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Eco-Physiological and Taxonomical Study of Blue Green Algae (B.G.A.) in Relation to their Role in Pollution Control

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ABSTRACT

The Blue Green Algae are unicellular or filamentous. Those sometimes form structures identifiable with the naked eye but typically require a microscope for identification; they differ from other groups in this flora because they are prokaryotes. Blue-green algae are present in all types of water bodies. Different species of algae can be grown to be everything from a food source to a source of biodiesel and also used in the bioremediation of wastewater. One of the benefits of growing algae is that the process is easy and direct to measure. The most primitive life forms are the ancestors of Blue Green Algae (Chapman & Chapman, 1973). Blue-green algae (BGA) resemble algae and bacteria and have been classified in the kingdom Plantae and Monera (Prokaryotes). In the kingdom Plantae, BGA is included in the division Cyanophyta or class Cyanophyceae or Myxophyceae, while in the kingdom Prokaryotes, they are included in the division Cyanobacteria (Murray, 1968) or order Cyanobacteriales (Gibbons & Murray, 1978). Thus BGA classification into taxonomic categories at the levels of kingdom, division, class or order has not been agreed upon, having, in fact, described as being in a state of chaos (Whitton, 1967, 1969). Here discusses problems encountered in identifying and classifying BGA and explores to overcome taxonomical problems. In this paper, we discuss Blue Green Algae's ability to control pollution from January to March 2023 in Kot Dam of Shakambari conservation reserve, Jhunjhunu district(Rajasthan).

Keywords: *Algae, Blue Green Algae, nutrients, bioremediation, pollution.*

INTRODUCTION

Blue, green algae have a unique ability to fix atmospheric nitrogen into ammonia, and thus, they can inhabit extremely nitrogen-deficient conditions. For the purpose of nitrogen fixation, they have a specialized structure in their bodies called heterocysts. But recent findings indicate that several non-heterocystous members of BGA can also reduce pollution. Moreover, some members of BGA are highly adapted to tolerate extreme conditions of very high temperature, pH, and excessive nutrient and pollutant load.

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Algae have been capable of their potential in the preparation of nonconventional food, commercial products, medicines, toxin preparation and bio-fertilizer production (Acharaya, 2008). Algae are now a day used in sewage oxidation and bioremediation, too (Baruah et al., 2009). Algae are used in bio-monitoring of water quality. In order to achieve that, phytoplankton assessment is pivotal by using proper techniques along with the assessment of water quality. The quality of water is described in terms of its physical, chemical and biological parameters. In a broad sense, algae are inseparable from the aquatic environment and therefore are regarded as purifiers of wetland ecosystems. Algae are the indicators of environmental problems in aquatic conditions. They used to grow quickly and are very sensitive to any kind of changes in environmental 9 quality. According to several workers (Frempong, 1981; Sudhakar et al., 1981, & Tilman et al., 1982), they are among the first organisms to respond to environmental changes and nutrient fluctuation. Kolkwitz and Marsson (1908, 1909) reported some pollution indicating algae for the first time. They described the pollution-oriented changes in composition and behaviour of algal communities in rivers and, thereby, identified three categories of river or water bodies polysaprobic (aquatic bodies that are oxygen deficit and with high molecular decomposable organic matter), Oligosaprobic (water bodies that are rich in oxygen and devoid of pollution) and Mesosaprobic (intermediate between the above two, showing various stages of decomposition and mineralization of organic materials).

MATERIALS AND METHODS

The research work was done at the Kot Dam of Shakambari Conservation Reserve, Jhunjhunu District. Aravalli Hills surround Shakambari Conservation Reserve and spans over 13,100 hectares of forest land. The total geographical area is 131 km^2.

Figure 1- Kot Dam, Village- Kot, Jhunjhunu (Raj.)

WATER SAMPLING–

Water samples will collect monthly from the Kot Dam for laboratory analysis in the 1-litre bottle before 8 am. Some physicochemical parameters will study on the spot and others in the laboratory, according to American Public Health Association (APHA), and Water Pollution Control Federation (WPCF).

WATER TESTING –

Some physicochemical characteristics of Dam water will be analyzed in the period of two months in 2023. Physical factors such as temperature, electrical conductivity (EC), colour, odour, total suspended solids (TSS), total solids (TS), total dissolved substances (TDS), turbidity and chemical parameters such as pH, alkalinity, hardness, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), salinity, chloride, fluoride, phosphate & nitrate were examined.

ALGAL SAMPLING –

The algal samples will collect from Kot Dam of shakambari conservation reserve. The Algal samples will be collected by plankton net of No.18nylon bolting cloth (mesh size 0.072 mm), transferred into the glass bottle, and preserved in 4% formalin solution. The identification of Algae will on the basis of their morphological feature up to the level of species according to literature in the laboratory and microscopic study.

ALGAL IDENTIFICATION–

The identification of Algae will on the basis of their morphological feature up to the level of species according to literature in the laboratory and microscopic study.

RESULTS AND DISCUSSION

Chemical analysis of water quality, such as organic/inorganic pollutants, and salinity, inorganic nutrients, organic nutrients is descriptive. However, performing continuous analysis is not beneficial because of specific time and cost restrictions. However, biological measurements can reveal all features of water quality over time and arrange for a direct measure of the ecological effect of ecosystem variables. Bio-monitoring provides a reliable and relatively inexpensive result of recording conditions at several locations.

