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Investigating the Use of Effective Microorganisms for the Restoration of Benghazi Lake

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Abstract

Surface water quality monitoring is an important tool for enhancing water quality. Benghazi Lake is suffering water quality degradation due to the various levels of pollutants generated from different contaminated sources. The use of effective microorganisms (EM) for treatment of Benghazi Lake was applied in this study to decrease the level of organic pollutant in the lake. Six points were selected for the study area; laboratory analyses were conducted to determine the values and concentrations of organic pollutants (DO, COD, TSS, TN, TP) before and after adding EM with different concentrations (1gm/l, 5gm/l, 10gm/l, 15gm/l and 20g/l) to the collected wastewater samples from the lake. The tested parameters were measured at intervals of 1, 3, 5 and, 7 days from adding EM to the sample. The concentrations of DO decreased significantly, as the added EM increased whereas all the pollutant levels increased.

Keywords: effective microorganisms; Enhance DO; decrease organic pollutant; Lake Restoration.

1. Introduction

Water is one of the most important natural resources for sustaining life on earth. Approximately, two -third of the earth is occupied by water, in the form of glaciers, oceans, rivers and groundwater.

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Out of these water resources, only 2.4% of water is considered as fresh water. The surface water in rivers, lakes and ponds are easily accessible for human consumption and other commercial activities. About one-third of the fresh water requirement of the world is supplied by naturally existing surface waters in river, streams, lakes and ponds. Now, surface water resources are most vulnerable to pollution due to the unscientific disposal of wastewaters [1]. The importance of water quality has become one of the most considerable issues due to the increase of the population and lack of water sources due to contamination and climate change. However, contaminated pollutants not only affected aquatic life but has also threaten the surrounding environment. For the reduction of water pollution level, various chemical and biological treatments are available; however, it is also important to search for low cost effective techniques as well. One of those is the use of a multicultural of anaerobic and aerobic beneficial microorganisms are presently gaining popularity due to its environmentally friendly nature. This effective microorganism (EM) technology uses naturally occurring microorganisms, which are able to purify and revive nature [2] Pollution of water in lakes is primarily caused by deposition of wastewater substances; this is usually done with little or no treatment plan before they are deposited. This is a common trend in most developing countries; there are many lakes that are designed for recreational purposes. The major problem facing the lakes has to do with non-point source pollution because of runoff from agricultural fields, domestic waste disposal and deposition of soil and organic particles due to erosion; this in a way has affected the surface water quality of the lakes. Hence, the aesthetic value is reduced and consequently the desire for recreational activities is reduced. To improve the water quality of the lakes, the type of pollution from different sources entering into the lakes must be identified and investigated to ensure adequate measures to control the pollutants from the sources without economic implication [3]. EM has been used widely in recent years in different fields in agriculture and forestry. This technique has become natural and sustainable and environmentally friendly. Many products are made by the metabolism activities of these ferments and bacteria (enzymes, vitamins *etc*.) This microbiological fertilizer has a positive effect in growing plants; to their development and metabolism [4]. EM consists of a wide variety or multi-culture of effective, beneficial and nonpathogenic microorganisms coexisting together. Essentially, it is a combination of aerobic and anaerobic species commonly found in all ecosystems. EM contains about 80 species of microorganisms divided into photosynthesizing