قدرة طحلب الـ *Scenedesmus quadricauda* على معالجة الكلوريد, الفوسفات والنتريت من مياه الصرف الصناعي

شيماء عبيس المعموري, بسام موسى الياسين, سرى احسان جابك, زينب عمران الرفاعي
جامعة بابل – كلية العلوم – قسم علوم الحياة

The Ability of *Scenedesmus quadricauda* to Treat Chloride, Phosphate and Nitrite from Industrial Wastewater

Shaymaa O. H. Al-Mamoori, Bassam M. Al-Yaseen, Sura I. A. Jabuk, Zainab Imran AL-Rifaie
University of Babylon - College of Science - Department of Biology
bassam.alyaseen@gmail.com

الخلاصة :

تضمنت الدراسة الحالية اختبار قدرة طحلب الـ *Scenedesmus quadricauda* على تقليل قيم بعض الملوثات (الكلوريد, الفوسفات والنتريت) من مياه الصرف الصناعي في مصنع الواحة لإنتاج المشروبات الغازية والعصائر في محافظة بابل في العراق. تم قياس بعض الخواص الفيزيائية والكيميائية لمياه الصرف قبل المعالجة.

تم استخدام مياه الصرف الصناعي لمصنع الواحة كوسيلة زراعة لتطوير *Scenedesmus quadricauda* عن طريق زراعتها في مياه الصرف في ظروف مختبرية مستقرة عند درجة حرارة (25 ± 2)م^0 وفي نظام إضاءة 16: 8 ساعة، الإضاءة: ظلام. تم اجراء بعض الفحوصات الكيميائية و الفيزيائية قبل المعالجة لمياه الصرف الصناعي و تم قياس قيم الكلوريد, الفوسفات و النتريت خلال مدة التجربة اي (3, 6, 9, 12 و 15) يوما.

اوضحت النتائج أن كفاءة *Scenedesmus quadricauda* لإزالة الكلوريد كانت 60٪، وكفاءة إزالة الفوسفات 100٪، وكفاءة إزالة النتريت 99.3٪، وهذا يشير إلى أن *Scenedesmus quadricauda* كانت نشطة واستهلكت المزيد من العناصر الغذائية من مياه الصرف للتمثيل الغذائي والنمو ، مما أدى إلى إزالة العناصر الغذائية. كانت هذه المعدلات مؤشرات على أن هذه الطحالب هي وسائل قيمة لتحسين جودة مياه الصرف. و اوضحت هذه الدراسة إمكانية استخدام Scenedesmus للحد او التقليل من التلوث البيئي الناتج من مياه الصرف الصناعي في العراق. تم عزل البكتريا الموجودة في مياه الصرف قبل المعالجة و هي *Klebsiella, Escherichia coli, Bacillus, Shigella spp, Salmonella spp, Enterobactera, Vibrio paraheomolyticus, Klebsiella and Proteus spp .*

Abstract

The current study included testing the ability of *Scenedesmus quadricauda* to reduce the values of some pollutants (chloride, phosphate and nitrite) from the wastewater at Al Waha Factory for the Production of Soft Drinks and Juices in Babylon governorate, in Iraq. Some physical and chemical properties of wastewater were measured before treatment.

Wastewater at Al Waha factory was used as a cultivation medium for the development of *Scenedesmus quadricauda* by cultivating it in wastewater under stable laboratory conditions at a temperature of (25 ± 2)^{o}C and in a 16:8 hour light system, lighting: dark. The *Scenedesmus quadricauda*, was acclimated in wastewater for a period of (3, 6, 9, 12 and 15) days before employed in treating settled wastewater at Al Waha factory.

The results showed that the efficiency of *Scenedesmus quadricauda* for removing Chloride was 60%, the efficiency for removing phosphorous was 100% and the efficiency for removing nitrite was 99.3%, and this indicates that *Scenedesmus quadricauda* was active and consumed more nutrients from wastewater for its metabolism and growth, which led to the removal of nutrients. These rates were indications that these algae are valuable means of improving the quality of wastewater. This

study demonstrated the possibility of using common *Scenedesmus* to reduce environmental pollution from wastewater in Iraq**.** Types of bacteria found in wastewater before treatment *Klebsiella, Escherichia coli Bacillus, Shigella spp, Salmonella spp, Enterobactera, Vibrio paraheomolyticus, Proteus spp and Klebsiella.*

Keywords:-
Scenedesmus quadricauda, Wastewater, Chloride, Phosphate, Nitrite.

