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Microalgal Diversity Study of Lake Basaka, Metehara, Ethiopia

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Abstract

Lake Basaka is characterized by a Na-HCO3-Cl type of water which is typical feature of saline water. Such saline environments may harbors unique microbial genetic resource which have wide industrial applications. This study was conducted with the objective of describing algal diversity of the lake Basaka. For algal diversity study 90 water samples were collected in October, 2015. Microscopic study of the water samples showed that phylum *Chlorophyta* and *Diatoms* were dominated the Lake during sample collection. *Scenedesmus*, *Selenastrum*, *Volvox*, *Navicula* and *Nitzschia* species were observed with high frequencies. Moreover, few algal species belong to Phylum *Euglinophyta* were observed.

Keywords: Algae; Diversity; Basaka

Introduction

Lake Basaka is a soda (alkaline lake) having PH 9.5 and it is situated in awash basin which is located in the northern Main Ethiopian Rift valley [1]. Lake Basaka is a volcanically dammed terminal lake located at near distance to the Afar Triangle. There is a number of hot springs supplying water to this lake. The outlets of these springs are currently submerged due to the abrupt rise of lake water. As the area is situated in the upper most part of central Rift Valley region of Ethiopia, it is vulnerable to the occurrences of various tectonic and volcanic activities [2,3].

Lake Basaka has been expanding drastically since the late 1960s [4]. The expansion of the lake is alarming and has had detrimental effect on the surrounding biological, physical, hydrological and infra-structural environment. The lake growth has affected the highway and railway structures which run along its northern shore and lake has flooded the highway, the only import-export line to the port of Djibouti, several times [5]. The growth of the Lake is a natural disaster for the surrounding ecosystems, as the expansion has created an unstable transitional zone between the wetland and nearby terrestrial ecosystem. The Metehara sugar plantation has been inundated and lost income from 161.55 ha of land [6]. The sugar plantation in Abadir suffers from salt-water encroachment and has lost more than 30 ha of farmland [5].

Microalgae are the major O_2 producer and they are commercially important in the food industry and aquaculture, as a natural source of high-value products such as fatty acids, carotenoids, steroids etc [7,8]. Microalgae uses as alternative source for fuel production [9,10]. Microalgae have been considered as potential source of energy, food, co_2-fixation (from atmosphere or industrial flue gas, hence, reduces global warming), up take nitrogen and phosphorus from waste water (consequently reduce eutrophication in aquatic ecosystems) and restoration of land (by fertilizer or soil conditioner obtained from biomass residue) [11-13].

Diversity measures are useful in lake ecosystems which harbour a large variety of algal species in general and species diversity within the genera. Detailed studies on algal diversity have been done by Aiyaz [14] Basavarajappa [15]. Most of these studies deal with the distribution of algal species in different water bodies. However the study on algal groups is lacking and the significant relationship between different groups of algae is insufficient.

The study was aimed to collect the water samples from the Basaka Lake and to identify the Microalgal species to make a record on its diversity from the sampling sites of the lake.

Material and Methods

Study area

Lake Basaka is an alkaline lake in the Oromia Region of central Ethiopia. It is located in the Great Rift Valley about 200 kilometres south east of the capital Addis Ababa in Metehara. The lake watershed area is 540km with latitude N8°41'- 9°0', longitude of E39°43'-39°59' and an altitude 1200 meters above sea level. The salt lake has grown significantly in the past 50 years, growing from 3 square kilometres (740 acres) in 1957 to 42.6 square kilometres (10,500 acres) in 2008. The lake is growing to the east and north east due to the local topography [16]. Due to the growth of the lake, there increasing concern that it will permanently damage the nearby Awash River, which is a major water source for nearby cotton and sugar plantations [17].

Sampling and analysis

Water samples were collected from six sampling stations of lake during October 2015. Water samples were collected in sterile 50 ml plastic bottles and 50 ml of the fresh water sample were preserved in 4% of 1ml formaldehyde solution. And also fresh water samples were collected from the lake in 100 ml bottle containing BG/BBM media. The collected samples were brought to Ethiopian biodiversity institute, microbial laboratory. Then, temporary mounts of microalgae specimen were prepared by placing a drop of the water samples onto a microscope slide and carefully lower a coverslip onto it and examined under an inverted microscope. Observing the Microalgal samples at lower magnification (X10, X40) and move sequentially up if necessary and their identification to genus or species level were made on the basis of various descriptors of Microalgae [18-21] and internet resources were also used for identification.