bacteria, lactic acid bacteria, yeasts, actinomycetes and fermenting fungi that are able to purify and revive nature. The different species of EM have their respective functions. EM could be applied to many environments to break down organic matter. It is not-genetically-engineered (non-genetic modification organism), not pathogenic, not harmful and not chemically synthesized. When EM is introduced into the natural environment, the individual microorganism effects are greatly magnified in a synergistic fashion. EM technology involves growing, applying, managing and re-establishing high populations of the beneficial microorganisms in an environment or system. It is a natural and organic technology that has been found to be useful in numerous ways to benefit humankind. It was discovered that EM exhibits very thorough effects, and its use now spreading into applications various fields is ambitiously promoted as a means of solving many of the world's problems. Some of the claims of EM applications include sustainable agricultural, industrial, health (livestock, pets and human), odor control, waste management and recycling, environmental remediation and eco-friendly cleaning. The interest in the application of EM technology has indeed brought revolution in the environmental aesthetic value [5]. Effective Microorganisms(EM), a culture of coexisting beneficial microorganism predominantly consisting of lactic acid bacteria, photosynthetic bacteria, yeast, fermenting fungi and actinomycetes that are claimed to enhance microbial turnover in soil and thus known increase soil macronutrients and increases plant growth and yield. and treatment of sewages or effluents. In the present study, the EM formulation was evaluated for reduction of alkalinity, total dissolved solids, biological oxygen demand, and chemical oxygen demand of domestic sewage under standard condition. All the parameters that were tested showed distinct reduction. But total hetrototropic bacterial and yeast population was increased. No change in fungal and actinomycetes population was recorded. The result of the experiment shows that EM has the potential to improve the effectiveness of treatment of domestic wastes [6]. Bioremediation is the technique which is economical and energy consuming. It is widely used over the world. In the industrial fields, it is used to treat sulphide from the wastewater [7]. Anaerobic microorganism consisting form phototrophic, lactic bacteria and yeast .EM has used to improve the effeteness and efficiency of the UASH reactor to treatment domestic water [8]. EM technology has been used recently, to purify and revive nature. Applications of EM using the formula known as effective microorganism activated solution (EMAS) have been experimented in several rivers in Malaysia depending on the scale, location, physical and geographical conditions with the principal objective of enhancing and improving the water quality. Microbiological bioremediation is one of the numerous water purification methods [9] involving an application of environmental probiotics, which contain microorganisms and the chemical compounds that they secrete [10]. According to Mingjun and his colleagues [9], this approach is up to 60-70% less expensive than traditional methods [9]. The use of EM to treat wastewater in essence simulates the role of biological treatment. It makes use of bacteria and other microorganisms to remove pollutants and impurities from water by digesting them; thereby getting rid of impurities in the water]. The bacteria consume and digest the organic material present in the wastewater and through their metabolism, the organic material is changed into cellular mass which is no longer in solution, but is settled at the bottom of a settling tank or container. A past study that focused on purification performance of nitrogen and phosphorus in slightly polluted landscape water by a combination of EM and submerged plants showed that the combination of EM and Hydrilla verticillata had a good purification effect on total nitrogen (TN) and total phosphorus (TP) in lightly polluted water, and the removal rates reached 70% and 97.3%, respectively [10]. The removal rates of TN and TP increased by 23.4% and 2.1%, and 23.4% and 41.3%, respectively, compared with the treatments by aquatic plants or EM alone [11].