Introduction

Pollution of the aquatic environment is one of the major global problems that occupies governments and people all over the world that strives to solve it because persistent pollution causes severe damage to human health, ecosystems, and civilization development (Saadi, 2006).

Wastewater (industrial, agricultural, and domestic) contributes to water pollution, so the treatment plants must have efficient units for wastewater treatment before they are introduced into the environmental medium, and this is consistent with the principle of integrated environmental protection, and treatment methods vary between physical, chemical and biological, when choosing a chemical treatment it must be taken into account the quantity and quality of contaminated water and the provision of the necessary chemicals as well as the safety and integrity of the process and the quality of the resulting pollution, and that the need to control processes, this is greater than in the case of biological treatment systems, if chemicals are used in high quantities or there is no appropriate contact time, the chemical will not be optimally formed, and as a result other new pollutants will be difficult to treat (Al-Bitar, 2005).

Bioremediation is one of the most important and best modern methods for wastewater treatment, which is defined as the use of biological interactions of various living organisms to mitigate or (for complete removal) all the harmful effects of environmental pollutants in a specific location, or it is defined as the transfer or destruction of pollutants to less risky materials, and many current studies confirm the possibility of some microalgae to play vital roles in treating pollutants into river and lake streams (Prasad *et al*., 2001).

Sewage is one of the most serious problems to public health because it is caused by the disposal of wastewater from homes or commercial establishments in the city within sewage networks, as these sources are characterized by being thrown into the water environment in the form of completely treated water or partially treated or sometimes untreated and constitute 28% of sources of water pollution (Al-Sayegh and Arwa, 2002 and Sarhan, 2002).

The use of algae in the treatment of domestic or industrial wastewater is considered to be better than the use of traditional methods used in treating wastewater, because it is (more profitable and requires low energy and reduces the radiation that causes high temperatures and helps reduce the formation of sludges that produce chemicals economically efficient). The use of algae in processing is considered an effective technology and a source of extracted fuel (Roa, DV 2012).

Materials and Methods

- Algae cultivation:

Scenedesmus quadricauda was obtained from the University of Baghdad / Iraq. Pure algae were cultivated using Chu10 medium (Chu, 1942). Algae isolates were cultivated on larger farms using batch cultures, after reaching stationary phase they were used for treatment (Al-Rubaie, 2003).

- Treatment of wastewater by algal farm

Algal treatment was done by taking 800 ml of sterile wastewater in sterile glass bottles capacity of 2500ml, and adding 200 ml of algae and the ratio is (80:20) or 800 ml Industrial wastewater : 200 ml algae sample as well as the ratio (50:50) and (20:80) after reaching the stationary phase (Al-Rubaie, 2003), then put the treatments with the control sample (which contains only 1000 ml of wastewater), in the culture room, and every three days for a period 15 days a certain size of the farm was taken for Measurement of chloride, phosphate, and nitrate.

- The density of algae cells

Absorption was measured to determine the density of algae cells using Spectrophotometer (Tom and Wong,1989).

- Physical & Chemical Analysis

Each of pH, T.D.S., and E.C. measured by Multi-meter type Hanna, Oakton-U.S.A. Total Hardness, Calcium, Magnesium, Sulphate, Total Alkalinity, Chloride, Nitrate, nitrite and Phosphate according to methods described by (APHA,2005).

- Isolation of bacteria from samples:

The samples were incubated in nutrient agar at 37°C for 24-48 hours. After growth, the isolating colony cultured on blood agar plates, MaConkeys agar, Salmonella Shigella agar and Mannitol salt agar agar and purified in the initial assay of the isolating nutrients of each type Of the types of bacteria developing and stored in the refrigerator at a temperature of (4) m. Bacterial isolates were identified by growing the colony size, color, surface, edge, slope and elevation (Mulamattathil *et al.* 2014 and Metropolis *et al.,* 2018).

