IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 16, Issue 11 Ser. I (November 2022), PP 03-08
www.iosrjournals.org

Algae composition and diversity in Benghazi Lake, Libya

Munay Abdulqadir Alteerah[1], Naeema Matuoog[2], Ahmed atta Mohamed[3], Khadija S. ELhariri[4]

[1,3,4] (Department of Botany, Faculty of science, University of Benghazi, Beng., Libya)
[2] (Department of Botany, faculty of Arts and Sciences, Ghemins, University of Benghazi)

Abstract:
Background*:Benghazi Lake is one of important Landmarks in the center of Benghazi city. It suffers a huge contamination because of sewage discourages.so the presentstudyaims to monitor and recodralgaespeciesfrom the surface water of benghazialgaethatcanbeindicators for Lake pollution.*
Materials and Methods*: Thirty-six samples were collected bi-monthly from 3 stations from Benghazi lake between march and august 2021 from the surface layer. All samples were fixed by 4% formalin and stored in the laboratory for microscopic analysis. Species cell density was determined by Utermöhl method, and Shannon-Weaver index and Simpson's index were calculated.*
Results*: The present phytoplankton listcomprised 39 species related to 5 algal divisions, comprising of, Chlorophyta51%, Cyanophyta23%, Bacillariophyta16%, Euglenophyta and Pyrrophyta5%divisions. the dominance was for Chlorophyta and Cyanophyta.*
Conclusion:*The biodiversity analysis in this study showed that the Benghazi Lake was quite rich in microalgae According to the indicator species that identified in this study, the lake suffered from high pollution.*
Key Word*: phytoplankton Algae, Diversity Indices, Lake eutrophication, chlorophytes dominance, Benghazi lake*

Date of Submission: 01-11-2022 Date of Acceptance: 12-11-2022

I. Introduction

Lakes ecosystems are increasingly affected by various anthropogenic impacts, such as eutrophication which is causing by excess of nutrients, toxic contamination of industrial, agricultural and domestic origin [1].

Phytoplankton comprises the base of the food chain in the aquatic environment, and constitutes the main group of primary producers [2]. They come in countless form and live in nearly all kinds of environments. It grows suspended in open water by taking up the nutrients from the water and energy from sunlight. Importance of phytoplankton in the aquatic environment can be originated from its biological nature as microscopic aquatic algae containing chlorophyll pigments and grow by photosynthesis. The influence of various factors on the seasonal appearance of phytoplankton differs significantly, with physical factors such as temperature and light intensity.

Bio-monitoring assessments depend on the variations of indicator species and aquatic communities in response to environmental changes, particularly those caused by the polluting agents to which they are exposed [3], [4], [5]. Species that have predictable responses to changes in a selected variable can serve as bio-indicators, reflecting the reactions of aquatic ecosystems to eutrophication and hydrochemical variables on aquatic populations. Using of algal bio-indicators is becoming more widespread due to changing environmental conditions [6], [7]. The assessments of aquatic ecosystems based on algological indicators are widely used but monitoring studies of aquatic systems in Libya are very few. Most of algae studies that done in Libya were on marine macroalgae [8] [9] [10] [11] [12] [13] [14] [15] [16] [17] [18] [19], and few that were done on freshwater algae [20] [21] [22] [23] [24] [25] and algae in saline lakes [26].

There are characteristics make Benghazi lake important. Therefore, it is necessary to determine pollution level, algae diversity of this lake. This study will make a basis to further studies. So, the aim of the present study was to establish the taxonomic composition of algae, species cell densities and indicator species in the Benghazi lake.

II. Material and Methods

Study Area

Benghazi Lake (Its name was 23rd July Lake) is located in the center of Benghazi and is one of the most prominent landmarks of the city. It is connected to the Mediterranean Sea by a small canal with the port of Benghazi with a width of 120 meters (Fig.1). Its total surface area is about 100 hectares with maximum depth

of 5 m while the minimum depth is approximately 2.5 m. The lake was salt flat area and later transformed into an artificial lake. It was a center of sea activities and fishing. From the nineties, the lake suffered from the problem of sewage discharges, which led to contamination of the lake and the death of fish except that can live on organic waste [27].