2. Material and Methods

2.1 Area of study

Benghazi Lake is the lake located in the center of the city of Benghazi, one of the most prominent features of the city and linked to the Mediterranean Sea a small canal. The lake is connected to the port of Benghazi, with a width of 120 meters and linked on the other side of the lake of the western lake, the lake area about 100 hectares, with a maximum depth of 5 m and a minimum depth of about 2.5 m, and the main bridge connecting the city's east and west. The lake is considered one of the most important fabricated lakes and the largest in the city, where the most important facilities in the city, such as the Tibesti Hotel, Ouzo Hotel, Sports City, Youth Houses, Islamic Da'wa Society, Equestrian Club, and other facilities surround the lake as illustrated in **Figure 1**. The main problem of the lake is embedded in the massive loads of pollutant it has received from the surrounding facilities weather domestic or medical or even due to military actions near by the lake. This has results in degrading the quality of water in the lake, which should be part of the surrounding recreational area and close to the port and could be an economic source of income for the country in raising aquatic animals.

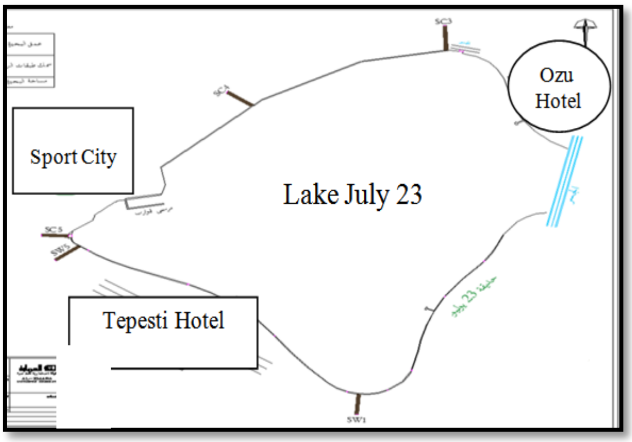


Figure 1: Illustrated diagram for Benghazi Lake

2.2 Sampling preparation

Five samples of waste water from different location of the lake(SW_1,SW_5, SC_5, SC_4 and SC_3) were collected from different sites in Benghazi Lake as presented in **Figure2**. The Effective Microorganisms was obtained from Agricultural ministry to be used for the experimentation tests. The concentration of 1 g/l, 5 g/l, 10 g/l, 15g/l and 20 g/l were prepared and added in each to a 1000 ml of wastewater obtained from the lake as demonstrated in **Figure 3**.

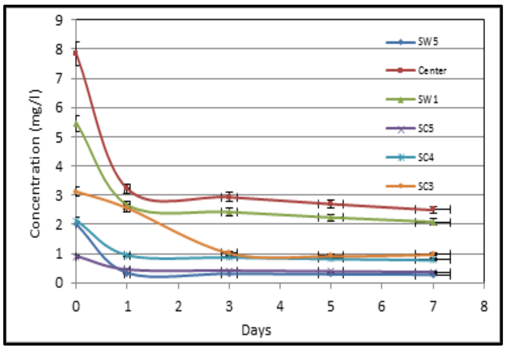
Figure 2: sample from Benghazi Lake

Figure 3: EM of 1g/l prepared

Four bottles were used as blank without adding EM. The concentration of 1 g/l, 5g/l,10 g/l, 15g/l and 20 g/l were prepared and each concentration also was divided equally into 500 ml in 4 bottles. Parameters including DO, COD, TSS, TN, TP were tested in the lab for initial concentration the after 1,3,5,and 7 days of adding the EM to the sample.

3. Result and Discussion

Figure 4 (a-e)shown the concentrations of dissolved oxygen in different sites when EM was added in different weights 1g/l, 5g/l, 10g/l, 15g/l and 20g/l. The period times for each adding weights of EM was seven days at1, 3, 5 and 7. The concentrations of DO showed significant decrease with increasing the added concentration of EM in all the selected sites. The concentrations of DO slowly decreased for 1g/l, 5g/l and 10g/l of EM and then a dramatic decreased was noticed when15g/l and 20 g/l EM was added for the samples taken from the different locations. The concentrations level of DO after adding different weights of EM on all sites ranged between 3.2 mg/l to 0.5mg/l. This decrease could be contributed to the use of the EM for the oxygen to feed on the available organic matter in the wastewater samples.



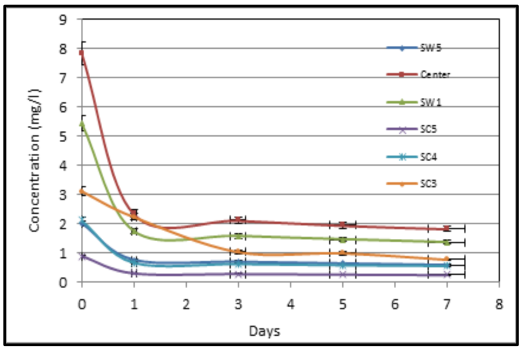
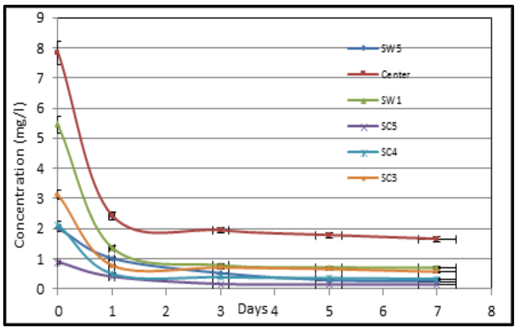