Results and Discussion

Diversity of microalgae: detailed microscopic examination of water samples revealed five families consisting of 27 genera of microalgae in the order: Chlorophyceae (13 genera), Bacillariophyceae (6 genera) Cyanophyceae (5 genera), and Cryptophyceae (2 genera) Euglinophyta (1 genera) (Table 1).
Chlorophyta- *Actinotaenium, Ankistrodesmus, Asterococcus, Chlamydomonas, Dunaliella, Oocystis, Palmella, Pieurococcus, Scenedesmus, Schroederia, Selenastrum Tetraspora, and Volvox*
Bacillariophyta- *Cyciotella, Gyrosigma, Navicula, Nitzschia, Syndra and Tabellaria*
Cyanophyta- *Aphanizomenon, Aphanocapsa, Chroccocus, Microcystis, and Snowella*
Cryptophyta- *Cryptomonas and Rhodomonas*
Euglinophyta- *Euglena*

Microalgae	cultured sample	preserved sample
CHLOROPHYTA		
Actinotaenium	-	+
Ankistrodesmus	-	+
Asterococcus	+	+
Chlamydomonas	+	-
Dunaliella	-	+
Oocystis	+	+
Palmella	-	+
Pieurococcus	-	+
Scenedesmus	++	++
Schroederia,	-	+
Selenastrum	++	++
Tetraspora	-	+
Volvox	++	++
BACILLARIOPHYTA		
Cyciotella	+	+
Gyrosigma	-	+
Navicula	++	++
Nitzschia	++	++
Syndra	+	+
Tabellaria	-	+
CYANOPHYTA		
Aphanizomenon	-	++
Aphanocapsa	-	+
Chroccocus	++	++
Microcystis	++	++
Snowella	-	+
CRYPTOPHYTA		
Cryptomonas	-	+
Rhodomonas	-	+
EUGLINOPHYTA		
Euglena	+	-

(+ present, ++ dominant, - absent)
Table 1: Microalgae taxon found from Lake Beseka.

The result showed that almost all the Microalgae genera found from the microscopic observation of the preserved samples was also found from aerated samples (The composite Microalgae samples was cultured on BBM liquid medium supplied with CO_2 from compressed gas cylinders (aerator)) except *Chlamydomonas* and *Euglina.* According to (http://site.iugaza.edu.ps/elnabris/files/2014/11/3-.pdf) this may be due to some algal species can be distorted or cannot be recovered in the sample at all and also organisms may shrink (lower cell volumes) when they preserved by formalin. And also this may be because of formalin preservation can cause contraction or diflagelation [22,23]. As represented in Table 1 the result showed that phylum Euglinophyta was present very less number in this month. Euglinophyta are usually found in environments where there is an abundance of decaying organic matter such as marshes, bogs, fens or mires essentially brown peat water systems. Due to their association with increased levels of dissolved organics, euglenoids have been used as environmental indicators of such conditions. During the present investigation on Lake Beseka maximum Microalgal diversity was shown by Chlorophyta and Diatoms. Chlorophyta are a large and important group of freshwater green algae including some of the most common species, as well as many members that are important both ecologically and scientifically [24]. Higher population of *Scenedesmus, Selenastrum, Volvox, Navicula and Nitzschia species* was also observed. When conditions in the upper mixed layer (nutrients and light) are favorable (as at the spring), Bacillariophyta competitive edge and rapid growth rate enables them to dominate phytoplankton communities. According to the survey on Baiyangdian Lake, Cyanophyta and Chlorophyta became dominant in the phytoplankton community, that may be caused by the increased organic matters after organic matters in industrial wastewater and domestic sewage came into the Lake Li Y [25] and resulted in the increase of varieties and number of phytoplankton, especially these species with high pollution tolerance. Generally speaking, in eutrophic lakes, Chlorophyta and Cyanophyta are the dominant species [26,27]. From this, a conclusion can be drawn that which the group Chlorophyta is becoming the dominant species, indicating that Beseka Lake had become.

Conclusion

Generally Lake Basaka was dominated by Chlorophyta and Bacillariophyta, which are indicators of good water quality. The finding of this study provides necessary theoretical and data support for the diversity of microalgae in Basaka Lake. However, further studies are still needed on the species composition, quantity characteristics and distribution characteristics of the Microalgae species in Basaka Lake for the conservation of biodiversity.

References

1. Alemayehu T, Ayenew T, Kebede S (2005) Hydrogeochemical and lake level changes in the Ethiopian Rift. Journal of Hydrology 316(4): 290-300.

2. Belay AE (2009) Growing Lake with Growing Problems: Integrated Hydrogeological Investigation on Lake Beseka, Ethiopia (Ph.D. dissertation) Universitäat Bonn, Germany.

3. Dinka M, Loisjkandl W, Ndambuki J (2014) Hydrochemical modelling for Lake Basaka: development and application of a conceptual water budget model. Environ Monit Assess 186(9): 5363-5379.

