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A Review on Diatom Flora and Cyanobacteria from Fresh Water

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Abstract: ***The Yamuna River is among the most significant rivers in northern India. This river, which was once the lifeline of the inhabitants of the region, hosts both plant and animals along its whole length, but freshwater vegetation is particularly important due to its place in the food chain. The majority of physicochemical characterization is used to measure water quality; Eutrophication and climate change, on the other hand, support the existence of dangerous Microcystins (MCs) producing cyanobacteria as a developing bio-indicator. This article's diatom floras and data provide a significant addition to modern taxonomic practise in these two key algal groups. Recent research on freshwater diatoms in diverse biological aspects has aided in the classification of these algae on a broad scale. Microalgal diversity/assemblage serves as a biological indicator of the environment of water bodies, and knowing the current level of quality of the Yamuna River is crucial for improving the water quality. This review examines the diversity of diatoms and the cyanobacterial elements of this river.***

Keywords: Yamuna River, Flora, Cyanobacteria, Diatoms, Biodiversity

1. Introduction

Yamuna River

The Yamuna River is the Ganga's most important tributary. This river is as well-known and revered as the Ganga itself. In Indian mythology, it is regarded as a sacred river, Yamunotri (Uttaranchal), PaontaSahib (Himachal Pradesh), Mathura, Vrindavan, Bateshwar, and Allahabad (all in Uttar Pradesh) are pilgrimage sites located along its banks. . On its banks there are large metropolitan areas such as Yamuna Nagar, Sonepat and Delhi, India's political hub, GautamBudh Nagar, Faridabad, Mathura, Agra, and Etawah. Large industrial parks have also sprouted up along the river's banks and in its basin. The Yamuna basin, notably in Haryana and Uttar Pradesh's Western region, is one of the most fruitful and productive basins in the country. All of this illustrates that the Yamuna River not just runs through the souls of Indians, but also has a significant impact on the country's wealth. Like other riverine systems, the Yamuna is influenced by difficulties brought on by industrialization, urbanisation, and rapid agricultural development **(CPCV, 2016)**

Diatoms

Diatoms are a type of tiny algae with complex silica cell walls. They are the most abundant phytoplankton in aquatic habitats, contributing 20–25% of global O_2 production and carbon assimilation. Diatoms greatest distinguishing characteristics are systems for using silica that they have evolved. They're used in bio monitoring, paleoecology, nanotechnology, and forensics because of their unique adaptations and ecology (**Smol, 2010)**

Applications Diatoms are essential and unique species because of all of the above qualities. Furthermore, gaining a better understanding of diatom ecology and lifetime has aided in their use for a variety of reasons. They show that nutritious supplements, antibiotics, anticancer treatments, and Nano biotechnology could all benefit from them. Diatom cells can be utilised to design various nano devices because they continuously and dependable create frustules of various forms and dimensions with micro or nano-scale structures. Frustules of diatoms are very detailed and appealing at the nano-scale that architects and nanotechnologists have been motivated to incorporate the structural concepts employed to generate frustules in building the design and construction, as well as naturally inspired designs **(Potapova, M.2011)**

Diatoms are being researched all around the world to assess the physical and chemical health of river ecosystems. This might be attributed to their universal nature, short lifetime, and fastreply to ecological and human pressures. (Wood, R. J., 2009). Diatoms are exceptional in that they have unmodified, resilient, clear, and species-specific frustules of silica that survive cell deathand remains in aqueous body deposits. As a result, diatoms are an effective tool for reconstructing historical biological circumstances and revealing water features of studied water bodies (Vinayak, V., 2015). Contamination by chemicals (both organic and inorganic) may cause silicified diatomaceous cell walls to respond swiftly and predictably, As a result, morphological alterations such as cell size variation, frustule shape variation, and raphe and stria patterns occur. (Falasco, 2009).

Diatoms (Bacillariophyceae) are microscopic algae with characteristic geometrical shapes that contain silica. They are photosynthetic, unicellular, eukaryotic creatures. Their cells range in size from 5 m to 0.5 mm. They can be found in moist or wet environments where photosynthesis is possible. In the natural world, Diatoms can be planktonic (floating) or benthic (attached to the seafloor) (attached to a substrate). Individuals either live alone or in colonies. Although the majority of diatoms are not mobile, a specialised raphe system1 secretes mucilage in some benthic diatoms to help them cling to or gliding across a surface. They are

additionally known to shape biofilms, which are layers of firmly associated microbe cells. Biofilms are organisms that develop on solid surfaces and are frequently encircled by extracellular fluids. **(Kale, 2015).**

Diatoms in Bio Prospecting

Diatoms create a variety of amino acids, vitamins, polysaccharides and lipids. Few diatoms have been found to produce pharmacologically vigorous chemicals with antibacterial properties, enzyme inhibition, toxicity, and other properties. Lipids are the most commercially important of them. **(Karthick, 2016).**

Past and Present Environmental Indicators

Diatoms are being utilized effectively to evaluate aquatic excellence in moderate and humid regions. Diatoms are quite specific about their surroundings, which includes anything from habitat to water quality. Aeration, conductivity, pH, and nutrient availability are examples of environmental factors, and its concentration has unique limits and tolerances for individual species. Because diatoms are highly sensitive to environmental changes, using statistical models, a diatom colony in a certain place and at a specific time can provide data on water quality. To assess water quality, various diatom indicators have been established. When compared to other regularly used bio indicators, collecting, enumerating, and archiving diatoms is a breeze. Diatoms are widely employed for bio monitoring in aquatic habitats around the world due to their advantages. **(Allen, 2011).**