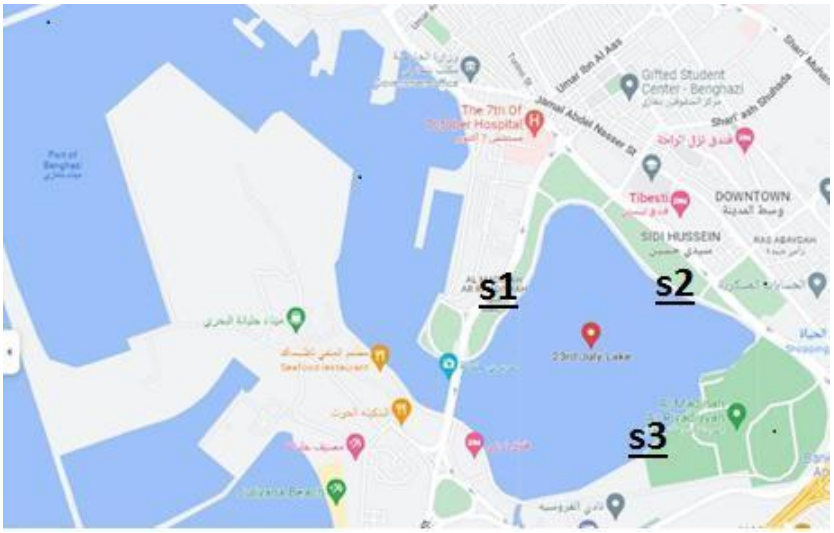

Figure 1: Map of the study area, Benghazi lake, S1, S2, S3 are sites of samples collection.

Data Collection and calculations

Thirty-six samples were collected bi-monthly from 3 stations from Benghazi lake between march and august 2021 from the surface layer. All samples were fixed by 4% formalin and stored in the laboratory for microscopic analysis. Observation and identification of phytoplankton was carried out in the phycology laboratory of University of Benghazi, Department of Botany. Microscopic examinations (in triplicate) were conducted at a magnification of 40 x using a light microscope. Samples were processed in three replicates and photographs were taken with phone camera. Counting were performed following the Utermöhl method [28] by haemocytometer chamber. Taxa identification was done by using keys, monographs and books [29] and algae base web site [30] [31].

Microalgae diversity calculations

Microalgae diversity was calculated by Shannon-Weaver index (Shannon and Weaver, 1949).

$H' = - \Sigma\ pi\ ln(pi)$

$Pi = n/N$

n is the proportion number of an individual in the sample

N is the total individuals in the sample

Simpson's index: $1 - \Sigma\ (pi^2)$

III. Result and Discussion

For the current study, Benghazi Lake was selected as it possesses abundant algal diversity often evident with bloom formation due to eutrophication and there were no previous reports on algal diversity in the area. A total of 39 phytoplankton taxa comprising of, Chlorophyta, Cyanophyta, Bacillariophyta, Euglenophyta and Pyrrophyta divisions. Chlorophyta has the highest percentage composition with 51%, followed by Cyanophyta 23% and Bacillariophyta 16% , while Euglenophyta and Pyrrophyta on the other hand had the least percentage composition of 5% (Fig.2). Chlorophytes was the most microalgae group encountered both in terms of abundance and frequency occurrence. Chlorophytes can live in wide range of nutrients and physical environments.

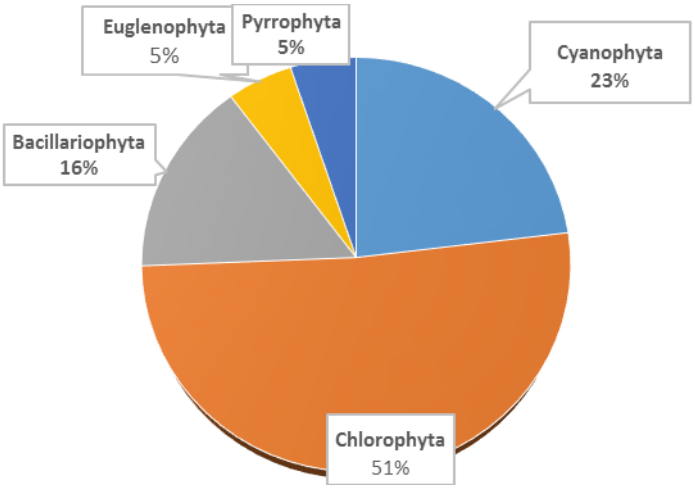

Figure 2: Algae composition in Benghazi lake.

