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Short Communication

Isolation of Toxic Cyanobacterial Communities Distribution in Lake Tana, Amhara Regional State, Ethiopia

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ABSTRACT

Lake Tana is the second largest lake next to Victoria Lake in Africa. This Lake is exposed to agriculture run off, industrial and urban waste since it has not buffer zone to protect any invading materials to the water body. The accumulation and growth of blue-green algae in water body calls for public attention because of its health concern. The major entry routes of these toxins are drinking water and water used for recreation. The main goal of this scientific study was to assess the distribution of potential toxic cyanobacteria in Lake Tana. Cyanobacterial distributions were studied in different water bodies of the Lake. In the present studied area *Anabaena, Nostoc, Chlorella, and Microcystis aeruginosa* species were dominantly exist. Therefore, maybe the numbers of fish depleted in Lake Tana due to the presence of microcystine molecule source, those are *Anabaena*, *Nostoc* and *Microcystis aeruginosa* species.

Keywords: Industrial; Urban waste; Cyanobacteria; Toxins; Microcystine molecule

INTRODUCTION

Recent studies show a serious decline in fish stocks due to the spread of the aquatic weed water hyacinth around fish spawning grounds in Lake Tana [1-5]. Cyanobacteria, commonly known as blue-green algae, are bacteria that contain photosynthetic pigments similar to those found in algae and plants. Their ability to fix nitrogen directly from the atmosphere gives them a competitive advantage over other algae.

Blue-greens cannot maintain an abnormally high population for long and will rapidly die and disappear after 1-2 weeks. If conditions remain favorable, another bloom can replace the previous one, making it appears as one continuous bloom lasting for up to several months. Toxic blue-greens are an emerging public health issue [5-9]. The primary exposure pathways of concern have been drinking water and recreational exposure. Consumption of fish containing blue-green toxins represents a poorly studied weather how much it is toxic or not [10]. Microcystins are heat stable and do not break down during cooking [11-18]. Several species of cyanobacteria can grow abundantly under favorable natural environmental conditions and form high biomass called water blooms which often is associated with eutrophication [19-22]. Cyanobacterial blooms commonly occur in many temperate lakes and also in coastal areas [23,24]. These blooms are considered a natural phenomenon, but in recent years their frequency has increased considerably [25-29]. Agricultural runoff and other effluents to fresh and marine water bodies and wetlands have resulted in increased nutrient enrichment of phosphorous and nitrogen, thus providing favorable conditions for the growth of toxic cyanobacteria [8].

Most of the harmful effects of cyanobacterial blooms have been reported from freshwater ecosystems. Several cyanobacteria blooms have also been reported from brackish and marine waters and may have harmful effects on humans and animals [9]. The bloom of a marine Cyanobacterium, Trichode smiumerythraeum causes sickness, dermatitis and other discomforts [10]. Therefore, this research hypothesis was the fish may be decline in Lake Tana by the microcystin which is released from harmful cyanobacteria. Hence, this study attempted to assess the presence of the harmful cyanobacteria in Lake Tana by identifying the species using microscope.

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MATERIALS AND METHODS

Water samples and cyanobacterial mats were collected from Lake Tana since October 2017 and February 2018 in Goregora side, Grand Hotel side, St.Michael side and St.Mariam by plastic bottles and using 3 ml/L Lugol's solution for micro algae sample nutrient source till sample analysis in laboratory. Then, 250 ml of water sample was filtered through the filter membrane with pore size of 0.22 µm. After filtration, membrane was washed in 5 ml of autoclaved water. The filtered microalgae were growing in the standard BGI medium for 15 days. The culture media of BGI containe $MgSO_4 .7H_2 O$-0.4 g; $MgCl_2 .6H_2O$-0.7 g; $CaCl_2 .2H_2 O$-0.5 g; $KH_2 PO_4$-0.3 g; $K_2 HPO_4$-0.3 g; $(NH_4)2SO_4$ -0.5 g; H_3BO_3-0.26 g; $CuSO_4 .5H_2 O$-0.5 g; $MnCl_2 .4H_2 O$-0.5 g; Mo-0.06 g and $ZnSO_4 .7H_2O$-0.7 g in 1 Liter of deionized water.

Isolation of blue-green algae

The cultivated micro algae sample by BGI media were transferred to 2% solid agar media, then different unit culture were observed after 10 days in this media. Finally, using a microscope the cultured cyanobacteria were identified.