Figure 4(a): Effluent DO *vs* 1 gm/l of EM added **Figure 4(b):** Effluent DO *vs* 5gm/l of EM added



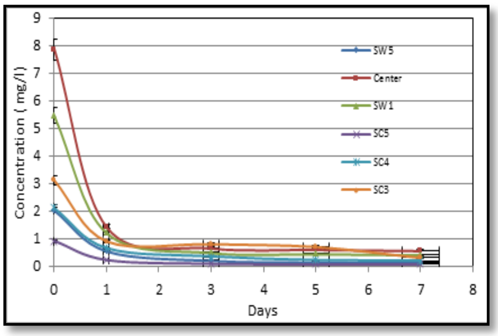


Figure 4(c): Effluent DO *vs* 10 gm/l of EM added **Figure 4(d):** Effluent DO *vs* 5gm/l of EM added

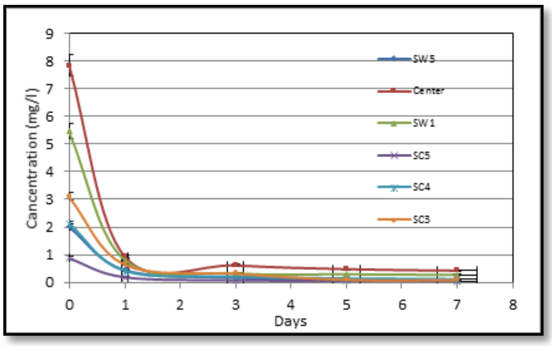


Figure 4(e): Effluent DO *vs*20 gm/l of EM added

3.2 Effect of adding different EM weights on chemical oxygen demand

Figure 5 (a-e) presents the concentrations of chemical oxygen demand (COD) in different sites when EM was added with different weights of 1g/l, 5g/l, 10g/l, 15g/l and 20g/l. The period times for each adding weights of EM was seven days at intervals of 1, 3, 5 and 7. The concentrations of COD significantly increased with increasing the added weights of EM in all the selected sites, but different respond for each site was noticed when EM was added. The concentrations level of COD after adding different weights of EM on all sites ranged between 320 mg/l to 16107mg/l.