Table 1: list of algae species collected from surface of Benghazi lake

Cyanophyta	*Oocyctisborgei*J.W.Snow
Microcystis aeruginosa (Kützing) Kützing	*Scenedesmusbijugus*(Playfair) V.May
Chroococcusturgidus(Kützing) Nageli	*Dictyochloropsissymbiontica*Tschermak-Woess
Merismopedia punctate Meyen, nom. illeg	*Stigeoclonium tenue* (C.Agardh) Kützing
*Calothrixconfervicola*C.Agardh	*Stichococcusbacillaris*Nägeli
*Phormidiumlucidum*Kützing ex Gomont	*Ulothrixaequalis* (Prescott) H.S.Forest
*Oscillatoriaprinceps*Vaucher ex Gomont	*Ulothrixzonata*(F.Weber& Mohr) Kützing
*Lyngbyaconfervoides*C.Agardh ex Gomont	*Coelastrummicroporum*Nägeli
*Stigonemamamillosum*C.Agardh ex Bornet&Flahault	**Bacillariophyta**
*Arthrospira platensis*Gomont	*Cyclotellameneghiniana*Kützing
Chlorophyta	*Nitzschiapalea*Grunow, nom. inval
Monoraphidiumminutum(Nägeli) Komárk.-Legn.	*Navicularhynchocephala*Kützing
Pandorinamorum(O.F.Müller) Bory	*Naviculatripunctata (O.F.Müller) Bory*
Spirogyra porticalis(O.F.Müller) Dumortier	*Naviculasubtilissima*Cleve
*Chlamydomonasreinhardtii*P.A.Dangeard	*Encyonemahamsherae*D. Winter and Bahls
Chlorella vulgaris Beijerinck	*Fragilariapectinalis*(O.F.Müller) Lyngbye
Tetraderon minimum (A.Braun) Hansgirg	**Euglenophyta**
*Oedogoniumgrande*Kützing ex Hirn	*Euglena viridis*(O.F.Müller) Ehrenberg
Chladophora vadorum (Areschoug) Kützing	*Euglena mutabilis*F.Schmitz
Enteromorphaintestinalis(Linnaeus) Nees	**Pyrrophyta**
Zygnemacruciatum(Vaucher) C.Agardh	*Peridiniumumbonatum*F.Stein
*Ulva lactuca*Linnaeus	*Prorocentrum lima* (Ehrenberg) F.Stein

There were clear fluctuations in the cell densities during sampling periods. The highest cell density was recorded in the site 1 from samples collected on 28 June, while the lowest cell density was recorded in the site 2 collected on 27 march (Fig.3). Simpson's index measure species heterogeneity, and it is a scale ranging from 0 to 1. 0 means no heterogeneity or no diversity in the community, while numbers close to 1 means high heterogeneity or lots of diversity (Tab.2).

The sampling sites (S1, S2, S3) were mainly dominated by Microcystis aeruginosa (Cyanophyta), this species is very toxic, it produces microsystin toxin [32], this toxin is carcinogenic [33]. Chlorophyta and Cyanophyta are impacted by nutrient levels [34]. Nutrient depletion may be a factor that relates to Microcystis causing a decrease in richness and evenness of algae biodiversity.

