Growth of Algae (Chlorococcum sp. and Chorella Vulgaris) in Waste Water and Extraction of Lipids Using UH-Biosurfactant

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Abstract: This study focused on the growth of Chlorococcum sp and Chlorella Vulgaris in waste water (activated sludge) and extraction of lipid using the UH-Biosurfactant and comparing the results with Chloroform/Methanol extraction method (gravimetric - Bligh Dyer method). The growth of the algal samples in the wastewater was comparable to commercially available nutrient media like the F/2 media. The UH-Biosurfactant was effective in extracting lipids and the results were comparable to that of the Chloroform/Methanol extraction method.

1. Introduction:

Algae are large group of diverse, simple, autotrophic organism. They are both unicellular and multicellular. They are photosynthetic like other green plants. Algae can be a fresh water or marine algae. In recent years there has been a rapid growth in investigating the use of algae to produce lipids as a replacement for fossil fuels (Hossain et al. 2008). Biofuel are biodegradable and emit less Carbon-di-oxide. Algae consist of lipid in their cells. Lipid consists of fatty acids **(**Demirbas et al. 2011) and fatty acid is the main component that can be extracted and converted as biofuel. Wastewater can be used as a media for growth of freshwater algae (Pittman et al. 2010) as it consist of nutrients like nitrates and phosphates necessary for growth of algae.

2. Objective:

The objective of this study was to investigate the growth of algae in waste water (activated sludge from waste water treatment plant) and extraction of lipids from algae using the UH-Biosurfactant and comparing it to the more conventional Chloroform/Methanol extraction (gravimetric -Bligh and Dyer method).

3. Materials and Methods

3.1 Algal strain and media for growth: The algae strain was collected close to a swimming pool and the strain was identified using a microscope as Chlorococcum sp. The algae Chlorella Vulgaris (UTEX # 1809) was provided by UTEX, the culture collection of algae from the University of Texas at Austin. The algal strains were grown in waste water media where 90 mL of the activated sludge was diluted with 1000 mL of distilled water. The study was performed in continuously stirred batch reactors in room conditions. The pH of the reactors were between 7 to 8 (Feng et al. 2010).

3.2 Analytical Methods:

3.2.1: Chloroform/method extraction: The lipid content in each algae was measured using solvent extraction method. Chloroform/Methanol (2:1) (Bligh and Dyer method) was used and is one of the widely used solvent extraction methods. Chloroform and methanol were added to 5 gm of algae in the ratio of 2:1. The mixture was left on the shaker for about 3 to 4 hours at room temperature. Additional 5 mL of Chloroform and 5 mL of water was added and mixture was again shaken for 30 minutes. Extract was filtered through Whatman No.1 filter paper with slight suction. The filtrate was transferred to a glass cylinder and allowed for separation of layers. Methanol-water layer was removed by aspiration. After re-extraction of residue cells, the chloroform extracts were heated to a temperature of 35 to 45 deg C to and the total lipid content was measured as dry weight.

3.2.2: UH-Biosurfactant method of extraction: The algae samples were treated with UH-Biosurfactant in the ratio of 1:1 (w/w). The sample was kept on a shaker at room temperature for about

30 minutes. The mixture was filtered using a Whatman No.1 filter paper. The filtrate was transferred into 50 mL test tube and gravimetric analysis using Methanol and Chloroform was performed as mentioned above. The algae from the Whatman No. 1 filter paper were reused as inoculants. Necessary corrections were made for the lipid content in the UH-Biosurfactant.

4. Analysis:

Based on the results, shown in below fig .2, the lipid content of Chlorella Vulgaris by Bligh Dyer method was 11% and by UH-Biosurfactant method was 11.86%. The lipid content of Chlorococcum sp. by Bligh Dyer method was 27.32% and by UH-Biosurfactant was 27%. The lipid analysis was done after 21 days of cultivation of algal sample in waste water.

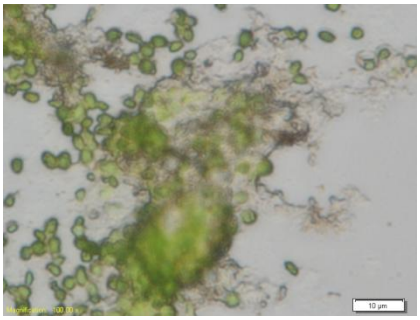

Fig1.Algae cells after Methanol and chloroform treatment

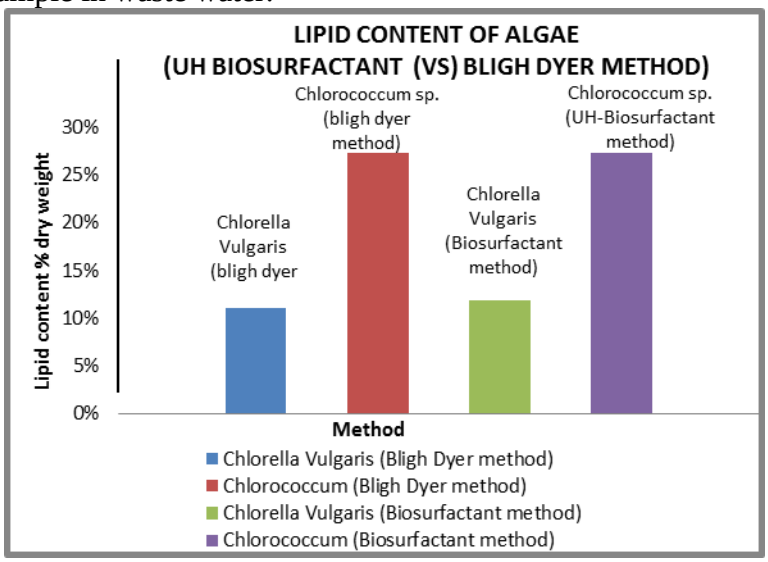

Fig 2.Lipid content of the algal species by Bligh Dyer method and UH-Biosurfactant method

5. Conclusion:

The lipid analysis using Gravimetric method (Bligh Dyer method) and UH-Biosurfactant method yielded similar results and the percentage dry weight lipid content of both the algal species were comparable. The UH-Biosurfactant is bio-friendly compared to the solvent extraction method and cells of the algae were reusable after subjecting it to UH-Biosurfactant method of extraction.

6. Acknowledgement:

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7. Reference:

Hossain, S., Salleh, A., Boyce, A.N, Chowdhury, P., and Naqiuddin, M., (2008) Biodiesel fuel production from Algae as renewable energy – American Journal of Biochemistry and Biotechnology – Volume 4, Number 3

Bligh E.G and Dyer, W. J. (1951) Can. Journal Biochemical Physiology 37: 911- 917.

Demirbas A. and Demirbas M.F., Importance of algae oil as a source of biodiesel - Energy Conversion and Management Volume 52, Issue 1, January 2011, Pages 163-170

Pittman J.K., Dean A.P. and Osundeko O., (2010) The potential of sustainable algal biofuel production using wastewater resources –Bioresource Technology - Volume 102, Issue 1

Feng Y., Li C. and Zhang D., (2011) Lipid production of Chlorella vulgaris cultured in artificial wastewater medium - Bioresource Technology - Volume 102, Issue 1, January 2011, Pages 101-105.