Indicator organisms of algae and related water quality in hot springs, Hanlin village, Wetlet Township, Sagaing Region

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Abstract

In this research, algal flora and analysis water from hot springs found in Hanlin Village, Wetlet Township, Sagaing Region was presented. All of the algae specimens were included in two divisions and two classes. Cyanophyceae were abundantly found all of study areas. Algae specimens and water samples were collected all of the study areas within the year 2016 to 2017. *Oscillatoria* and *Phormidium* were mostly observed in high temperature hot springs. According to water analysis results, station B and D in Hanlin were recorded to temperature variation between 50˚C to 52˚C. Stations A, C in Hanlin have 41˚C to 47˚C and station E in Hanlin has 39˚C. The physico-chemical parameter like pH, water temperature, total solid, total hardness, total alkalinity, calcium, magnesium, sulphate and chloride were analyzed in the laboratory and presented in this research. Among them, the amount of chloride was found to exceed the maximum permissible limit of WHO guideline valve (2000) in Hanlin hot springs.

Key words: Water analysis and algal flora

Introduction

Hot spring also called thermal spring with water at temperatures substantially higher than the air temperature of the surrounding region. Most hot springs discharge ground water this is heated by shallow intrusions of magma (motion rock) in volcanic areas. Some thermal springs, however, are not related to volcanic activity. A thermal spring of water is warmer than 36˚C.

In general, thermal are scientifically defined as warm as hot water that have higher temperature than the annual atmospheric temperature of the distinct. The related term "warm spring" is defined as a spring with water temperature less than a hot spring by many sources, although Pentecoste (2003) suggests that "warm spring" is not useful and should be avoided. Warm spring of water temperature is between 20˚ and 50˚C.Geothermal activity is probably responsible for the creation of the most numerous high temperature environments. Hot springs associated with volcanic activity often has temperature for the development of thermophilic organisms.

A recent survey (Warring 1965) reveal that thermal waters are widely distributed over the face of the earth, although springs are often concentrated in restricted areas. The longest concentrations of hot springs and fumaroles are found in Yeuowstone National Park (Keefer 1971), Iceland (Barth 1950), New Zeland and Japan.

Many of the colors in hot springs are caused by thermophilic (hot-loving) microorganism, which include certain type of bacteria such as, and species of archaea and algae many thermophilic organisms grow in huge colonies called mat that form the colourful scums and slime on the sides of hot springs, dissolved sulfides, methane, iron, ammonia and arsenic. In addition to geochemistry the temperature and pH of hot springs play a central role in determining which organisms inhibit them.

The majority of Cyanophyceae and other algae two usually exists through the range of two units or less, and only a few species are adapted to wide range of pH. The pH range of common fresh water masses is usually from pH 6.02 – 8.0.

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Hanlin is twelve miles away from south of Shwebo. The modern history of Shwebo begins with the rise of Alaungpaya, the founder of the Third Burmese dynasty. The geological features of the area in which salt wells occur are similar. A large alluvial plain through which the Mu River runs, extents from the hill range on the west bank of the Ayeyarwady to the range when runs parallel to and about three miles to the west of Mu River. The tertiary beds of Burma are believed to have been deposited under basinal condition. The tertiary beds are the origin of the salts font in these districts. The salts which these beds contain would be dissolved out and taken into solution by underground water, which exists almost universally, and these places would find conditions suitable for rising to the surface. The rainfall in these area, it may be noted about 30 inches. Total area of Hanlin is 3500 feet east to west and 2500 feet south to north. There are twenty miles away to the northeast is HtiikyanTaung and twenty-five miles away is KabyuteTaung (ancient volcano).

The aim of the present study is to record some algal found in hot springs, to reveal algal taxa and related water qualities, to know the information of hot springs. The objectives of the study area are to assess the current status of water quality in study areas whether it is beyond the quality thresholds value or not, to evaluate the correlations between the characteristics of the physical and chemical parameters of water quality.