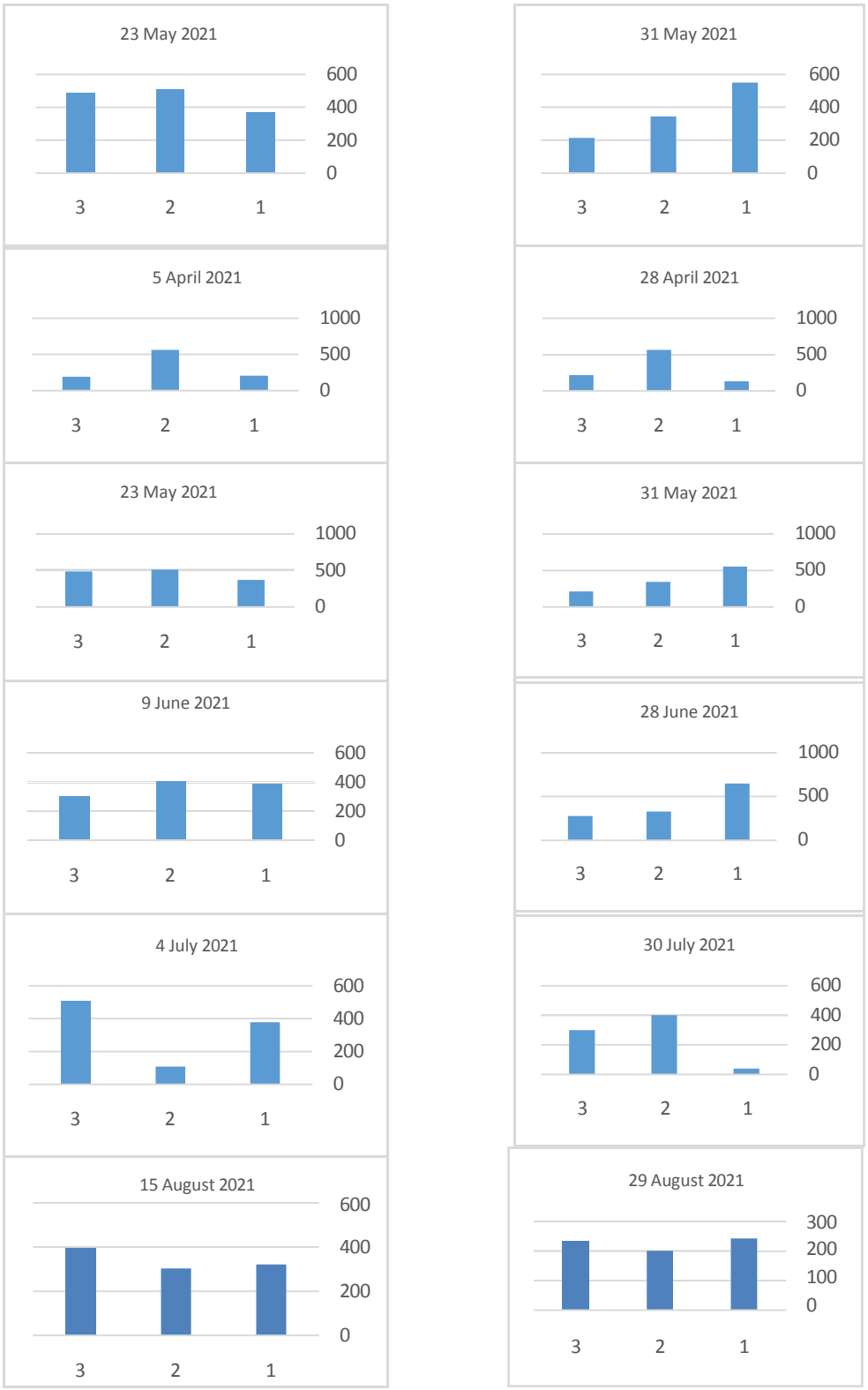

Figure 3: Cell density (cell/L) of algae during sampling time in Benghazi lake.

Table 2: Shannon-Weaver diversity index and Simpson's index of algae in Benghazi lake.

	Shannon-Weaver diversity			Simpson's index		
Date of collection	Site 3	Site 2	Site 1	Site 3	Site 2	Site 1
17-Mar	0.434	0.938	0.985	0.179	0.384	0.394
27- Mar	0.459	1.05	0.407	0.169	0.637	0.176
5-Apr	0.433	1.411	0.200	0.175	0.591	0.074
28-Apr	0.394	1.410	0.286	0.156	0.591	0.115
23-May	0.364	0.498	0.972	0.141	0.218	0.435
31-May	0.651	1.093	0.836	0.312	0.455	0.438
9-Jun	0.738	0.595	1.471	0.300	0.279	0.588
28-Jun	0.433	0.736	0.793	0.176	0.415	0.275
4-Jul	0.527	1.778	1.382	0.205	0.748	0.548
3-Jul	0.402	0.633	2.165	0.293	0.235	0.873
5-Aug	0.593	0.861	0.956	0.998	0.315	0.382
29-Aug	0.680	0.551	0.854	0.265	0.236	0.318

Cyanophyta (blue-green algae) have been shown to outcompete Chlorophyta (green algae) at higher nutrient levels, causing a decrease in biodiversity [35]. Cyanophyta used as a critical indicator for water quality because of their toxicity and their probable risk to human health. Growth of Cyanophytes increased with increasing temperature and organic contents in water bodies.

