Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 8647 - 8653
Received 25 April 2021; Accepted 08 May 2021.

Using Blue-Green Algae *Hapalosiphon Sp.* & Green Algae *Scenedesmus Spp.* In Reducing Organic Pollutants from Wastewater

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Abstract

The traditional processes of wastewaters have been used to eliminate settled and the organic material present in wastewater. Organic materials that were released into the environment lead to organic pollution. Microalgae cultures offer an elegant solution to the tertiary treatment of wastewater processes. The present study illustrated the role and efficiency of the blue-green algae and green algae in wastewater treatment. *Hapalosiphon sp.* and *Scenedesmus spp.* were cultivated on wastewater for 15 days for phycoremedation of wastewater and production biomass of algae, *Hapalosiphon sp.* removed 85.41% of BOD,84.16% of COD, pH was between 7.65-7.95, chlorophyll a reach highest growth 7.75 mg/l in nine days of the experiment, *Scenedesmus spp.* removed 60.41% of BOD,66.04% of COD, pH was between 7.62-7.92, chlorophyll a reach highest growth 3.84 mg/l in nine days of the experiment, this study shows that *Hapalosiphon sp*. is the most efficient algae for wastewater phycoremedation and higher biomass production.

Keywords: Algae, wastewater, BOD, COD, phycoremedation.

Introduction

The demand for renewable energy resources has risen rapidly due to increased industrialization and urbanization (Kim *et al*., 2019). The limited supply of petroleum-based fuels and their contribution to global warming has required creating new renewable energy resources (Amit *et al*.,2017). Renewable energy sources, such as biofuel (biodiesel and bioethanol), oils, and biogas, are currently being fossil-fuel alternatives and fuels, making about 10% of total global emissions utilization of electricity (Amit,2018). Microalgae are unicellular, fast-growing organisms that evolve by consuming water, carbon dioxide, and nutrients (Aung&swe,2019). Temperature, light intensity, nutrients, CO_2 concentration, cultivation position, and pH are all factors that influence microalgae development (Rai and Gupta, 2016). Algae are a diverse and complex group of organisms that belong to various phyla and can be characterized by various physiological characteristics (Wu *et al*., 2013). Because of this diversity, different algae species needed different growth environments in various cultivation mediums (Chakraborty *et al*., 2016). Biosorbents, which are made of plant-based products, agricultural waste, and algae, can absorb various wastewater pollutants. Wheat bran, wheat straw, and green algae have all been identified as an easy, inexpensive, long-lasting, and efficient bio-sorbent for water purification (Emparan *et al*., 2020).

In contrast to traditional tertiary treatment, algal treatment is a promising method for complete nutrient removal (Ledda *et al*., 2015). Municipal sewage as well as industrial wastewaters such as paper mill effluent, sugar mill effluent, dairy industry wastewater, piggery wastewater, and

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pharmaceutical industry wastewater can all be used to grow microalgae. These wastewaters are high in macronutrients like nitrogen and phosphorus, as well as micronutrients like magnesium, manganese, calcium, and sodium, all of which are essential for the activation of various metabolic pathways such as photosynthesis, energy storage, and several cellular enzymes (Gani *et al*.,2017). To achieve maximum growth of microalgae, the optimal concentration of these nutrients is required. Apart from these inorganic nutrients, carbon is the most significant ingredient in microalgae, accounting for approximately half of the total chemical composition. The major source of carbon in wastewater is organic carbon, which handles microalgae growth. Several studies showed wastewaters are an excellent medium for producing significant quantities of biomass (Gupta *et al*. 2016, Wang, 2010) showed that *Chlorella coloniales* is an excellent, simple, and low-cost bio-sorbent that can remove up to 83% from wastewater. Mahapatra et al., (2013) look into the treatment efficiencies of a Mysore-based algae-based sewage treatment facility. The study found that 60 percent of total COD was removed, 50 percent of filterable COD was removed, 82 percent of total BOD was removed, and 70 percent of filterable BOD was removed, indicating moderate treatment levels.

Pollution reaches rivers from several causes, which differ in intensity and volume (Karakurt *et al*., 2019). The composition of wastewater represents the producing society's lifestyles and technologies (Apiratikul, 2020), it's a confusing combination of organic and inorganic products, as well as synthetic compounds. Carbohydrates, fats, proteins, amino acids, and reactive acids make up three-quarters of the organic carbon in sewage. A wide variety of microorganisms, especially bacteria, viruses, and protozoa, thrive in the wastewater environment (Rasheed *et al*., 2018). The majority are safe and can be used in biological sewage treatment. However, sewage often contains pathogenic microorganisms that are excreted in large quantities by sick people and a symptomatic carrier (Jawed *et al*., 2020). In sewage, bacteria that cause cholera, typhoid, and tuberculosis, viruses that cause infectious hepatitis, protozoa that cause dysentery, and parasitic worm eggs can all be found (Ghaemi *et al*., 2017). The elimination of total coliform species is used to assess sewage disinfection effectiveness (Yan *et al*., 2020).

