

Occurrence and Diversity of Diazotrophic Cyanobacteria in Distillery Effluents

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Abstract: Cyanobacteria are unique and rare among the entire microbial community. A large number of Cyanobacterial strains are well known for their diazotrophic nature and significant for nitrogen economy of the soil, however being damaged by environmental contamination such as agrochemical and industrial effluents. In present study occurrence of diazotrophic Cyanobacteria exposing their diversity in distillery effluent was investigated. The physicochemical properties of effluents of two distillery industries situated in Bilaspur district were analyzed. Total 19 strains of diazotrophic Cyanobacteria were identified and isolated from distillery effluent flooded area, whereas *Anabaena* was found more abundant with 05 species followed by 04 species of *Nostoc*, 02 species of *Calothrix*, *Gloeotrichia* and *Scytonema* while *Aulosira*, *Cylindrospermum*, *Plectonema* and *Revularia* were observed with single species. The abundance of Cyanobacteria in these effluents was due to favorable contents of oxidizable organic matter, rich Calcium, high Alkalinity and abundant nutrients such as nitrates, phosphate with less dissolved Oxygen. However various non-diazotrophic Cyanobacteria were also observed.

Keywords: Distillery Industries, Effluents, Diazotrophic Cyanobacteria, Physico-chemical properties, Bilaspur district.

1. Introduction

Out of various biological processes on the earth the photosynthesis and nitrogen fixation are the most important, it is wonder to note that some Cyanobacterial strains have the capacity to fix atmospheric nitrogen along with carbon assimilation. Photosynthetically they belong to the most archaic organism on the earth, whereas the proterozoic eon is sometimes called as "Age of Cyanobacteria" due to its dominant at that time [1].

As autotrophic prokaryotes Cyanobacteria are common inhabitants of water logged area throughout the world and very significant due to nitrogen fixing ability of its heterocystous forms in nature, so called as diazotrophic microorganism. However so many non-heterocystous forms may call as non-diazotrophic Cyanobacteria can dominant phytoplankton in various water reservoirs. It is said that they flourish well either in nutrient rich and warm water or at times in water with apparently low nutrient subjected to higher temperature and bright light condition [2], [3]. Other physico-chemical properties of water like pH, CO₂, alkalinity, nitrates and phosphates etc. are important factor determining the occurrence of Cyanobacteria and they are also capable to abating various kinds of pollutants and have advantage as potential biodegradation organism [4], [5]. However, the diversity in physical, chemical and biological properties of industrial effluents are so great that each waste water habitat requires a separate study. With this view, present study was aimed to assess the physico-chemical analysis of distillery effluents and evaluating of Cyanobacterial diversity in local area flooded with effluents discharged by both distillery industries situated in Bilaspur district.

2. Material and Methods

Samples of both effluents and Cyanobacterial thallus/ mass were collected periodically from the area / sites of both the distillery industries in Bilaspur district namely Narmada drinks, Sirgitti, Bilaspur and Welcome distillery industries,

Kota, Bilaspur (C.G.), India.

Effluents and Cyanobacterial samples were collected in large sterilized containers and zipped polythene bags respectively.

On priority based different parameters of physico-chemical properties of effluents were examined following the standard methods [6]. The Cyanobacterial samples were primarily examined by microscopic observation and preliminary identification was made considering the features of habit and habitat with the help of key provided by [7], [8]. Using specific media like Chu-10, BG-11 and BG-110, the Cyanobacterial strains were isolated under standard *In-Vitro* culture techniques [9][10].

3. Results and Discussion

Periodically collected samples of effluents and Cyanobacteria were assessed systematically. Observed Values of physico-chemical analysis of effluents collected from both distillery industries have been computed in Table – 1, that can be compared with standard value of water quality.