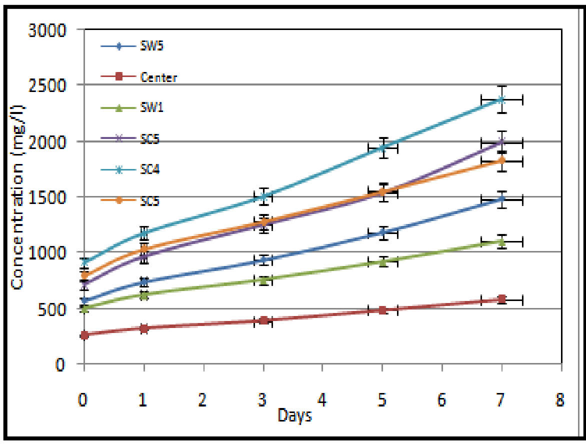


Figure 5 (a): Concentration of COD at 1g/l

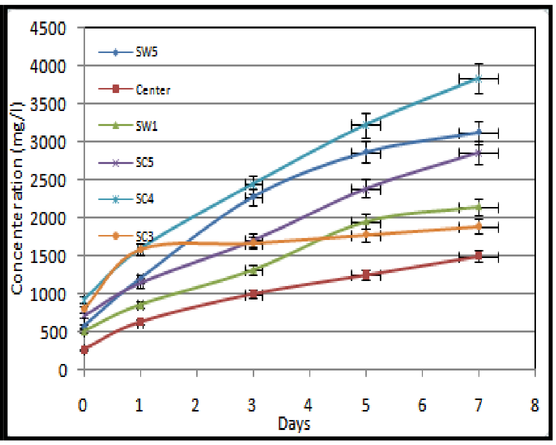


Figure 5(b): Concentration of COD at 5g/l

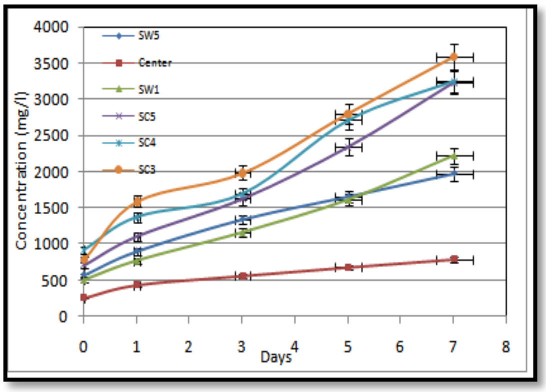


Figure 5(c): Concentration of COD at 10g/l

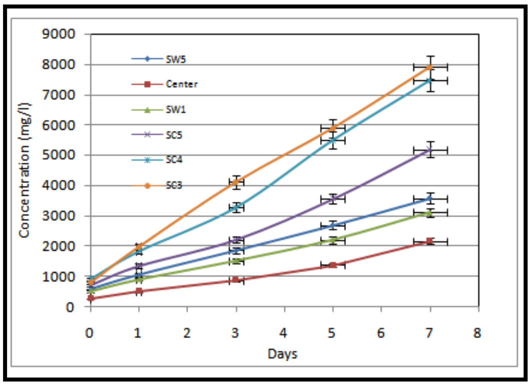


Figure 5(d): Concentration of COD at 15g/l

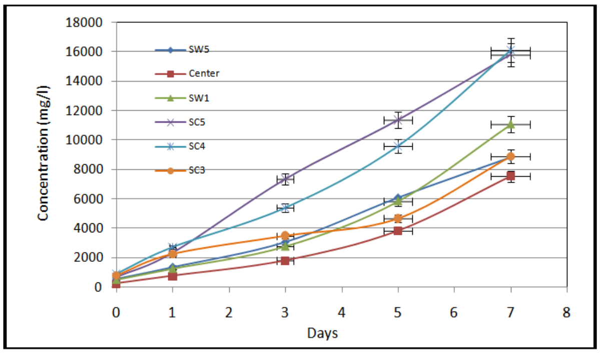


Figure 5(d): Concentration of COD at 20g/l

3.3 Effect of adding different EM weights on total suspended solid

Figure 6 (a-e) is shown the concentrations of total suspended solid (TSS)in different sites when EM was added in different weights 1g/l, 5g/l, 10g/l, 15g/l and 20g/l. The period times for each adding weights of EM was seven days at1, 3, 5 and 7. The concentrations of TSS was given significant increasing with increasing the adding different weights of EM in all the selected sites, but different respond for each site was noticed when EM was added. The concentrations level of TSS after adding different weights of EM on all sites ranged between 280 mg/l to 5000mg/l at adding 1g/l.