The present study illustrated blue-green algae and green algae in wastewater treatment compared to the two algae and showed the most efficient biological treatment of wastewater.

Material &Methods

Algae strain was *Scenedesmus spp*. isolated from marshes and *Hapalosiphon sp*. from algae research Lab, It was preserved in Chu-10D media containing the chemicals mentioned below ; $MgSo_4.7H_2O$25 mg/l , $Ca(No_3)_2.4H_2O$57.60mg/l, $NaHCO_3$15.85mg/l, $Na_2SIO_3$6.26mg/l, $FeCl_3$1.46mg/l, Na_2.E.D.T.A.$2H_2O$3.18mg/l, $CaCl_2.2H_2O$35.83mg/l, K_2HPO_4 10 mg/l, $MnCl_2.4H_2O$0.045mg/l, $MoNa_2O_4.2H_2O$0.007mg/l, $ZnSO_4.7H_2O$0.056mg/l, $CuSO_4.5H_2O$0.02mg/l, $CoSO_4.7H_2O$0.01mg/l, $H_3Bo_3$0.72mg/l, Algae were inoculated in 250 mL flasks containing 100 mL liquid medium. The culture flasks were incubated under stationary condition at 25±2°C and intensity of illumination 1600 lumen for 15 days of cultivation period.
wastewater collected from (wastewater station of the University of Basrah),COD (Figure 1), BOD, Chlorophyll a, and pH were determined for all samples (APHA,2005).

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Figure (1): COD Reactor

Results and Discussion:

The pH values of unsterilized wastewater ranged from 7.65 to 7.95 when treated with blue-green algae *Hapalosiphon sp.*, while the wastewater treated with green algae *Scenedesmus spp.*, the pH values ranged between 7.62-7.92 (figure 2), suggesting that the wastewater was in the alkaline direction.

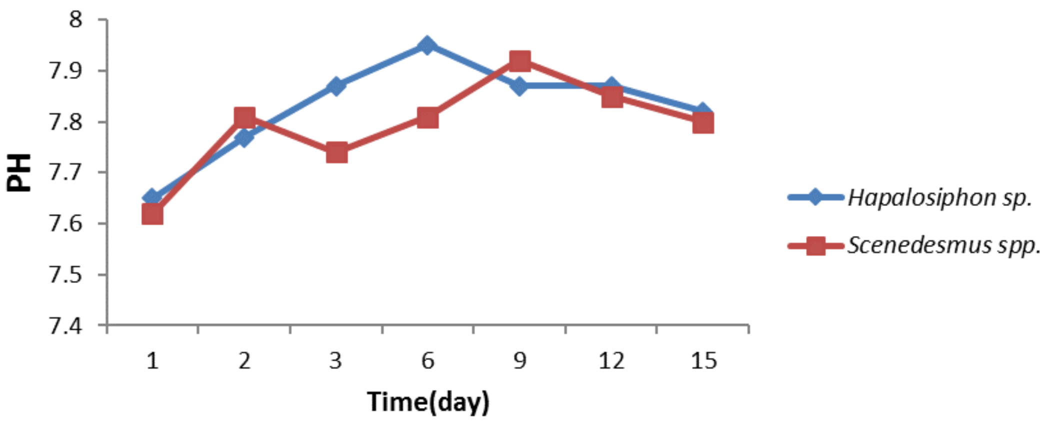

Figure (2) pH values for *Hapalosiphon sp.& Scenedesmus spp.*

Hapalosiphon sp. removed 63.3%COD, 45% BOD during nine days, removal percentage reach 84.16% COD, 85.41% BOD at the end of the experiment *Scenedesmus spp.* removed 53.3% COD, 29.16% BOD after 12 days to catch 66.04% COD, 60.41 BOD at the end of the experiment (figures 3&4).