Materials and Methods

Study Area

Sample of water with algae were collected from five stations of hot springs in Hanlin. These hot springs are situated at the Hanlin village, Wetlet Township, Shwebo District, Sagaing Region (Figure 1). Study area is named as station A, B, C, D and E of hot springs (Figure 2).

Identification of Algal Taxa

Collected algae specimens were examined under compound microscope (Olympus) at the laboratory of Botany Department, Shwebo University. Several slides were prepared and scanned under microscope to identify the type and relative abundance of each algal species present and dimensions measured by micrometer. After that they were recorded by digital camera. Specimens were identified based on the thallus shape, size, color and chloroplasts. Then, the specimens were classified up to species level based on Desikachary 1959), Dillard (1989 – 2000), Komarek (1985 – 1990), Prescott (1962) and West (1920).

Sampling and Analysis of Water

The water samples for analysis were also collected at each samplings site of hot springs in the morning in three seasons (summer, rainy, winter) and measured their temperature by thermometer. The pH of water was measured by pH meter (Hanna instruments model number 991301, USA). The water sample for physico-chemical properties were analyzed at the water laboratory, water and Sanitation Department Public Health Laboratory, Mandalay Region.

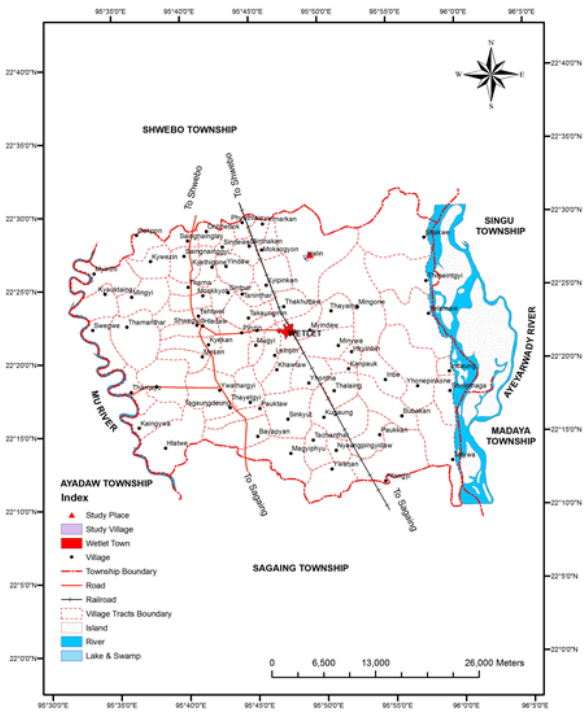

Figure 1. Location Map of Hanlin

Figure 2.Sampling sites A.Thirimingalar B. U Tin Thaung C. Man's Bathing Well D. Egg Boiling Well E. Ma Aye Ton

Algal Flora

In this research, all of the 50 collected algal specimens were recorded from these study areas. All of the collected algae samples were included into two divisions: Cyanophyta and Chrysophyta. In the present study one class, three orders and four families and seven genera belong to thirty six species of Cyanophyta were described; one class, one order, seven families and twelve genera belong to fourteen species of Chrysophyta were observed. List of algal species from Hanlin hot springs were shown in Figure 6-8. Physico-chemical parameters of water from sampling sites were shown in Figure 3-5.

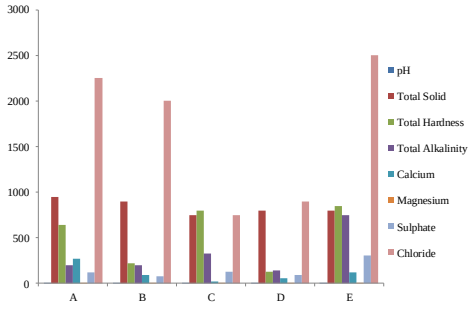

Figure 3. Physico-chemical parameter of hot springs in Hanlin (Summer season)

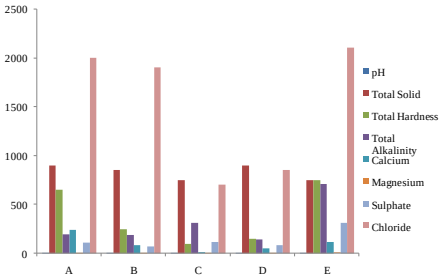

Figure 4. Physico-chemical parameter of hot springs in Hanlin (Rainy season)