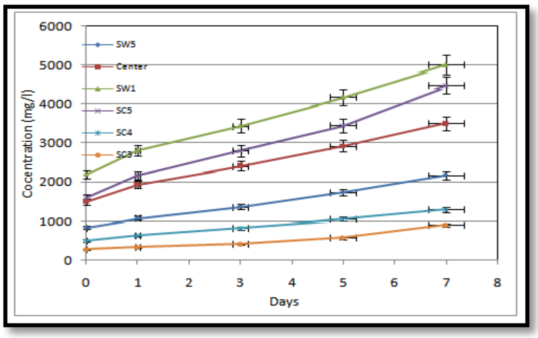


Figure 6(a): Concentration of TSS at 1g/l

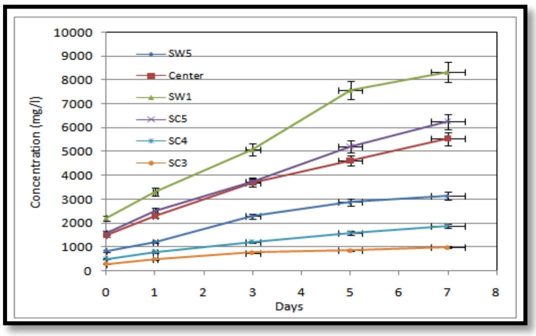


Figure 6(b): Concentration of TSS at 5g/l

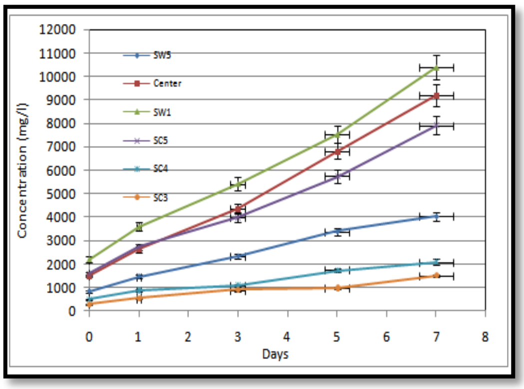


Figure 6(c): Concentration of TSS at 10g/l

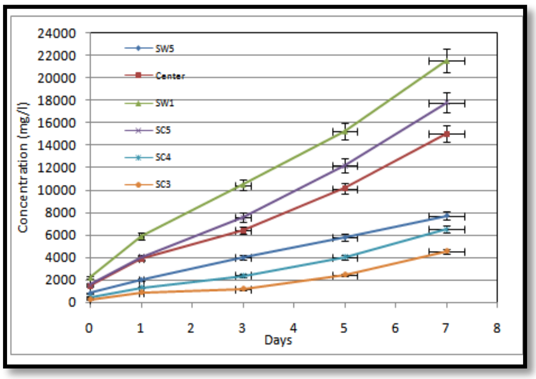


Figure 6(d): Concentration of TSS at 15g/l

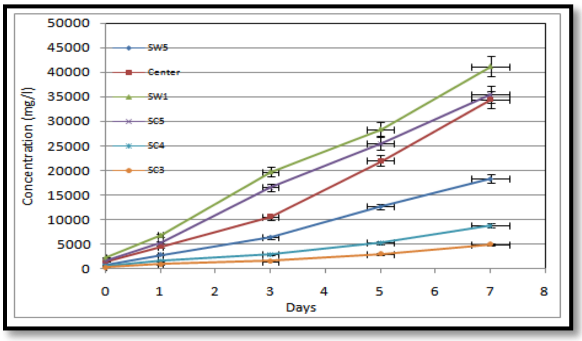


Figure 6(e): Concentration of TSS at 20g/l of EM

3.4 Effect of adding different EM weights on total nitrogen

Figure 7 (a-e) is shown the concentrations of total nitrogen (TN**)** in different sites when EM was added in different weights 1g/l, 5g/l, 10g/l, 15g/l and 20g/l. The period times for each adding weights of EM was seven days at 1, 3, 5 and 7. The concentrations of TN was given significant increasing with increasing the adding different weights of EM in all the selected sites, but different respond for each site was noticed when EM was added. The concentrations level of TN after adding different weights of EM on all sites ranged between 0.32 mg/l to 4mg/l.

