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Utilization and Characterisation of Pond Algae for bio-Ethanol production

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ABSTRACT

Bio ethanol is the fast growing and alternative source of fuel all over the world. Micro algae biomass is use to derive bio fuels, ithave a high capacity of co_2 fixation and accumulate lipids, proteins and carbohydrates. The bio ethanol produce by algae is the 3rd generation of bio fuels. Due to the short life cycle, algae are surely a valuable source of biomass. It helps in bringing down frequent environmental imbalances. Micro algae found in local pond and river micro algae can be use to characterise its algae species. The collected algae sample is carried out with manual drying, grinding and pre-treatment process. It results in the modification of carbohydrate structure and variation in the amount of ethanol produce after fermentation. The research is related to the production of bio ethanol by the use of microalgae and reduces the use of non-renewable energy resource.

Keywords: Bio ethanol, Bio fuel, Fermentation, microalgae, environment.

INTRODUCTION

The non-renewable source of energy such as fossil fuels (petroleum), depleting very fast and causing climate change and pollution. A crucial energy source to be used as an alternative is Biomass fuel. There are multiple benefits of Bio fuels which lessen the dependency on petroleum imported from foreign countries. They help to overcome political and economic vulnerability and have adverse effect on pollutants and green house gas emission. Bio fuels make the economy dynamic by increasing demand and prices of agricultural products.

The first and second generation feedstocks are used for bioethanol production. Feedstock such as human food (e.g., soybean, wheat, rice, corn etc) and lignocellulosic materials Biomass containing carbohydrate which can be converted into sugar, these natural sugars after fermentation result as bioethanol. The major disadvantage is their production is just for certain periods of time. Algae which are the third generation feedstock for biofuels, it is very convenient, high productivity and easy to cultivate. They have high lipid content and useful for biodiesel production. Bio fuels have a cellulosic structure and contain large amounts of carbohydrate that makes them suitable for the bioethanol production which largely depends upon the raw materials employed. It employs three major steps to obtain fermentable sugars, fermentation process in which sugar is converted to ethanol, and distillation and purification of produced ethanol. Several pre-treatment methods for raw materials to produce bioethanol arepresented. Study the algal characteristic grown in water fresh and control the water pollution by using the biomass.

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BIOMASS: POND ALGAE

Algae are classified as microalgae and macroalgae. Microalgae are prokaryotic or eukaryotic photosynthetic microorganisms that can survive in hard conditions with their unicellular or simple colony structures. They contain chlorophyll and use light for photosynthesis. Algae are perennial and can everywhere such as salty waters, fresh waters, lakes, deserts and marginal fields etc. For the cultivation of algae some open systems like photo bio reactors and ponds are used. Open ponds are the most popular cultivation systems in industrial sectors.

In Raipur district of Chhattisgarh where the climate is hot and sub humid there are around 58,514 ponds that cover an area of 0.744 lakh and have high plankton variety. Phytoplankton: A total of 67 algal genera where Chlorophyceae constituted the largest group among phytoplankton.Koushik Roy, Sandipan Gupta and Saurav Kumar Nandy ISSN 1817-3098 © IDOSI Publications, 2015 offer the checklist of Commonly Available Phytoplankton and Zooplankton Genera of Urban and Rural Ponds of Raipur, Chhattisgarh, India. They include; Chlorophyceae (chloros, green; phyceae, algal organisation) or green algae. They are mostly fresh water algae, few in brackish and salt water and few are terrestrial.There is a wide range of differences in their thallus structures like unicellular motile (Chlamydomonas) and non-motile (Chlorella), coenobium (Volvox), palmelloid (Tetraspora), dendroid (Ecballocystis), filamentous branched (Cladophora) and unbranched (Spirogyra)(Dr. Ashok Kumar Awasthi), heterotrichous (Coleochaete), siphonaceous (Vaucheria) and parenchymatous (Ulva). The cell wall is composed of cellulose, and has constituent elements as hydroxyproline glycosides or xylans and mannans.Inner to the cell wall, semi permeable cell membrane is present which encircles the protoplast. The cytoplasm consists of multiple small vacuoles which push the nucleus with cytoplasm towards the periphery and is called primordial utricle. There is an eye-spot or stigma in the anterior portion of the flagellate cells, which remain inserted at one side of the chloroplast. The pigments are positioned in the chloroplast.

