in field. The significant fossil fuels are oil, petrol, natural gas and coal as well collected by extraction taking out via drilling and mining. One promising alternative is the conversion of plant biomass into ethanol. Biodiesel has by now been approved to be an optional to fossil fuel and is at present used by many countries in biodiesel combinations. The blend of microbial consortium like yeast *Saccharomyces cerevisiae, Aspergillus niger, Bacillus sp., Neurospora crassa, E.coli* (Genetically modified), *Fusarium oxysporum, S. cerevisiae, and Paecilomyces sp*.**,** Microalgae, *Chlorella sp., Spirulina sp., Dunaliella* sp. , *Clostridium sp.* , etc. One of Cholorophyta is *Cholerlla vulgaris* is a type of microalgae, which is utmost important mainly used as food supplements in oriental food cuisine but this microalgae is also used as source of biomass in biofuel production.

Keywords: *Ethanol, Fossil fuel, biofuel, Cholerlla vulgaris*

Introduction:

Non-dietary crops like *Jatropha*, Mustard ,*Camelina*, and seashore mallow used for biofuel as biodiesel, can bloom on subsidiary agricultural ground where many agri-crops will not grow, or would generate only sluggish growth results. Microorganisms are the tiny living organisms cannot be seen by naked eyes. Such small organism plays a very important role in our various day to day life activities. These activities are beneficial to us. Microorganisms play an important role in biofuel production, fermentation, as an enzyme, biofertilizer etc. (Edubirdie, 2022). The present review focuses on the beneficial role of microorganisms in biofuel production. There is immense increase in demand for petroleum product throughout the world. This demand for petroleum product cannot be fulfilled due tolimited stock. It is now necessary to search an alternative way which replaces petroleum product. One of the alternatives is biofuel (Mekkawi et al, 2019). Many bacteria and algae produce Biofuel throughdifferent metabolic pathways such as TCA, glycolysis andother. Biofuel production by bacteria ex. Clostridium iscarried out by EMP pathway. Clostridium an anaerobicbacteria ferment sugar in an anaerobic environmentproduces ethanol. Similarly Genetically engineered Escherichia *coli* used in large amount for the production ofbiofuel. *Pseudomonades* convert their metabolic energy intoelectricity. *Zymomonas mobilis* can also produce biofuelusing ED pathway after genetic modification. *Bacillus subtilis* and *Bacillus thuringiensis* was found effective for production of biofuel from sugarcane Biofuel productionusing *cyanobacteria* is possible as it can grow in lab. And ourside also, with or without sunlight and with various carbon sources.

Many Fungi mostly *Saccharomyces, Trichoderma, Mortierella* sp. can produce biofuel from lignocellulosic material such as sugarcane. Microalgae have recognized as very good supplements for bioethanol production for their relatively good amount of fatty acids and excessive biomass production. Algae with high triglycerol content can produce large amount of sustainable biofuel (Khan et al 2020). Fermentation is a process in which sugar, present in algae is convertedto ethanol by the activity of microbes. Microorganisms ferment variety of sugars such as glucose, Sucrose, Lactose, fructose, maltose, produce ethanol. Bacteria, algae, fungi are the useful for the production of potential biofuel. Quality and the gain of product depends on fermentation method which is affected by physiological factors and fermenting microorganism utilized (Khan et al,

2018). There are other factors except all above which enhance the growth of algal biomass. Plant hormone such as auxin, cytokinin, abscisic acid, gibberellins and brassino steroids was found effective substance enhancing algal biomass (Liu et al, 2019). Present studies elucidate the utilize of microalgae as resource for biofuel making.

Chlorella vulgaris

Algae are the photosynthetic organisms grow very well in aquatic environment with different conditions of reservoir such as lakes, ponds, ocean, river and waste-water. It can grow alone or in symbiosis with other microorganisms. They can grow at various different environmental conditions like temperature, salinity, various pH ranges, and light intensities. Chief nutrients for the cultivation of an algae is nitrogen and phosphorous with some macronutrients K, Na, Ca, etc and trace elements such as, B, Co, Fe, Zn , Mo, etc . Algae can be grown in Wastewater which is the good source containing required nutrient. Microalgae are single celled photosynthetic organisms with moderately maximum photosynthetic capacity (Miao & Wu, 2006). Large biomass production of Microalgae has found future benefits in biofuel product formation. Starch and cellulose can cover 40% of the dry weight of microalgae. As microalgae have no lignin content, not produce any toxic compounds during hydrolysis. Thus fermentable sugar can be easily produced from hydrolysis of carbohydrate, which is then used for fermentation by microorganisms to produce desirable product (Seon et al, 2020). Bioethanol can be produced by algal fermentation.