- Removal Percentage Efficiency

The following formula was used for calculating the percentage of removal efficiency (% removal efficiency).

$$\text{Percent Removal Efficieny} = \frac{\text{Values before treatment} - \text{Values after treatment}}{\text{Values before treatment}} \times 100\%$$

Results and Discussion

Through the results of the current study, algae growth in industrial wastewater and absorption values increased with increasing algal cell density. The highest absorption values were on the ninth day of the experiment (Figure 1).

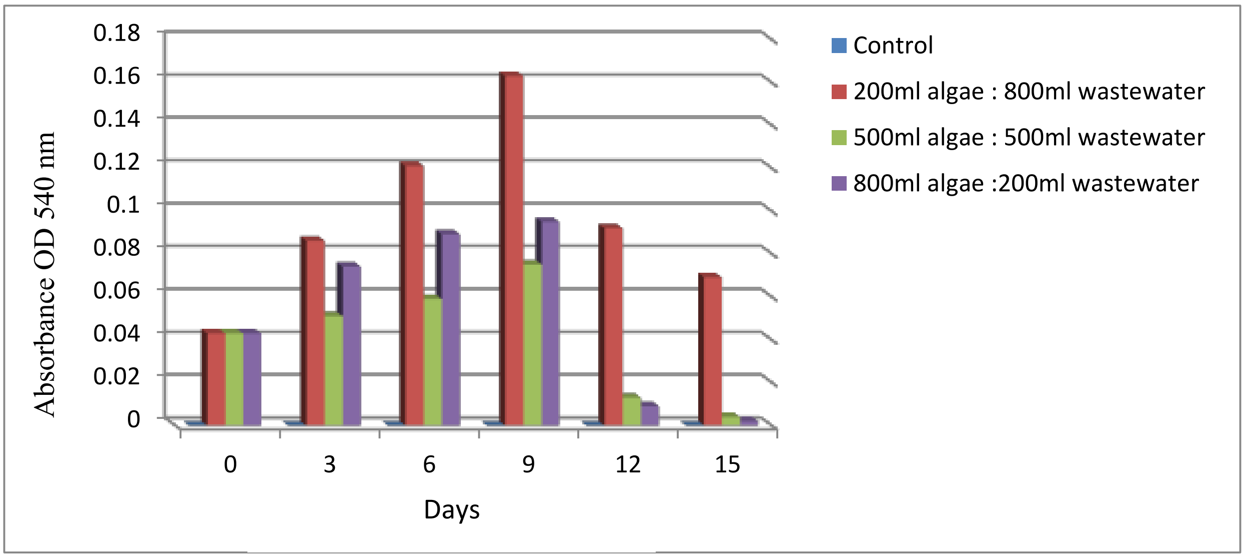

Figure (1): Growth for the algae during bioremediation

Table (1) show some physical and chemical properties of industrial waste water before the treatment by the *Scenedesmus quadricauda.*

Table (1) Some physical and chemical properties of industrial waste water before the treatment

Parameters	Concentration
pH	8.3
TDS (mg/l)	715

E.C (μs/cm)	998
Total Hardness (mg/l)	440
Calcium (mg/l)	96.19
Magnesium (mg/l)	83.89
Sulphate (mg/l)	109.6
Alkalinity (mg/l)	220
Chloride (mg/l)	199.94
Nitrite (mg/l)	0.57
Nitrate (mg/l)	0.3
Phosphate (mg/l)	0.09

The results of the current study showed that algae have the ability to reduce phosphates as they reach the highest chloride reduction by 60% on the ninth, twelve, and fifteenth day using 800 ml of algae: 200 ml of wastewater, while the lowest chloride reduction has been recorded on the third day when using 200 ml of algae: 800 ml of wastewater at a percentage of 25 as shown in Figure (2).