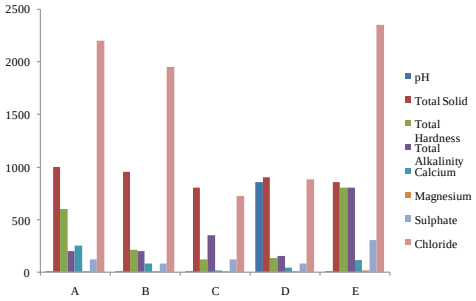

Figure 5.Physico-chemical parameter of hot springs in Hanlin (Winter season)

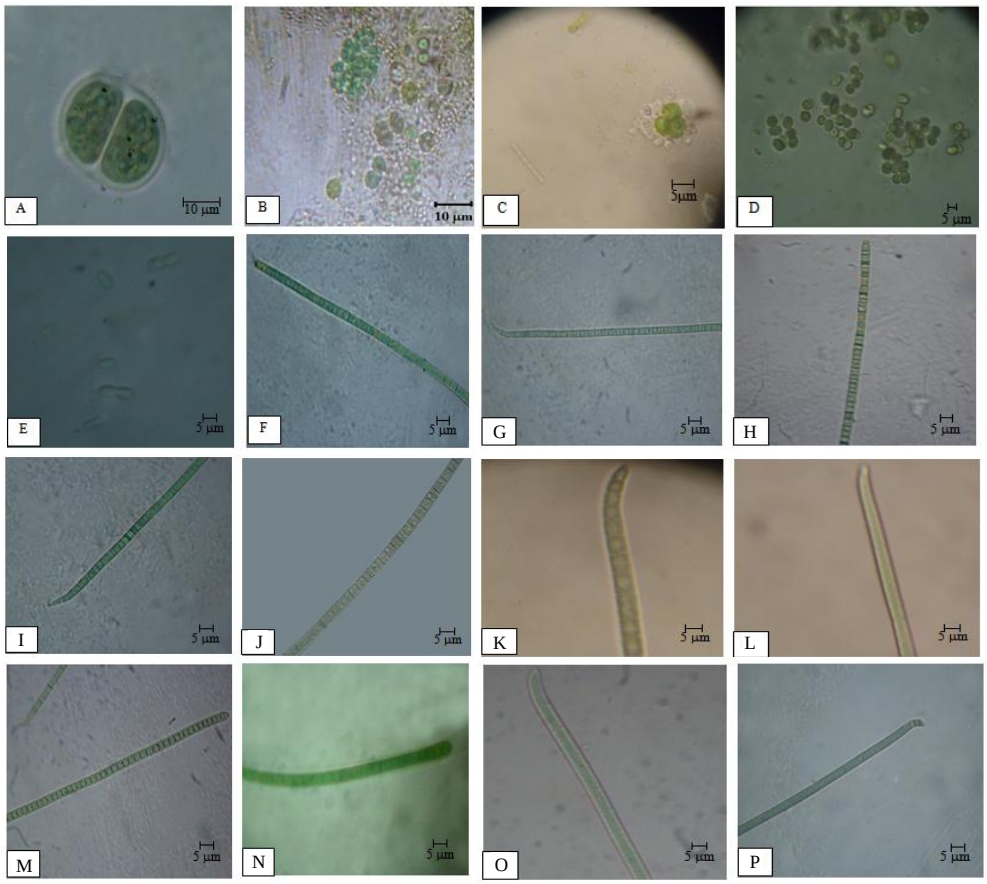

Figure 6. A. *Chroococcus turgidus* (Kutzing) Nageli. B. *Synechococcu saeruginosus* Naegeli
C. *Gloecocapsa stegophila* Itzigs D. *Aphanothece stagnina* (Sprengel) Brawn
E. *Aphanothece nidulans* Richter F. *Phormidium acidophilum* (Copeland) Anagnostidis et Komarek
G. *Phormidium animale* (Agardh ex Gomont) Anagnostidis et Komarek H. *Phormidium articulatum* (Gardner) Anagnostidis et Komarek
I. *Phormidium breve* (Kutzing ex Gomont) Anagnostidis et Komarek J. *Phormidium chlorium* (Kutzing ex Gomont) Anagnostidis et Komarek
K. *Phormidium formosum* Anagnostidis L. *Phormidium latevirens* Anagnostidis
M. *Phormidium nigrum* (Vaucher ex Gomont) Anagnostidis et Komarek N. *Phormidium papyraceum* Gomont ex Gomont
O. *Phormidium subuliforme* (Gomont) Anagnostidis et Komarek P. *Phormidium terebriforme* (Agardh ex Anagnostidis