Microalgae are an ideal biodiesel feedstock with the ability to enhance lipid production and high photosynthetic efficiency. Due to their high amount of starch they are useful for bioethanol production.Moreover microalgae do not require energy consumption for distribution and transportation of starch molecules. Absence of lignin or having less lignin in the structure, simplifies the hydrolysis stages [3]. Microalgae changes with the algal species but they have various amounts of heteropolysaccharides in their structures.

The fermentation of algal polysaccharides which are starch, sugar and cellulose form the basis of ethanol production. For microalgae, The carbohydrate content (mostly starch)of the microalgae can be reached to 70% under specific conditions. Microalgal cell walls are divided into two layers viz inner cell wall layer and outer cell wall layer. Outer cell layer can be trilaminar outer layer and a thin outer monolayer.The Outer cell walls of microalgae consist of polysaccharides like pectin, agar and alginate. The composition varies from species to species. As opposed to the prevalent thought inner cell walls of microalgae contain mostly

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cellulose, hemicellulose and other materials. The presence of cellulose in their cell walls and starch, microalgae are suitable as a feedstock for production of bioethanol. The cell wall of algae, polysaccharides and starch can be fermented for bioethanol production.

METHODS AND PROCEDURE

1. Sample collection: the algal sample is collected from a local pond near Raipur. Almost 1000gm sample is collected from the pond.

2. Drying of sample: equal amount of four algal samples is dried manually in room temperature (1 day drying, 2days drying, 4 days drying and 6 days drying). The drying process will in the variation in the amount of ethanol quantity.

3. Grinding: the dried sample is properly grind in the mortar and pestle to make fine powder.

4. Per treatment process:

- Acidhydrolysis: four sample with variation of sulphuric acid percentage and make up the solution 500ml.
- Autoclave:Four samples are autoclave with different time 15min, 20min, 25min and 30min at 125^0 **C.**
- Carbohydrate extraction: manually filter the autoclaved solution.
- Maintain the pH at 4.5-5. (Adding concentrated sulphuric acid with NaOH).
- Steam sterilization (autoclave).

5. Fermentation:

The fermentation converts carbohydrate into sugar in the presence of microorganism. Saccharomyces cerevisiae, commonly known as baker's yeast is used as a microorganism.

Taking the sample solution and putting it for fermentation with difference in days. The fermentation time as 3 days, 5days, 7days and 10 days.

6. Ethanol production:

Here we had checked the production of ethanol by simple test:

- 1M NaOH solution and 0.5 M iodine solution
- Take 20drops of the sample solution in a test tube
- 50 drops of iodine solution
- And 20 drops of NaOH solution.
- After 2mins carefully observed the solution
- Cloudy yellow precipitate is formed in the solution(triidomethane)

7. Alcohol meter:

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Used alcohol meter to measure the quantity of alcohol produced by fermentation.

RESULTS AND DISCUSSION

The main objective of the research was to find the production of bioethanol by algal biomass. With easy and cost effective methods this research is carried out and successful too. By taken variation in the sample, we studied the difference in the quantity of bioethanol.

Using local pond algal reduce the water pollution as we can clean the algal biomass and use as bioethanol production.

Table 1: Air drying and ethanol percentage

Sample no.	Air drying time (days)	Ethanol percentage
1	1	0.65
2	2	0.70
3	4	0.75
4	6	0.78

Table 2:fermentation time and ethanol percentage

Sample no.	Fermentation time (days)	Ethanol percentage
1	3	0.68
2	5	0.79
3	7	0.86
4	9	0.91

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