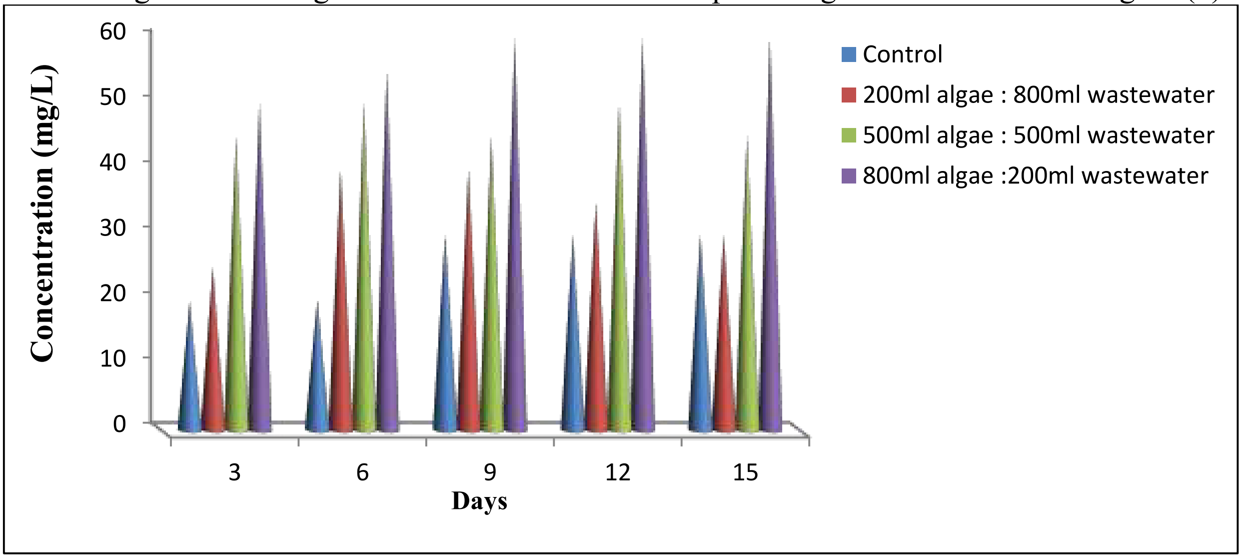

Figure (2): The percentage of chloride removal

The lowest reduction for nitrite 15.79 % was recorded on the third day when using 500ml algae: 500ml wastewater, while the highest reduction was recorded on the day fifteenth of the experiment when using 800ml algae: 200ml wastewater and at a percentage of 98.8% as shown in Figure (3).