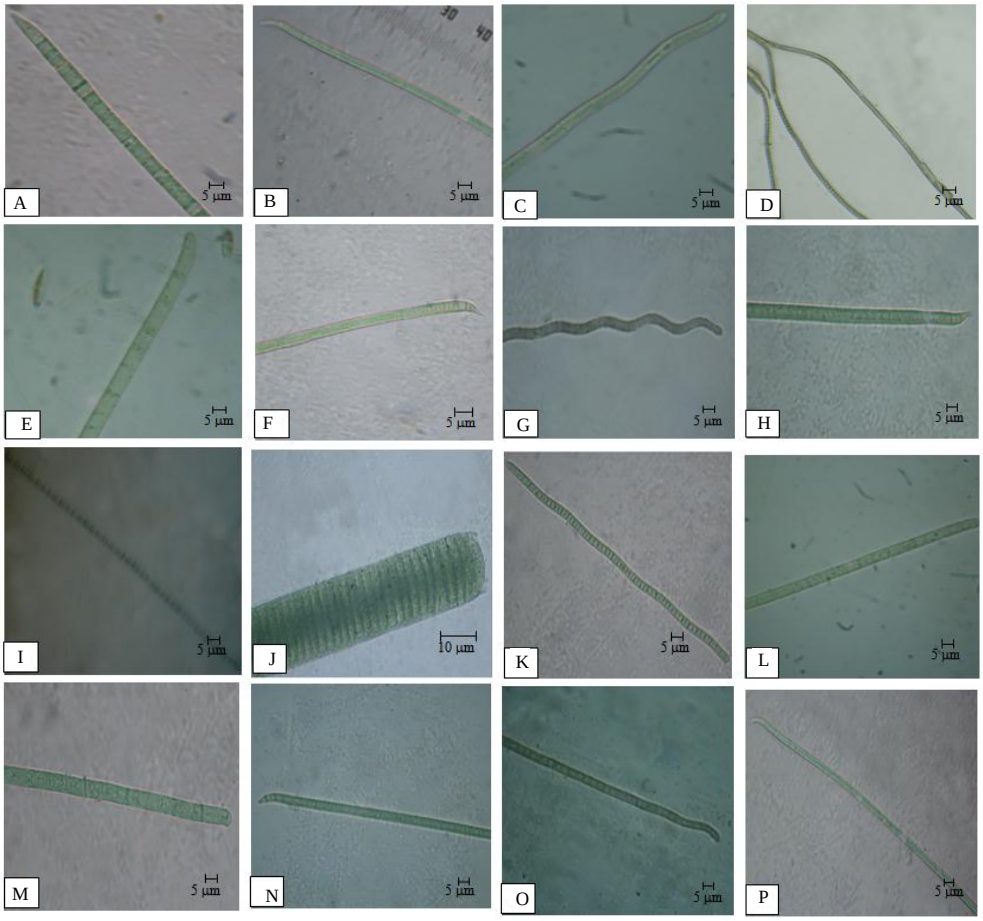

Figure 7. A. *Phormidium torluosum* Anagnostidis B. *Oscillatoria acuta* Bruhl
C. *Oscillatoria acuminata* Anagnostidis D. *Oscillatoria acutissima* Kufferath
E. *Oscillatoria anguina* Bory ex Gomont F. *Oscillatoria animalis* (Sensu Borge) Anagnostidis
G. *Oscillatoria boryana* Bory H. *Oscillatoria euboeica* Anagnostidis
I. *Oscillatorialacustris* (Kleb) Geitler J. *Oscillatoria limosa* Agardh ex Gomont
K. *Oscillatoria meslinii* Fremy L. *Oscillatoria quadripunctulata* Bruhl
M. *Oscillatoria refringens* Gardner N. *Oscillatoria salina* Biswas
O. *Oscillatoria serpentina* Richter ex Kutzing P. *Oscillatoria subbrevis* Schmidle