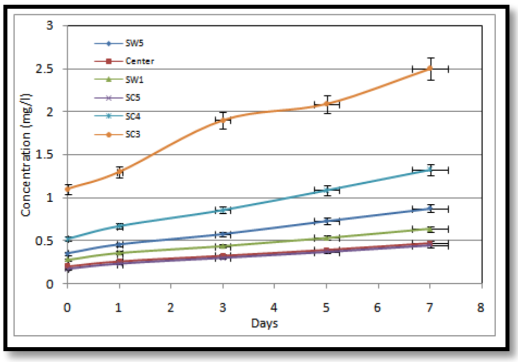


Figure 7(a): Concentration of TN at 1g/l

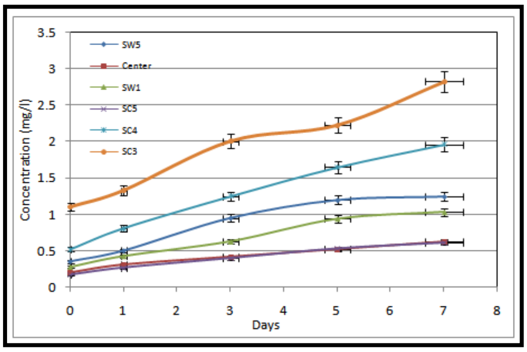


Figure 7(b): Concentration of TN at 5g/l

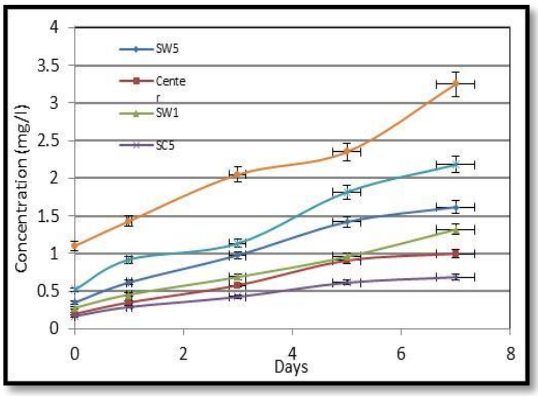


Figure 7(c): Concentration of TN at 10g/l

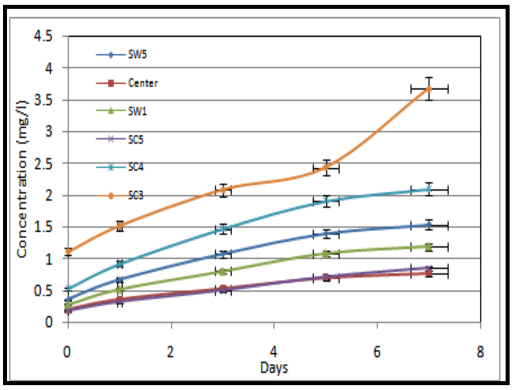


Figure 7(d): Concentration of TN at 15g/l

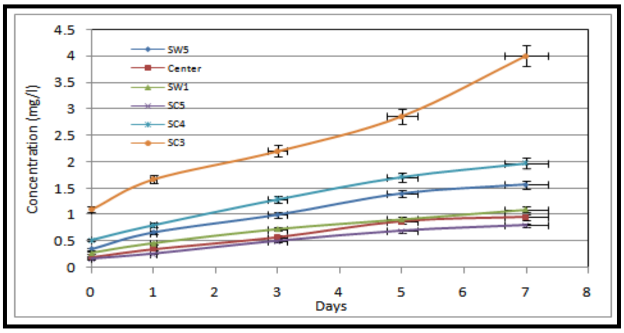


Figure 7(e): Concentration of TN at 20 g/l

3.5 Effect of adding different EM weights on total phosphorous

Figure 8 (a-e)is shown the concentrations of total phosphor(TP**)** in different sites when EM was added in different weights 1g/l, 5g/l, 10g/l, 15g/l and 20g/l. The period times for each adding weights of EM were seven days at1, 3, 5 and 7. The concentrations of TP was given significant increasing with increasing the adding different weights of EM in all the selected sites, but different respond for each site was noticed when EM was added. The concentrations level of TP after adding different weights of EM on all sites ranged between 3.32 mg/l to 99 mg/l.