IV. Conclusion

Overall, the biodiversity analysis showed that the Benghazi Lake was quite rich in microalgae especially with high abundance of unicellular and colonial forms. Cyanophytes and Chlorophytes were found to be dominant in the study area. According to the indicator species that identified in this study, the lake suffered from high pollution. The anthropogenic activities and urbanized catchment area are mainly responsible for eutrophication in these lakes. So there is urgency to take conservation steps to prevent these lakes from further eutrophication. Strongly recommend to the concerned authorities of the city corporation to take restoration programs and minimize the anthropogenic activities in and around the lakes. Also this study recommends to isolate Microcystis aeruginosa to test its effect on the genetic material of living cells in further study.

References

[1]. Atici, T., Ahiska, S., Altindag, A., & Aydin, D. Ecological effects of some heavy metals (Cd, Pb, Hg, Cr) pollution of phytoplanktonic algae and zooplanktonic organisms in Saŕyar Dam Reservoir in Turkey. African Journal of Biotechnology. 2008;7(12).

[2]. Abdel-Moniem, A. M. and Konswa, A. H. Some biotic and abiotic variables controlling primary productivity in hyper trophic lake (Lake Qarun, Egypt. Egypt Jour. Aquati. Boil. & Fish.2001; 5(3): 1-16.

[3]. Barinova, S., &Krassilov, V.A. Algal diversity and bio-indication of water resources in Israel. International Journal of Environment and Resource. 2012; 1(2): 62-72

[4]. Adeniyi, A. O., &Akinwole, A. O. Phytoplankton composition and physico-chemical parameters of lower river Niger, Agenebode, Edo state Nigeria. International Journal of Fisheries and Aquatic Studies.2017; 5(3): 256-260.

[5]. Ozer, T., Erkaya, I. A., Solak, C. N., &Udoh, A. U. Diversity and ecology of algae from Melen River (Western Black Sea river catchment) in Turkey. Turkish Journal of Fisheries and Aquatic Sciences, 2018; 18(10): 1187-1194.

[6]. Omar, M.A., Naqqiuddin, M.A., Shohaimi, S., Omar, H., & Ismail, A. Phytoplankton diversity in relation to different weather conditions in two urban made lakes. Sustainability, Agri, Food and Environmental Research, 2016; 4 (1).

[7]. Fan, J., Wu, J., Kong, W., Zhang, Y., Li, M., Zhang, Y., ... & Zhang, M. Predicting bio-indicators of aquatic ecosystems using the support vector machine model in the Taizi River, China. Sustainability, 2017; 9(6), 892.

[8]. Nizamuddin, M. and Godeh, M. Stypopodiumtubruqense (Phaeophyta, Dictyotales), a new species from the Mediterranean Sea .Willdenowia . 1989;(18): 603-608.

[9]. Nizamuddin, M.Observation on the genus Flabellia (Caulerpales, Chlorophyta). Nova Hedwigia. 1987; 44: 175-188.

[10]. Nizamuddin, M. CladophoropsisgerloffiiNizamuddin, a new siphonoc-lada-ceous algae from the coast of Libya. Willdenowia .1988;(17): 229-234.

[11]. Nizamuddin, M. The Green marine algae of Libya. 1991; 230.

[12]. Godeh, M. M.; Nizamuddin, M. and El-Menifi, F. O. Marine algae from Eastern Coast of Libya (Cyrenaica). Pak. J. Bot. 1992; 24 (1): 11-21.

[13]. El- Baghdadi, H. Study of effects of some algae species from order Dictyotales against bacteria. Master thesis, botany department, faculty of science, Garyounis university.2001.

[14]. El-Fergani, O. Study effects of Rytipharatinctoria (Clem.) C.Agardh. extracts against growth of some human pathogenic bacteria. Master thesis, botany department, faculty of science, Garyounis university.2001.

[15]. Tuqan, I. Study effects of some green algae species from order Ulvales against bacteria. Master thesis, botany department, faculty of science, Garyounis university.2003.