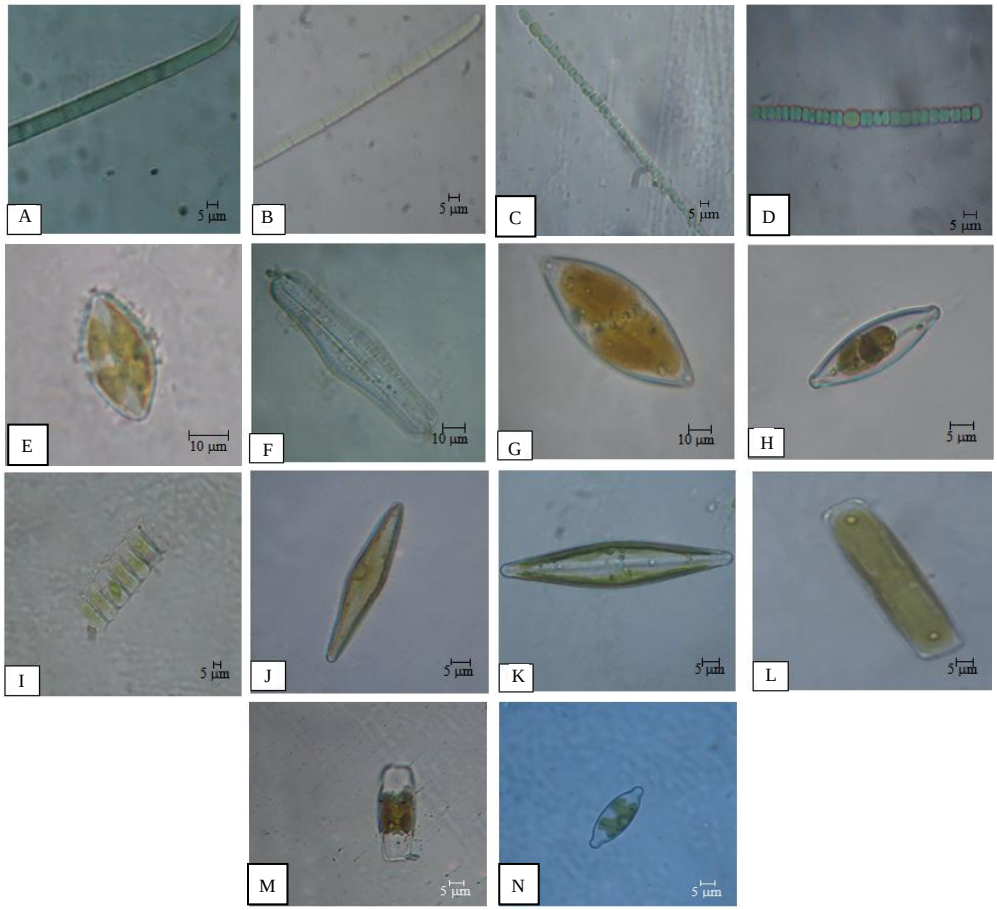

Figure 8
A. *Oscillatoria tenuis* Agardh ex Gomont
B. *Oscillatoria willei* Gardner
C. *Anabaena constricta* Klebahn
D. *Anabaena iyengarii* Bharadwaja
E. *Amphora ovalis* Kutzing
F. *Rhopalodia gibba* (Ehrenberg) Muller
G. *Navicula mutica* Kutzing
H. *Mastogloia smithii* var. *abnormis* Grunow
I. *Fragilaria islandica* Grunow
J. *Gomphonema hereuleana* (Ehrenberg) Cleve
K. *Gomphonema seminatum* Ehrenberg
L. *Epithemia argus* (Ehrenberg) Kutzing
M. *Nitzschia serista* Cleve
N. *Denticula pelatica* Husted
O. *Tabellaria fenestrata* (Lyngbye) Kutzing
P. *Eunotia pectinalis* (Kutzing) Robenhorst
Q. *Eunotia pectinalis* (Kutzing) Robenhorst
R. *Calonis amphibaena* Bory

Discussion and Conclusion

In the present study, the abundant occurrence of the thermal Cyanophyta was noted at temperatures from 35°C- 45°C. Especially Cyanophyceae comprises the greatest number of species and plays the most important role in almost all the hot spring. Vock (1936) reported that the thermal algae may be divided into four communities, hypothermophilous community (15-26°C); Mesothermophilous community (26-45°C); Euthermophilous community (45-65°C) and Hyperthermophilous community (65°C and more). According to this report, algae in station A and E are Mesothermophilous community; algae in station B, C and D are Euthermophilous community.

According to the results of the water analysis report, pH of all stations is ranging from 7.2 to 7.5 in hot spring Hanlin. The most common of Cyanophyceae was noted as pH 6.0 to7.5, it was agreed with the results of the present study. The simple, themals numerous species of various genera were growing in all stations. The important thermal genera (*Synechococcus, Oscillatoria* and *Phormidium*) are, of course abundantly found in simple thermal, but it is a prominent feature that species of *Anabaena*is rich in there. The vegetation of *Phormidium* type is most observed and hot springs places. In the present study, above the species were occurred most abundantly in station B and station D in Hanlin hot springs. Totally amount of 50 species were occurred in this study whereas Cyanophyceae (Myxophyceae) were 36 species and 14 species of Bacillariophyceae, respectively.