Preliminary identification by microscopic observation just after collection of Cyanobacterial samples and confirmative identification was done after isolation of their pure culture. Total 19 species of diazotrophic Cyanobacterial strains belonging to 9 genera were isolated and identified as mentioned in Table – 2. It has been evident that the occurrence of diazotrophic Cyanobacteria was observed more frequent in the effluent of Narmada drinks, Sirgitti, Bilaspur with respect to Welcome distillery, Kota, Bilaspur. However, from the analysis of all the collected samples the heterocystous forms or diazotrophic strains were identified in the effluents of both industries. *Anabaena ballyganglii*, *Anabaena fuellibornii*, *Anabaena iyengrii*, *Anabaena spherical*, *Anabaena unispora*, *Aulosira prolific*, *Calothrix geitonos*, *Calothrix ghosei*, *Cylindrospermum eindentum*, *Gloeotrichia echinulata*, *Gloeotrichia longicauda*, *Nostoc carneum*, *Nostoc ellipsosporum*, *Nostoc hatei*, *Nostoc*

spongiformae, *Plectonema wolleii*, *Rivularia aquatic*, *Scytonema bohmeri* & *Scytonema stuposum* were found in the effluents of both industries.

The abundance of diazotrophic Cyanobacteria are attributed to favorable contents of oxidizable organic matter and less dissolved oxygen (table – 1), such observation supports [11], [12]. Observation of [13] suggest that cyanophyceae grow luxuriantly with great variation and abundance in ponds rich in calcium. Besides calcium, high amounts of oxidizable organic matter, traces of dissolved oxygen, considerable amounts of nitrate and phosphate in the effluents observed were probably the factors favoring the growth of Cyanobacteria, as also suggested by [8], [11], [13], [15], [16], [17].

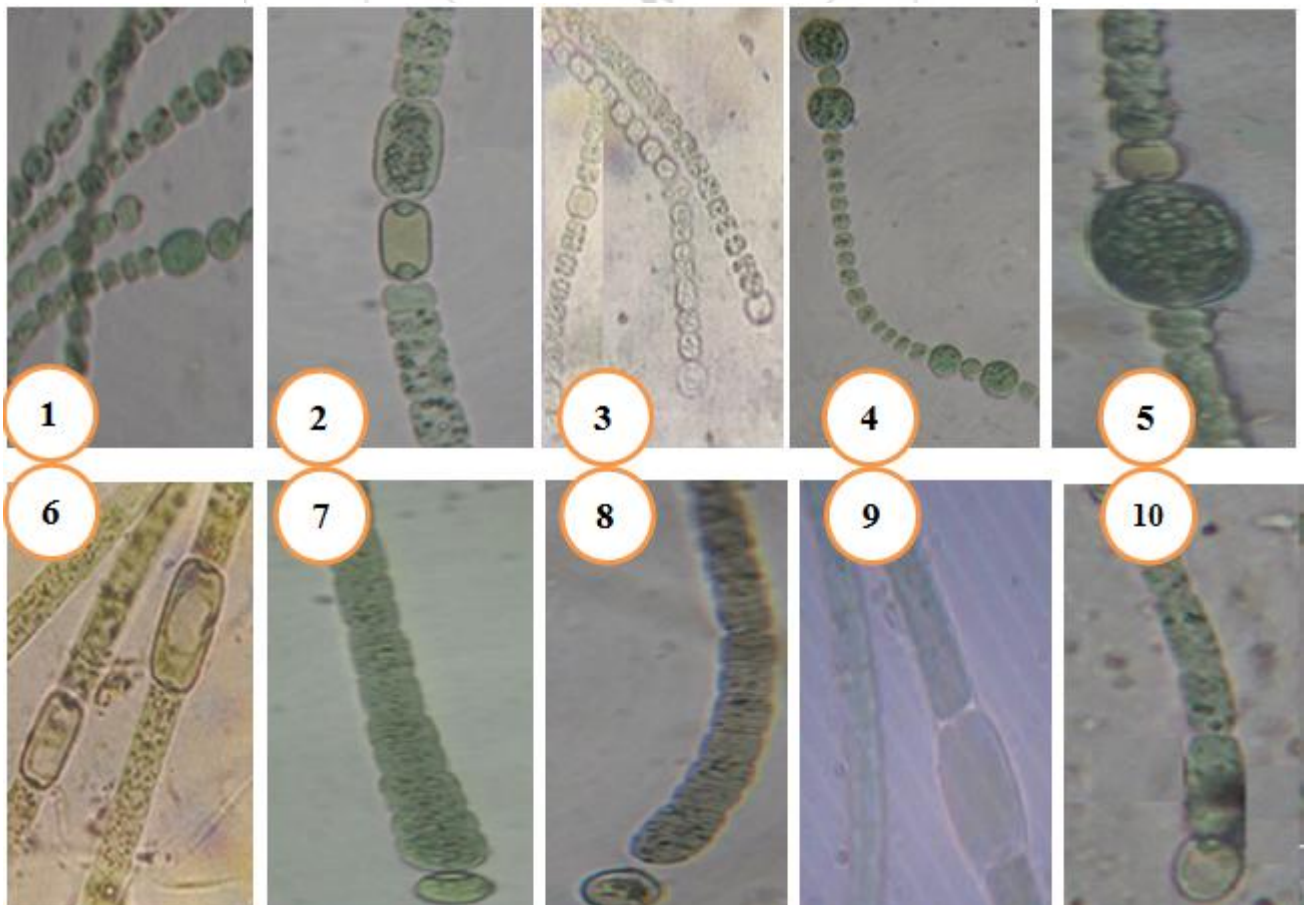
Table 1: Physicochemical properties of distillery effluents and Standard value of water quality-