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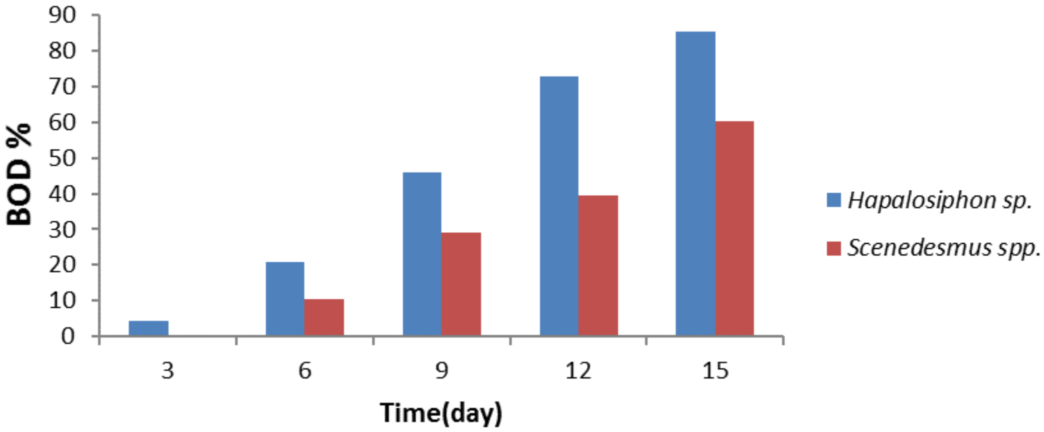

Figure (3) The percentage of removing the biochemical oxygen demand for *Hapalosiphon sp.& Scenedesmus spp.*

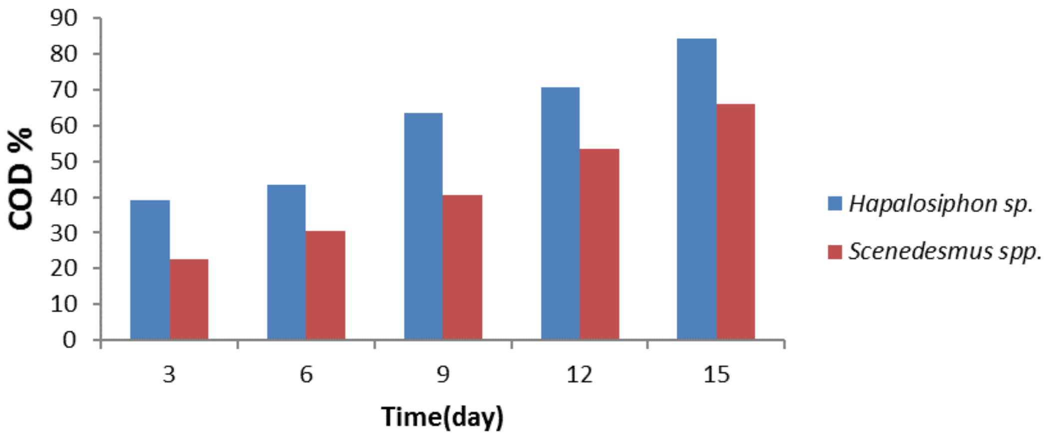

Figure (4) The percentage of removing the chemical oxygen demand for *Hapalosiphon sp.& Scenedesmus spp.*

A decrease in the biochemical oxygen demand was observed when treating with blue-green algae *Hapalosiphon sp.* The highest percentage of decrease among the algae used in the study was recorded for the algae's need for organic materials in nutrition, as well as the need for algae to analyze organic materials in the photosynthesis process, thus increasing the percentage of dissolved oxygen in the water, and this leads to a decreasing in the rate of the biochemical oxygen demand (Alhattab,2014)

Algae's ability to decrease and reduce the biochemical oxygen demand values for wastewater was noted, as the highest percentage of reduction of 85.41% was recorded when treated with algae *Hapalosiphon sp.* Since there is a direct connection between total dissolved salts and biochemical oxygen demand and an inverse relationship between dissolved oxygen and total dissolved salts and biochemical oxygen demand, dissolved oxygen rises, and total dissolved salts fall. (Nikita,2015).

The removal rates of the chemical oxygen demand in this study came with high percentage removal rates that reached 84.16% when wastewater treatment with Hapalosiphon sp. which is due to the algae's need for organic materials necessary for their growth and production of biomass (Aung&swe,2019), and this agree with Mahapatra *et al*., (2013) and Wang (2010). Algae need carbon to grow and thrive, and carbon is costly, so its availability in wastewater is a source of nutrition for algae and their increase in growth when growing algae in wastewater, and the rate of COD reduction is inversely related to carbon dioxide (Hu *et al*., 2012).