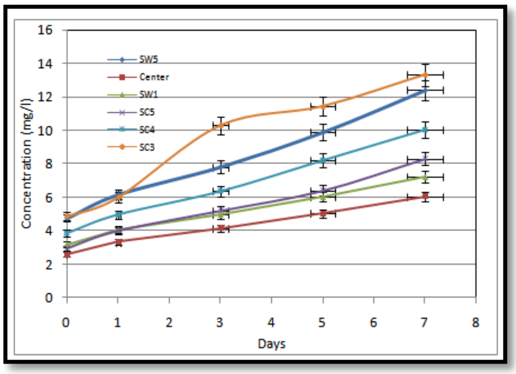


Figure 8(a): Concentration of TP at 1g/l

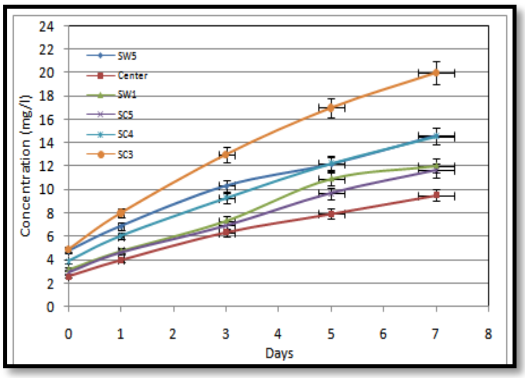


Figure 8(b): Concentration of TP at 5g/l

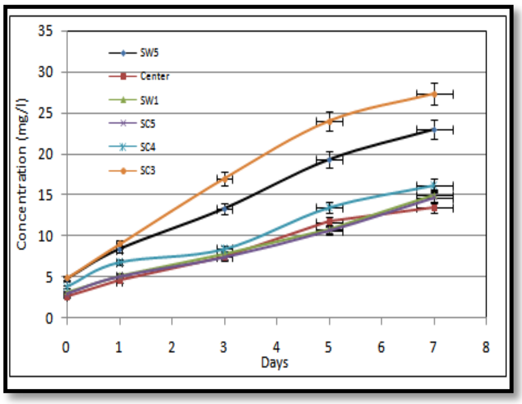


Figure 8(c): Concentration of TP at 10g/l

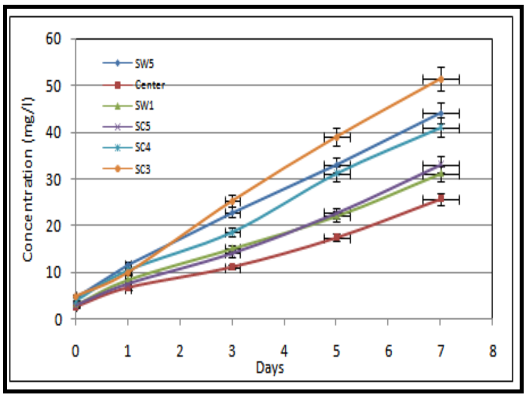


Figure 8(d): Concentration of TP at 15g/l

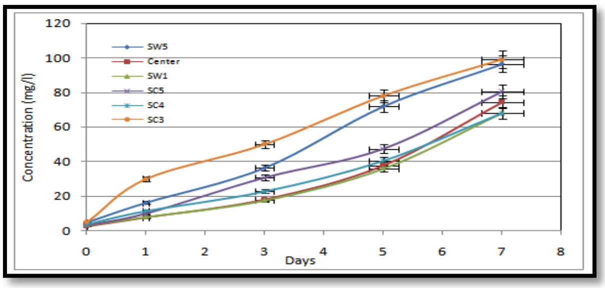


Figure 8(e): Concentration of TP at 15g/l

4. Conclusion

This study has applied sustainable and friendly green technique for the environment. The use of effective microorganisms (EM) for treatment of Benghazi Lake has given very significant values for reducing the amount of contamination of the selected pollutants in Benghazi Lake. The effect of adding different EM weights on DO, COD, TSS, TP and TN was very effective to reducing the amount of contamination .This can be noticed from the obtained results, which the concentration of each studied pollutant decreasing by increasing adding EM in different samples. In addition, effect the time was clear, which by increasing the period time over days the amount of pollutant decreasing. The percentage removal recovery of adding different EM weights on all the selected pollutants gave acceptable results, which ranged around 90%. EM is simple and convenient for use, safe, low cost and economically effective and this has increases the effectiveness of application of this technology. Moreover, the regular monitoring of water pollution level of river basin, appropriate purification treatment and community participation in water resources management will certainly help managers in taking informed decisions for water resources sustainability and management.

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