4. Ayenew T (2004) Environmental implications of changes in the levels of lakes in the Ethiopian Rift since 1970. Reg Environ Change 4: 192-204.

5. Tessema Z (1998) Hydrochemical and water balance approach in the study of high water level rise of Lake Beseka, MSc. Thesis [unpublished], 90 pp., University of Birmingham, UK.

6. WWDSE (1999) Study of Lake Beseka, Ministry of Water Resources, Addis Ababa, Ethiopia, Main Report 1: 203.

7. Cardozo K, Guaratini T, Barros M, Falcao V, Tonon A (2007) Metabolites from algae with economical impact. J Comp Physiol 146(2): 60-78.

8. Olmos Soto J, Paniagua Michael J, Contreras P, Trujillo L (2002) Moleular identification of β carotene hyper producing strains of *Dunaliella* from saline environments using species specific oligonucleotides. Biotechnol Lett 24: 365-369.

9. Saha S, Uma L, Subramanian G (2003) Nitrogen stress induced changes in the marine cyanobacterium *Oscillatoria willei* BDU 1300511. FEMS Microbiol Ecol 45(3): 263-272.

10. Ilavarasi A, Mubarak A, Praveen K, Baldev E, Thajuddin N (2011) Optimization of various growth media to freshwater microalgae for biomass production. Biotechnology 10(6): 360-365.

11. Oliver R, Hamilton D, Brookes J, Ganf G (2012) Physiology, Blooms and Prediction of Planktonic Cyanobacteria. In: Whitton BA (Eds.), Ecology of Cyanobacteria II, Springer, Netherlands, ISBN-13: 9789400738546, pp: 155-194.

12. Tang Y, Koch F, Gobler C (2010) Most harmful algal bloom species are vitamin B_1 and B_{12} auxotrophs. Proc Natl Acad Sci USA 107(48): 20756-20761.

13. Muthukumar C, Muralitharan G, Vijayakumar R, Panneerselvam A, Thajuddin N (2007) Cyanobacterial biodiversity from different freshwater ponds of Thanjavur, Tamil Nadu (India). Acta Botanica Malacitana 32: 17-25.

14. Aiyaz R, Mir A, Wangones A, Yusuf R (2010) Diversity index of algal flora in Kashmir lake. Nature Environmental Pollution Technology 9: 293- 298.

15. Basavarajappa S, Raju N, Hosmani S, Niranjana S (2009) Studies on the water quality parameters of four freshwater lakes of Mysore, Karnataka State, India. Journal of Environmental Ecoplanning 16: 413-419.

16. Olumana M, Loiskandl W, Furst J (2009) The expansion of highly saline Basaka Lake and its effects on the sustainability of Metehara Sugar Estate. Proceedings of the 34th-WEDC International Conference. Refereed Paper (296), Addis Ababa, Ethiopia, pp: 571-579.

17. Mercy Kahenda (2012) Ethiopia: Expansion of Lake Beseka a Threat to Metehara.

18. John D, Whitton B, Brook A (2002) The freshwater algal flora of the British Isles: An identification guide to freshwater and terrestrial algae. The British Physiological Society, Cambridge.

19. Janse van Vuuren S, Taylor J, Gerber A, van Ginkel C (2006) Easy identification of the most common freshwater algae. A guide for the identification of microscopic algae in South African freshwaters. African Journal of Aquatic Science 32(3): 317-318.

20. John D, Wehr, Robert G, Sheath (2002) Freshwater Algae of North America Ecology and Classification A volume in Aquatic Ecology.

21. Bellinger E, Sigee D (2010) Freshwater Algae: Identification and Use as Bioindicators. Wiley: Chichester, UK.

22. Slack KV (1973) Methods for collection and analysis of aquatic biological and microbiological samples, book, chapter A-4. In: Techniques of water- resources investigation of the United States Geological Survey. United States Printing Office, Washington, D.C.

23. United States Environmental Protection Agency (1976) Guidelines establishing test procedures for the analysis of pollutants- amendments. Federal Register 40: 52780-52786.

24. Palmer CM (1980) Algae and Water Pollution, Castle House Publication, London, pp: 123.

25. Li YH, Cui BS, Yang ZF (2004) Influence of hydrological characteristic change of Baiyangdian on the ecological environment in wetland. Journal of Natural Resources 19(1): 62-68.

26. Pang QQ, Li BY (2003) Eutrophication degree assessment of Dongping Lake, China. *Water Resources Protection* 19(5): 42-44.

27. Dayananda C, Kumudha A, Sarada R, Ravishankar G (2010) Isolation, characterization and outdoor cultivation of green microalgae *Botryococcus* sp. Sci Res Essays 5(17): 2497-2505.