RESULTS AND DISCUSSION

The cyanobacterial species *Anabaena*, *Microcystis aeruginosa* and *chlorella* species were found in St.Michel Monastery side of Lake Tana as shown in Figure 1A, cyanobacteial species from Goregora side of the Lake *Chlorella* and *Nostoc* species were investigated as shown in Figure 1B. Three cyanobacterial species were found at St.Mariam side of Lake Tana those were *spirulina platensis*, *Microcystis aeruginosa* and *chlorella* species as shown in Figure 1C. Also, the dominant cyanobacteria species, *Anabaena* were founded in the Grand hotel side as shown in Figure 1D.

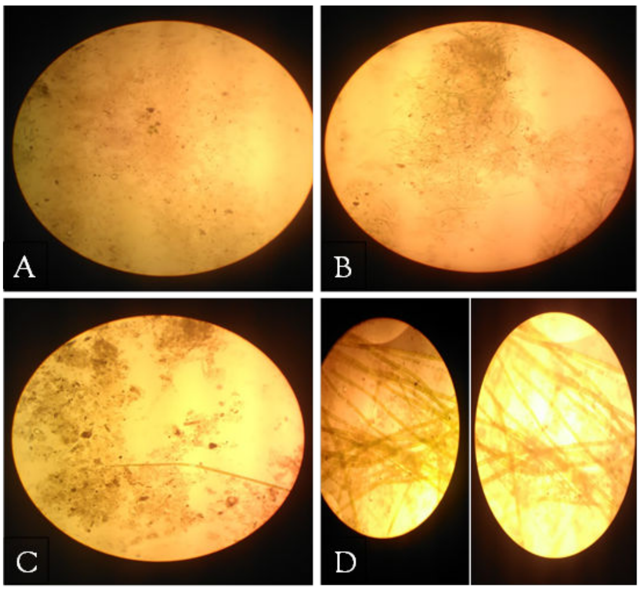

Figure 1: Growth of cyanobacterial species in different regions. (A) St.Michael (*Microcystis aeruginosa species*), (B) Goregora (*Nostoc species, and chlorella*), (C) St.Mariam (*spirulina platensis, Microcystis aeruginosa and chlorella species.*), (D) Grand hotel (*Anabaena species*).

Cyanobacteria are well known for their source of a multitude of highly toxic and allelopathic compounds. The toxic compounds include various cyclic peptides (the hepatotoxic microcystins) and alkaloids (the potent neurotoxins and the hepatotoxic cylindrospermopsin), which have been studied both from a toxicological and a biological perspective [30]. In this study, *Microcystis aeruginosa*, *Nostoc*, and *Anabaena* species, dominantly existed in Lake Tana. Those cyano bacteria (blue-green algae) are potential toxic and cytotoxic effects source of different animals, for example from the genus *Nostoc*, nostocyclamide, which is a cyclic hexapeptide inhibits growth in algae and bacteria [34,35]. Nostocarboline that functionally similar to anatoxin is an inhibitor of acetylcholinesterase and the first serine protease inhibitor of an alkaloid structure that has been described [36]. Nostocine inhibited the growth of various algae and cultured plants [37,38].

Microcystins are produced by *Anabaena*, *Fischerella*, *Gloeotrichia*, *Nodularia*, *Nostoc*, *Oscillatoria*, members of *Microcystis*, and *Planktothrix*. Microcystins are the most widespread cyanobacterial toxins and can bioaccumulate in common aquatic vertebrates and invertebrates such as fish, mussels, and zooplankton. Microcystins primarily affect the liver (hepatotoxin), but can also affect the kidney, and reproductive system [39].

CONCLUSION

The present results indicate that potentially toxic cyanobacteria that synthesis microcystine molecules were *Microcystis aeruginosa*, *Anabaena*, and *Nostoc*, were occurred in the studied areas of Lake Tana. Therefore, as we know these cyanobacteria are very toxic and harmful to aquatic organisms, so it may affect the fish in the lake. This research finding recommend Lake Tana should have standard buffer zone to protect the Lake from agriculture runoff, urban, industrial waste and other water pollutant source since the nutrient source of cyanobacteria is from outside the Lake and finally, harmful algal blooms in Lake Tana should be continuously monitoring to protect human and animal health.

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