Table 1:- Physico-Chemical Parameters of Kot Dam in Research Duration

S.N.	Physico-Chemical Factor	1 January 2023	20 January 2023	20 February 2023	25 March 2023
1.	**Temperature (in ^{0}C)**	14.5	15.3	16.7	16.5
2.	**pH**	8.13	8.05	7.11	7.06
3.	**Dissolved Oxygen**	0.5	0.7	0.3	0.3
4.	**Biological Oxygen Demand (B.O.D.)**	265.8	215.63	201.36	198.12
5.	**Chemical Oxygen Demand (C.O.D.)**	140.5	118.6	109.8	107.3
6.	**Free Co_2**	0.85	0.66	1s.21	1.34
7.	**Total Dissolved Solids (T.D.S.)**	2586	2544	2312	2268

Classification of Blue Green Algae (B.G.A.)

Traditional classifications-

No sexual reproduction has been confirmed among BGA. habitual classifications (Geitler, 1932; Fritsch, 1945; Drouet, 1951; Desikachary, 1959; & Bourrelly, 1970a) were therefore classification of B.G.A. based almost completely upon morphological features. The main morphological features used in taxonomy of BGA are: 1) growth form: unicellular, colonial, filamentous 2) compactness and shape of the colonies 3) shape of the filaments 4) sheath: presence, absence, shape 5) cell differentiation: presence or absence of heterocysts and akinetes 6) size and shape of vegetative cells, heterocysts and akinetes 7) polarity: base and apex of filaments distinguishable 8) branching: presence or absence, false or true, when false, "y"- shaped or geminate 9) nature of true branches: uniseriate or multiseriate Combinations of these different characters have been used for designing traditional classification of BGA. Table 1 is an example of one of the many possible combinations of characters showing the morphological diversity of BGA arranged by increasing order of morphological complexity. In the traditional classifications, BGA is placed in the phylum Cyanophyta, which comprises a single class; Cyanophyceae. The taxonomic system for BGA was established in the 19th century by Kuetzing (1849), Thuret (1875), Bornet and Flahault (1886-88) and Gomont (1892). In 1875, Thuret considered all filamentous BGA under Hormogonae while the remaining organisms were placed under Coccogonae. Subsequently, several classifications were proposed emphasizing different morphological characters. At one extreme, Elenkin (1936) considered that there were 12 orders and 47 families, and at other extreme, Drouet (1951) recognized no distinct orders but only 8 families (cf. Fogg et al., 1973).

Table 2:- Blue Green Algal Species, their Diversity and Abundance-

S.N.	BLUE-GREEN ALGAE TYPE *(CYANOBACTERIA)*	Abundance
1.	*Anabaena varabilis*	++
2.	*Anabaena oscillarioide*	++++
3.	*Cylindrospermum major*	++
4.	*Cylindrospermum musicola Kuetz.ex Born.et Flah*	+
5.	*Scytonema hofmannii*	++
6.	*Sigonemadendroideum*	++
7.	*Anabaena oryzae Fritsch.*	+++
8.	*Anabaena spiroides Klebain.*	+++
9.	*Cylindrospermum majus Kuet. Bhatli and Bheden.*	+++
10.	*Nostoc carnaeum Ag.ex.Born. et.Flah.*	++++
11.	*Nostoc linckia(Roth.) Born.ex Born,et Flah.*	++
12.	*Nostoc muscorum Ag.ex Born.et.Flah.*	+
13.	*Nostoc rivulare Kuetz.ex.born.et.Flah*	++++
14.	*Tolypothrix sp.Kuetz.*	++
15.	*Calothrix marchica Lemm.*	++
16.	*Calothrix elenkini Koss.*	+++
17.	*Calothrix brevissina West,G.S*	++
18.	*Rivularia sps.(Roth) Ag.*	++
19.	*Calothrix parietinaThuretexBorn.et.Flah*	++

+ -low density
++ -medium density
+++ -high density
++++ -very high density

CONCLUSIONS

Blue-green algae (BGA) resemble algae and bacteria and have been classified in the kingdom Plantae and Monera (Procaryotae). In the kingdom Plantae, BGA is included in the division Cyanophyta or class Cyanophyceae or Myxophyceae, while in the kingdom Prokaryotes. The difficulty of achieving an acceptable classification of unicellular BGA belonging to the order Chroococcales in terms of traditional taxonomic criteria has been generally recognized. Their structural simplicity provides the taxonomist with very few useful characters that are determinable by microscopy (Zehnder, 1973). The classifications are based on morphological characters.

The aim of taxonomy is not only the elaboration of the list of existing representatives of one group of organisms but also the summarization of the knowledge on their morphological, physiological and ecological diversity. In the case of BGA, it is clear that morphological features alone are not enough to identify and classify taxa. Hence, actual trends in BGA taxonomy is to evolve a system which is a synthesis of many available criteria paying more attention to the criteria which are stable in different environmental conditions and can be easily determinable. So far, the work done in different aspects of BGA taxonomy has established only a route to such a taxonomy. Though inadequacies exist in conventional taxonomy, it would be premature to reject the classical system until a concrete system is evolved, embodying fool-proof distinguishing characteristics of different taxa for easy identification. An ideal taxonomy should be a common tool for ecological, physiological and biochemical studies; such a classification has still to be designed for BGA.

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Author Contribution:
Both authors have participated in critically revising of the entire manuscript and approval of the final manuscript.

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