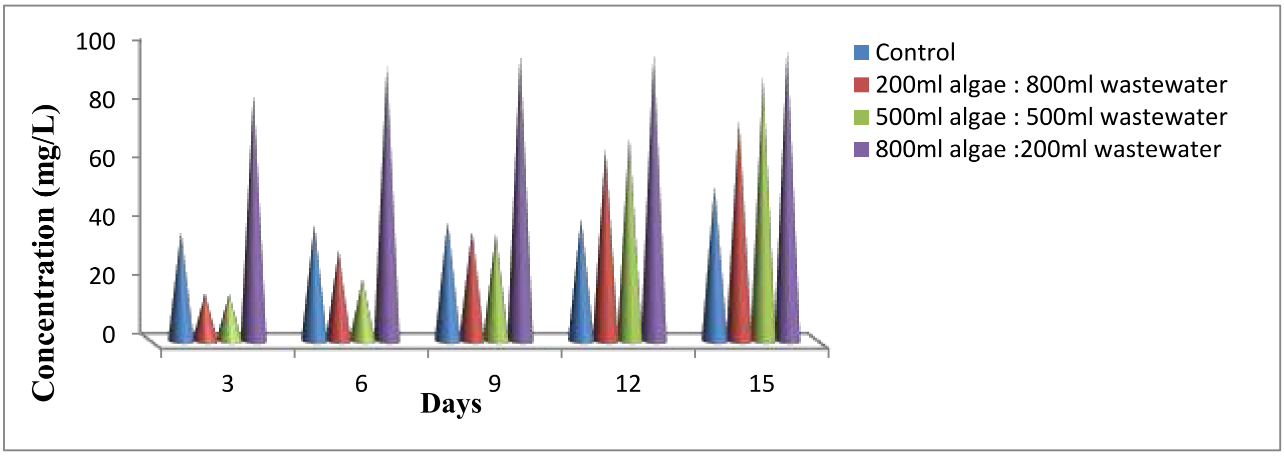

Figure (3): The percentage of nitrite removal

The results of study showed that *Scenedesmus quadricauda* has a great ability to reduce the phosphate completely as it reaches the highest phosphate reduction 100% on the fifteenth day for all concentration and also it was 100% on the day twelve when using 800ml algae: 200ml wastewater and 500ml algae: 500ml wastewater, while the lowest phosphate reduction was recorded on the third day when using 200ml algae: 800ml wastewater and by a percentage of 27.8 as shown in Figure (4).

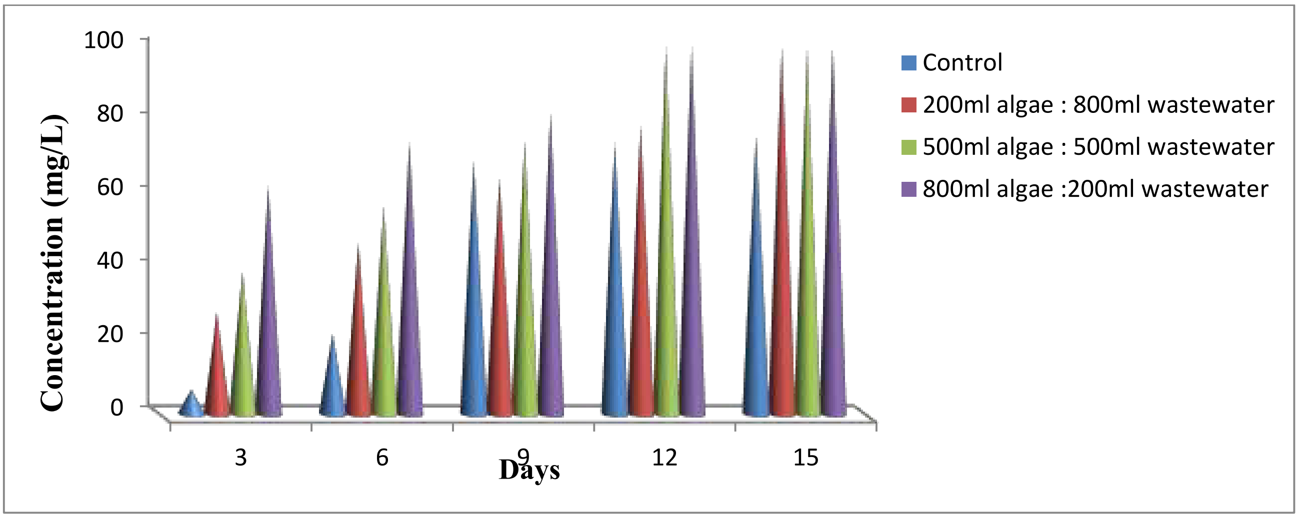

Figure (4): The percentage of phosphate removal

The results showed that algae have a great ability to reduce phosphorous and nitrate values from industrial wastewater due to its use in metabolism, nutrition and growth processes and it is one of the determinants of growth due to its easy association with other ions such as carbonates and iron. (Richmond, 2009, Yaakob *et al*, 2014, and Al-Mamoori *et al.* 2019). Nitrite is one of the most abundant forms of nitrogen in water, as nitrite is one of the most important sources of nitrogen, which has a strong impact on metabolic processes and the growth that occurs in algae (Crawford et al. 2000). The high phosphorous concentrations in wastewater may be attributed to high phosphate detergents (Derrick & Keane, 2008).

The results of the study showed that the samples of industrial wastewater were contaminated with some types of bacteria as in Table (2).

Table (2) Types of bacteria found in the industrial wastewater before treatment

NO.	Types of bacteria
1	*Klebsiella*
2	*Escherichia coli*
3	*Bacillus*
4	*Shigella spp*
5	*Salmonella spp*
6	*Enterobactera*
7	*Vibrio paraheomolyticus*
8	*Proteus spp.*
9	*Klebsiella*

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