When blue-green algae *Hapalosiphon sp.* is cultured in wastewater, medium growth rate reaches 7.75 mg/l, and on industrial medium Chu-10D 3.39 mg/l figure (4), Microalgae consume nutrients to expand, which aids in the phycoremediation of wastewater contamination.

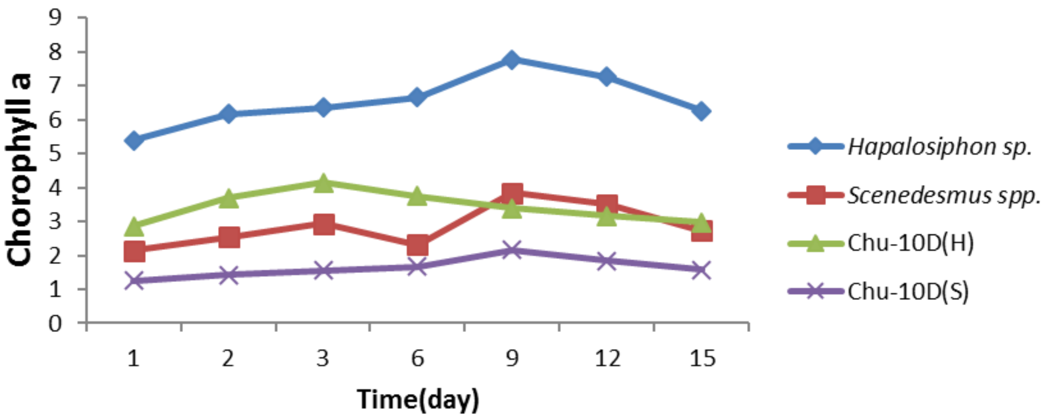

Figure (5) Chlorophyll a values for *Hapalosiphon sp.& Scenedesmus spp.* and compare with industrial media Chu-10D

As a result, this method is well suited to the goal of combining wastewater microalgal remediation and biodiesel production (Reyimu and Ozçimen,2017) while Scenedesmus spp. the growth rate on wastewater medium 3.84 mg/l, 2.15 mg/l on industrial medium Chu-10D in nine days, is due to the presence of unwanted toxic compounds hindering the metabolic activities of microalgal cells resulting in low growth of microalgal biomass (Amit,2018)
In conclusion, the blue-green algae and green algae in wastewater treatment showed high efficiency for biological treatment of wastewater. It can be used as an eco-friendly method for organic pollution removal.

Acknowledgment
We would like to thanks the head of the Biology and Ecology departments for their supports.

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References

1. Alhattab, M. (2014). Production of Oil from Freshwater and Marin water microalgae for biodiesel production. Master of Applied Science.Dalhousie University, Halifax, Nova Scotia. Canada.
2. Amit, Chandra R, Ghosh UK, Nayak JK (2017) Phycoremediation potential of marine microalgae Tetraselmis indica on secondary treated domestic sewage for nutrient removal and biodiesel production. Environ Sci Pollut Res 24:20868–20875.
3. Amit, Ghosh, U.K.An approach for phycoremediation of different wastewaters and biodiesel production using microalgae. *Environ SciPollut Res* 25, 18673–18681 (2018).
4. Al-Nihmi, F. M. ., Salih, A. A. ., Qazzan, J. ., Radman, B. ., Al-Woree, W. ., Belal, S. ., Al-Motee, J. ., AL-Athal, A. ., Al-Harthee, A. ., Al-Samawee, H. ., Al-Samawee, B. ., & Atiah, H. . (2020). Detection of Pathogenic Waterborne Parasites in Treated Wastewater of Rada’a City -Yemen. Journal of Scientific Research in Medical and Biological Sciences, 1(1), 30-39. https://doi.org/10.47631/jsrmbs.v1i1.23
5. APHA,(2005), Standard method for examining water and wastewater,20th ed American Public Health Association American water works Association and water. Pollution control federal, Washington,D.C.
6. Apiratikul, R., 2020. Application of analytical solution of advection-dispersion-reaction model to predict the breakthrough curve and mass transfer zone for the biosorption of heavy metal ion in a fixed bed column. Process Saf. Environ. Prot. 137, 58–65.
7. Aung, Z.N.&Swe, Z.M.(2019).Observation study of wastewater treatment by the use of Microalgae.International journal of science and Engineering Applications, No.8.
8. Chakraborty S, Mohanty D, Ghosh S, Das D (2016) Improvement of lipid content of Chlorella minutissima MCC 5 for biodiesel production. J Biosci Bioeng 122:294–300.
9. Mahapatra, D.M., Chanakya, H.N. & Ramachandra, T.V. Treatment efficacy of algae-based sewage treatment plants. *Environ Monit Assess* **185,** 7145–7164 (2013). https://doi.org/10.1007/s10661-013-3090-x
10. Emparan, Q., Jye, Y.S., Danquah, M.K., Harun, R., 2020. Cultivation of Nannochloropsis sp. microalgae in palm oil mill effluent (POME) media for phycoremediation and biomass production: effect of microalgae cells with and without beads. Journal of Water Process Engineering 33 (101043).
11. Gani P, Sunar NM, Matias-Peralta H, Mohamed RMSR, Latiff AAA, Parjo UK (2017) Extraction of hydrocarbons from freshwater green microalgae (sp.) biomass after phycoremediation of domestic wastewater. Int J Phytorem 19(7):679–685.
12. Ghaemi, N., Zereshki, S., Heidari, S., 2017. Removal of lead ions from water using PESbased nanocomposite membrane incorporated with polyaniline modified GO nanoparticles: performance optimization by central composite design. Process Saf. Environ. Prot. 111, 475–490.
13. Gupta PL, Choi HJ, Pawar RR, Jung SP, Lee SM (2016) Enhanced biomass production through optimization of carbon source and utilization of wastewater as a nutrient source. J Environ Manag 184:585–595.
14. Hu, B., Min, M., Zhou, W., Li, Y., Mohr, M., Cheng, Y., Lei, H., Liu, Y., Lin,X.,Chen,P.,Ruan,R.,2012. Influence of exogenous CO_2 on biomass and lipid accumulation of microalgae Auxenochlorella protothecoides cultivated in concentrated municipal