Parameter	Narmada Drinks	Welcome Distillery	Standard Water Quality
Temperature °C	28	26.7	26.37
pH	6.5	6.3	7.58
Turbidity	780	680.5	3.1
Free CO ₂	88.15	71.5	---
Electric Conductivity	2.1	1.5	0.03
Total Alkalinity	128.91	117.21	134.83
Total acidity	53.2	62.3	6
DO	1.9	2.05	8.28
BOD	1086	784	2.88
COD	1134.5	1027	10.62
Chloride	165.5	172	34.83
Total Hardness	1051.5	1056	163.02

Calcium	541	707	40.5
Magnesium	1054	823.5	36.7
Nitrate Nitrogen	464.5	494	0.92
Phosphate	48.5	53.8	0.08
TDS	1103	1185	16.4
TSS	2791.5	3115.5	37..5
Sulphate	11.45	9.24	6.73

Table 2: Occurrence, diversity and Frequency of diazotrophic Cyanobacteria isolated from distillery effluents

Sl. No.	Name of Organism	Narmada drinks	Welcome Distillery	Frequency (%)
1	<i>Anabaena ballyganglii</i>	+++	++	62
2	<i>Anabaena fuellibornii</i>	++	++	55
3	<i>Anabaena iyengrii</i>	+	-	15
4	<i>Anabaena spherica</i>	+++	+	52
5	<i>Anabaena unispora</i>	++++	+++	78
6	<i>Aulosira prolifica</i>	++	+	42
7	<i>Calothrix geitonos</i>	+++	++	59
8	<i>Calothrix ghosei</i>	+	+	36
9	<i>Cylindrospermum</i>	++	-	21
10	<i>Gloeotrichia echinulata</i>	+	+	37
11	<i>Gloeotrichia longicauda</i>	+++	+++	72
12	<i>Nostoc carneum</i>	+	+	39
13	<i>Nostoc ellipsosporum</i>	+++	++	64
14	<i>Nostoc hatei</i>	-	+	18
15	<i>Nostoc spongiformae</i>	++	++	50
16	<i>Plectonema wolleii</i>	+	+	35
17	<i>Rivularia aquatic</i>	+	-	16
18	<i>Scytonema bohmeri</i>	++	++	52
19	<i>Scytonema stuposum</i>	+	+	34