[16]. El-Jahmi, H. Study effects of some green algae species from order Ulvales against human pathogenic fungi and bacteria. Master thesis, botany department, faculty of science, Garyounis university. 2007.
[17]. El-Fatimy, A. Study of effects of some algae species from order Dictyotales against some pathogenic fungi. Master thesis, botany department, faculty of science, Garyounis university.2008.
[18]. El-Fatimy, A. S. and Said, A. A. Antibacterial activity of methanolic extract of dominant marine algae (Padinapavonia) of Tolmeta Coasts Libya. J. Amer. Sci. 2011; 7(4): 745-751.
[19]. Omar, F. Study the efficiency of Colpomeniasinuosa extracts against some human pathogenic bacteria. Master thesis, botany department, faculty of science, Garyounis university.2013.
[20]. Marchesoni, V. Flora algologica del Fezzan e dellaregione di Gat. Mém. Ist. Ital. Idrobiol. 3, 431-461.
[21]. Léonard, J., Misonne, X., Klerkx, J., De Heinzelin, J., Haesaerts, P., Van Noten, F., &Petiniot, R. (1969). Expéditionscientifiquebelgedans le désert de Libye. Africa Tervuren, 1947; 15 (4):101-134.
[22]. Khan MA. Floristic studies of Diatom communities and habitat characteristics of some inland waters in Libya. Arab Gulf J. Sci. Res., 1995;13: 133-149.
[23]. Issa, A. A., Attitalla, I. H., & El-Mesmary, H. M. A first Report of Fresh Water Algae at Suluq lake, Libya. Top class Journal of Microbiology.2012; 1(1) :18-24
[24]. Hamida. EL. &Hanan. M. A. Collection and definition of freshwater algae in City of Shahat, Libya. Journal of Environmental Science, Toxicology and Food Technology, 2018;(12)12: 37-41
[25]. Loujanqi, A. K. M. A, Alteerah and M. M. Godeh. dentification of Freshwater AlgaeFromKufrah, Libya. Libyan Journal of Ecological &EnvironmentalSciences and Technology, 2020; 2(1): 13-17.
[26]. Elzen, A., Elsambany, M. M., &Elshahed. A. Diatom Assemblage in the Lake of Gaberoun, Southern Libya. Journal of Advanced Laboratory Research in Biology, 2012; 3(3), 158-163.
[27]. El-mabrouk, F, Zayani, A and Elbagrmi, H. Study water pollution of 23July lake in Benghazi. International Science and Technology Journal, 2019; 20: 54-73.
[28]. UTERMÖHL, H., 1958, Zurvervollkommung der quantitativen phytoplankton-methodik. Mitt. Int. Verein. Limnol., 9: 1-38.
[29]. Bellinger, E. G., &Sigee, D. C. Introduction to freshwater algae. Freshwater Algae: Identification and Use as Bioindicators.2010;1-40.
[30]. Guiry, M., &Guiry, G. AlgaeBase. World-wide electronic publication. National University of Ireland, Galway.2013.
[31]. Guiry, M. D., &Guiry, G. AlgaeBase.2008.
[32]. Omidi, A., Esterhuizen-Londt, M., &Pflugmacher, S. Interspecies interactions between Microcystis aeruginosa PCC 7806 and Desmodesmussubspicatus SAG 86.81 in a co-cultivation system at various growth phases. Environment international, 2019; 131(10): 50- 52.
[33]. Shi, L., Du, X., Liu, H., Chen, X., Ma, Y., Wang, R., ... & Zhang, H. Update on the adverse effects of microcystins on the liver. Environmental Research, 2021;195: 110890.
[34]. Nwankwo D. I., Owoseni T. I., Usilo D. A., Obinyan I., Uche A. C. &Onyema I. C. Hydrochemistry and plankton dynamics of Kuramo lagoon. Life Sci. J. Acta Zhengzhou Univ. Overseas Ed. 2008;5: 83–8.
[35]. Falconer I. R. Cyanobacterial Toxins of Drinking Water Supplies. Taylor & Francis, Inc., Oxford, UK.2004.

Munay Abdulqadir Alteerah, et. al. "Algae composition and diversity in Benghazi Lake, Libya."*IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*, 16(11), (2022): pp 03-08.