Chlorella vulgaris is the representative members of algae group for extracting biofuels to its rapid growth and easy cultivation. So, it is important to be industrially possible due to its less lipid content (Liu et al. 2008). As rising of lipid amount in C. *vulgaris* is a key research field that important to be researched and report as well. The combo necessities of increasing biomass and lipid production are difficult to accomplish. The biomass production and the lipid biomolecules constituent of *C. vulgaris* might be increased if particular physiological factors provided (Lv et al. 2010). Among algae *Chlorella Vulgaris* is used as a good source for bioethanol production *Chlorella vulgaris* is a small green microalgae containing high content of protein, carbohydrate and lipid. *Chlorella vulgaris* do not contain lignin which makes it easily accessible to degradation by microorganisms and enzymes.

Table: 1 – Biomolecules comparison of *C. vulgaris* (Mohamed et al., 2013; CORONADO-REYES et al, 2020).

constituent	(%)
Moisture	5.83
Dry matter	94.17
Crude protein	51.45
Carbohydrates	11.86
Crude lipid	12.18
Crude fiber	9.18
Ash	9.50

C. vulgaris Can grown autotrophically (by photosynthesis) or by heterotrophically (using carbon source as energy (Fatemeh and Mohsen,2016).Thus even if there is no proper light source available biomass production of this algae is possible. Widjaja *et al.* mentioned that many researchers state that lipid content in most of microalgae like chlorella was improved under variable conditions. Enhancing the concentration of lipid percentage under environmental variable conditions could also vary in biofuel yield.

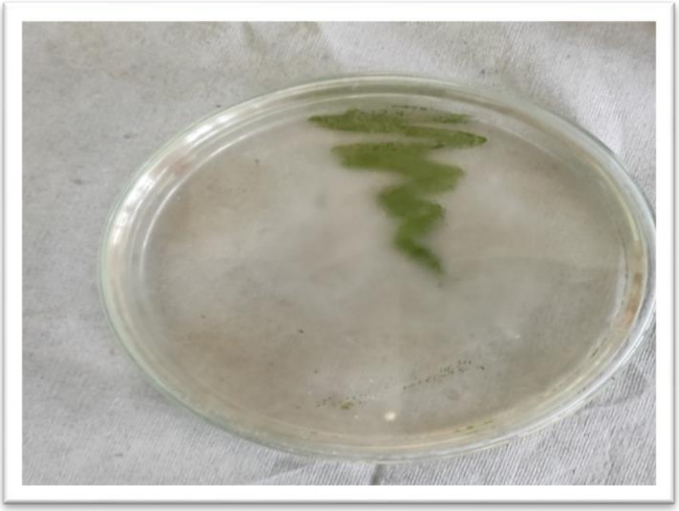

Figure showing plates with *Chlorella vulgaris* (photo by Arti Chirwatkar)

Spirulina is important algal biomass of cyanobacteria (blue-green algae) that can be utilized as foods and foddar. The three species are *Arthrospira platensis*, *A. fusiformis*, and *A. maxima*. grow worldwide, *Arthrospira* are used as a nutritional supplement or complete foodstuff (Wikipedia). Spirulina sp. are very important Cyanobacteria that have attain a significant recognition in the biofuel sector, food and health industry and pisciculture. It is filamentous

cyanobacterial which grows and habitat in water can be easily harvested recovered and marketed. It is being researched to deal with food supplement and malnutrition, and as nutritional value in latest space flight or Mars missions (Wikipedia). The importance for food supplements is that it require only limited field to grow and less water than any other food to produce energy protein and other nutritional constituents. Dry matters of spirulina sp. contain 60% (51–71%) protein8% fat, 5% water, 24% carbohydrates,etc. It has very high content of protein supplements micronutrients, macronutrients, trace elements represent complete lipid content for biofuel production of 5.6-7% of dry weight (in both *S. platensis* and *S. maxima*).