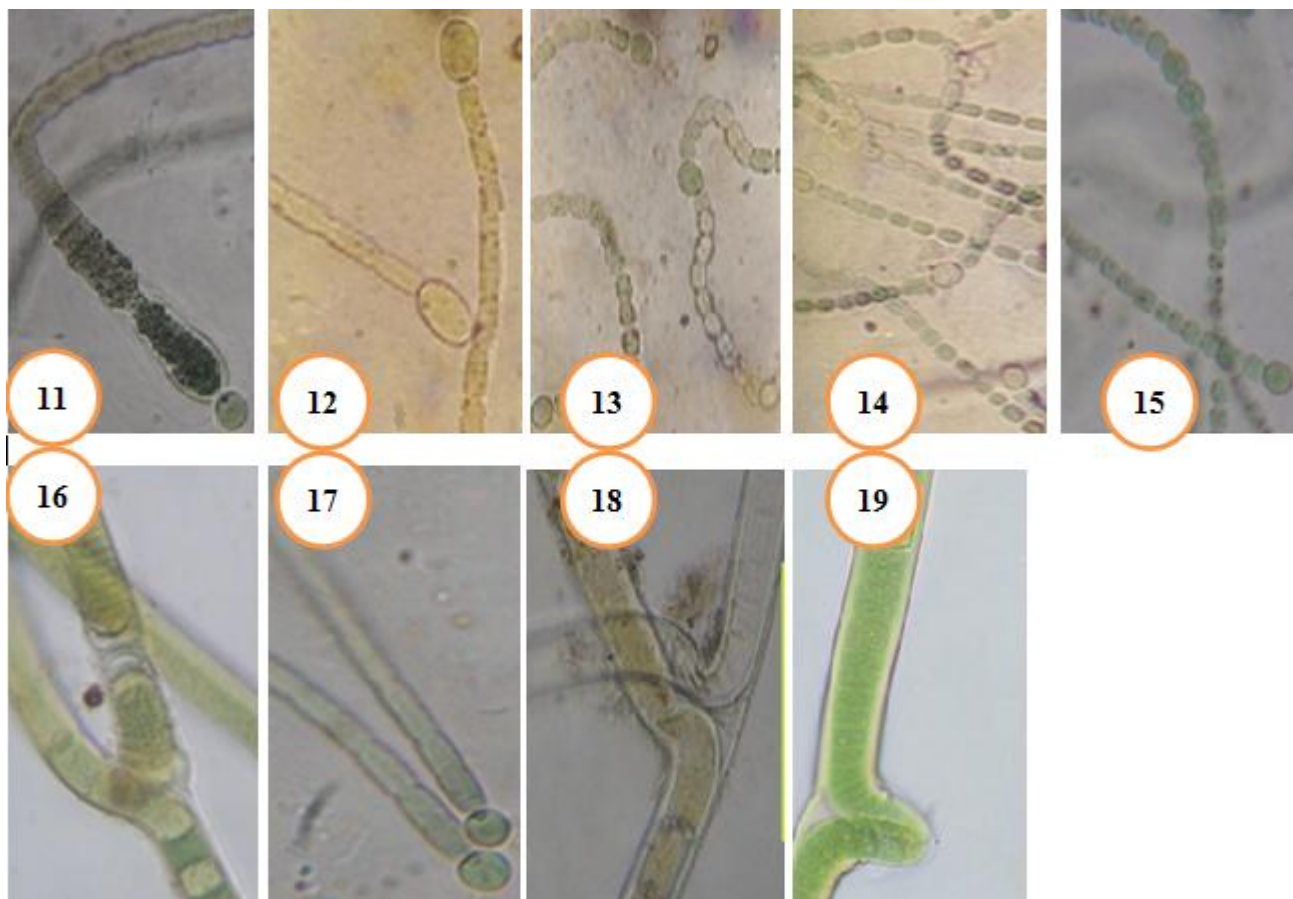


Figure 1: Micro photograph of diazotrophic Cyanobacteria from the effluents of distillery industries in Bilaspur district.

4. Conclusion

Present investigation revealed that the effluents of distillery industries, especially diluted state, provide the favorable condition for growth of diazotrophic as well as non-diazotrophic Cyanobacteria. Probably Cyanobacterial strains have the capacity to degrade the organic and inorganic components of the effluents. Cyanobacteria expressed their significant features and can facilitate the bioremediation of industrial effluents.

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