wastewater. Appl. Biochem. Biotechnol. 166, 1661–1673.

15. Jawed, A., Saxena, V., Pandey, L.M., 2020. Engineered nanomaterials and their surface functionalization for the removal of heavy metals: a review. Journal of Water Process Engineering 33, 101009.
16. Karakurt, S., Schmid, L., Huebner, U., Drewes, J.E., 2019. Dynamics of wastewater effluent contributions in streams and impacts on drinking water supply via riverbank filtration in Germany–a national reconnaissance. Environ. Sci. Technol. 53 (11), 6154–6161.
17. Kim, J.E., Kuntz, J., Jang, A., Kim, I.S., Choi, J.Y., Phuntsho, S., Shon, H.K., 2019. Techno economic assessment of fertilizer drawn forward osmosis process for greenwall plants from urban wastewater. Process Saf. Environ. Prot. 127, 180–188.
18. Ledda C, Idà A, Allemand D, Mariani P, Adani F (2015) Production of wild Chlorella sp. cultivated in digested and membrane pre treated swine manure derived from a full-scale operation plant. Algal Res12:68–73.
19. Wang, L., Min, M., Li, Y., Chen, P., Chen, Y., Liu, Y., Wang, Y., & Ruan, R. (2010). Cultivation of green algae Chlorella sp. In different wastewaters from municipal wastewater treatment plant. *Applied Biochemistry and Biotechnology*, *162*(4), 1174–1186. https://doi.org/10.1007/s12010-009-8866-
20. Nikita,2015. Wastewater Treatment Using inverse fluidization unit by algae. National Institute of Technology (NIT), Rourkela, Odisha.
21. Rai MP, Gupta S (2016) Effect of media composition and light supply on biomass, lipid content and FAME profile for quality biofuel production from *Scenedesmus abundans*. Energy Convers Manag 141:85–92.
22. Rasheed, T., Bilal, M., Nabeel, F., Iqbal, H.M.N., Li, C., Zhou, Y., 2018.Fluores centsensor based models for the detection of environmentally-related toxic heavy metals. Sci. Total Environ. 615, 476–485.
23. Reyimu Z, Ozçimen D€ (2017) Batch cultivation of marine microalgae
24. Nannochloropsis oculata and Tetraselmis suecica in treated municipal wastewater toward bioethanol production. J Clean Prod 150:40–46.
25. Wu LF, Chen PC, Lee CM (2013) The effects of nitrogen sources and
26. temperature on cell growth and lipid accumulation of microalgae. Int Biodeterior Biodegradation 85:506–510.
27. Yan, J., Karlsson, A., Zou, Z., Dai, D., Edlund, U., 2020. Contamination of heavy metals and metalloids in biomass and waste fuels: comparative characterization and trend estimation. Sci. Total Environ. 700, 134382.