Figure showing plates with *Spirullina* (photo by Arti Chirwatkar)

Extraction of biofuel from cyanobacterial mass is depends on its fatty acids composition and the overproduction and transesterification of fatty acids, these two very important processes involved in the biofuels production. The saponification value consists mainly of phosphatidyl glycerol (25.9%), sulfoquinovosyl diglyceride (5%), other diglycerides (23%), low conc. of Phosphatidyl choline, and phosphatidyl inositol Undefined phospholipids (4.6%) and triglycerides.

Table: Spirullina sp. - Chemical composition % of different type of fatty acids)

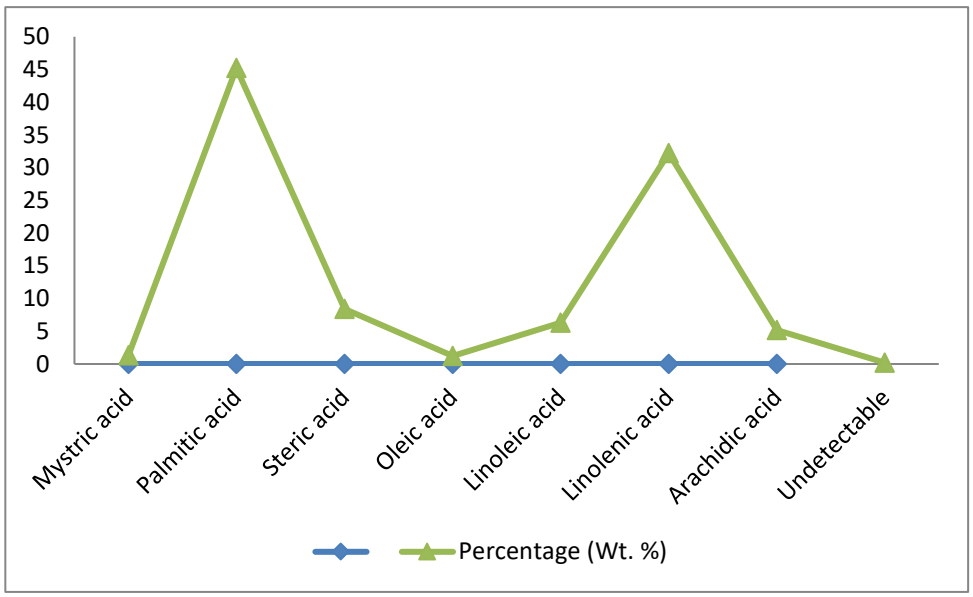

Fig : Fatty acid composition in spirullina sp.

Conclusion:

The present review study investigates the probable of a future promising biofuel and environmental contamination decline theory by integrating microalgae like *Chlorella* and *Spirullina* biomass production with crop - agricultural wastes and their by-products. It was found that the crop - agricultural wastes and their by-products have a significant potential for a possible biofuel production from growth of cyanobacterial biomass.

They says that –

'THE USE OF ALTERNATIVE ENERGY IS INEVITABLE AS FOSSIL FUELS ARE FINITE'

-GAWDAT BAHGAT, *ALTERNATIVE ENERGY IN THE MIDDLE EAST*
www.notable-quotes.com

"*A STRONG RENEWABLE ENERGY INDUSTRY IS GOOD FOR OUR ENVIRONMENT AND OUR ECONOMY.*"

—ROY COOPER

'IN A SENSE OF , THE FOSSIL FUELS ARE A ONETIME GIFT THAT LIFTED US UP FROM SUBSISTENCE AGRICULTURE AND AVENTUALLY SHOULD LEAD US TO A FUTURE BASED ON RENEWABLE RESOURSES'

-KENNETH DEFFEVES , todayinsci.com
In Hubbert's Peak : The Impending World Oil Shortage(2001)160

' IT IS TIME FOR A SUSTAINABLE ENERGY POLICY WHICH PUTS CONSUMERS, THE ENVIRONMENT, HUMAN HEALTH, AND PEACE FIRST.'

-DENNIS KUCINICH SPEECH, SEP. 27, 2005

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