According to the water analysis report, water contain as hardness concentration of 120-180 mg/l is classified as hard (Spellman 2008). Total hardness of WHO standing have 100mg/l (highest desirable level) and maximum permissible level have 500mg/l. Hard water have high in calcium and corresponding have a pH of between 7.2-9.4. Prescott (1962) observed that it the lakes have pH 7.6-8.5, blue-green algae are abundantly occurred in almost all stations. This finding is agreement with the above mentioned especially station A and B in Hanlin host springs at all seasons, whereas the total hardness has more than maximum permissible level (500mg/l). Highest desirable level of totally alkalinity was 600mg/l in WHO guideline. In this study all stations of Hanlin hot springs was occurred lower than highest desirable level of total alkalinity.

Calcium contant of WHO standard have 75mg/l (highest desirable level) and maximum permissible level have 200mg/l. In this study, calcium contant was found ranging from 10-272 mg/l in Hanlin hot springs. In stations A of Hanlin hot springs, calcium contant was found 272 mg/l so this amount was lower than maximum at all seasons permissible level (200 mg/l).

Sulphate is relative nontoxic and its limit in drinking water has been kept at 200 mg/l. More than 500 mg/l sulphate produces a bitter taste (U.S.E.P.A 1973). In this study, sulphate content of Hanlin hot springs was ranging from 70 to 304 mg/l whereas station E have 300 mg/l to 310 mg/l at all seasons. So, water of station E has been noted that unsuitable to drink because it is sulphate content was more than limit for drinking.

Chloride content of WHO guideline was limited ranging from 0 mg/l 142 mg/l was excellent to good for irrigation and 355 mg/l and above were be unfit for irrigation. Chloride content of Hanlin hot springs was ranging from 700 mg/l to 2500 mg/l water at all stations. So, water in this area was be unfit for irrigation.

It was concluded that water in Hanlin hot springs were unfit to drink and not suitable for irrigation. Especially blue green algae found abundantly as indicator

organisms hot springs and diatoms were second most abundantly found in hot springs as indicator organisms. There were being not found the green algae in hot springs.

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