Usually diatoms included Pinnularia major, Synedra ulna, Naviculaconfervacea, Gomphonemamontanum, Frustulia sp., Nitzschiacommunis, and Cymbelladeliculata. The presence of Gomphonemaparvulum, as well as the dominance of G. Montanum, CymbellaHustedii, and NitzschiaAcicularis, yielded certain intriguing outcomes during the current study. These are good indications of contamination in the water. They grow the most throughout the winter season. Diatoms were more abundant in the winter than in the summer, and they were scarce abundant during the wet season. Diatom species develop luxuriantly in conditions of high pH, NO_3, high biotic matter, low phosphate concentration, and low temp. (**Tiwari, 2006).**

These malformed frustules could be useful markers of water quality at the sites that have been studied. At the community, population, and individual levels, diatom taxonomic and morphological features are routinely utilised for biomonitoring. However, other diatomaceous criteria, mostly living qualities, such as the development and leaking of lipid bodies and changes in cytoplasmic composition under various stress conditions, receive far less attention. These two characteristics are simple to measure, fast to analyse, and internationally comparable, As a result, they are perfect for the purpose of biomonitoring and evaluating the environmental health of river ecosystems. The vast majority of diatoms are unicellular organisms, and can form groups in the form of threads or ribbons. In diatom communities, aberrant cell formation, shrinkage and teratological changes have been observeddue to the impacts of industrial pollutants, mining operations, waste from agriculture, the intensity of the sun, sedimentation of the rocks, drought, rising temperatures, reduced water flow, and velocity changes. (**Gautam, 2017).**

Cyanobacteria

Cyanobacteria (blue-green algae) are one of the world's successful autotrophic organisms. Having mastered a variety of circumstances (Yadav et al., 2021). Cyanobacteria are photosynthetic prokaryotes present in a diversity of light habitations, albeit not all of them. In terms of population, they are also among the most significant species on the world. And their worldwide biomass is 3 10 14 g C, or 1, 000 million tones (10 15 g) of wet biomass, according to statistics. Chlorophyll an is produced by all of them. However, a few genera generate neither, instead forming different colours as a result. Regardless of the fact that cyanobacteria may be found in a wider ranges of conditions and habitats, a number of characteristics frequently contribute to their own survival. The history of cyanobacteria dates back 3, 500 million years**. (Whitton & Potts, 2012).**

Cyanobacteria's outermost layers are composed of three distinct sorts of layers: a mucilaginous layer, a cell wall, and an innermost plasma membrane. Cyanobacteria's cytoplasm has coloured lamellae that are not organised into plastids. Chlorophylls, carotenes, xanthophylls, c-phycoerythrin, and c-phycocyaninare the pigments found in cyanobacteria, whereas the latter two are found in blue-green algae. Cyanobacteria classification introduced in 1985, with four orders of bacteria designated as Chroococcales, Nostocales, Oscillatoriales, and Stigonematales, and their respective phyla. are Chroococcales, Gloeobacterales, and Pleurocapsales, **(Koller, 2015; M Meena et al., 2019; Mukesh Meena et al., 2019) .**

Cyanobacteria's Roles as Functional Foods:

Meals thatsupply essential nutritional elements like proteins, carbs, minerals, vitamins, and lipids in adequate levels (El Sohaimy, 2012) Bioactive substances are naturally occurring chemicals derived from some plants, animals, or microorganisms that benefit human health. Food supplements containing cyanobacteria can be beneficial. **(Chittora et al., 2020) .**

Roles of Cyanobacteria As A Bio Fertilizer:

The population of the world is always growing. The demand for contamination-free, natural, healthful food has grown in direct or indirect proportion to the increase in population (Chittora et al., 2020). Cyanobacteria can digest a variety of contaminants and play a multiple roles in the soil ecosystem to keep soil fertile. **(Subramanian & Uma, 1996) .**

2. Discussions

Increased pressure on land and water resources has resulted from the indiscriminate growth of human population and development. Cyanobacteria and microalgae, when compared to other species they are more environmental friendly, that have large cell sizes, and generate extra biomass, making them the greatest and most sustainable answer to problems with soil fertility and accessible water resources. In light of the discussions, it tends to be inferred that due to their autotrophic nature and morphological

flexibility, micro-algae are an underutilised gathering of organic assetswith remarkable potentialfor producing bio-fertilizers and bio-fuels. Remediation by microalgae and cyanobacteria may be a harmless and long-term solution for removing heavy metals found in municipal sewage water, as well as assisting in the breakdown of contaminants in industrial waste water. Local farmers may use open ponds for production and harvesting of regionally adapted microalgae on a massive scale since they are cost-effective. Bio-fertilizers made from cyanobacteria could be useful.

The adoption of a more specific species concept based on more precise frustule morphology revealed the existence of multiple taxa that had previously been overlooked by broader species conceptions. Describe a distinguishing trait of the water quality in this country's region. Thus, the comprehensive diatom taxonomic analysis in these 10 Delhi water bodies reveals a wide range of diatom blooms in different seasons and locations around the city, serving as a significant ecological, environmental, and forensic indication.

3. Conclusion

Diatoms and cyanobacteria are critical taxon on account of their variety and biology, yet additionally due to their utilizations in ecological monitoring, biofuels, nanotechnology, agriculture, medication and the food stuff manufacturing. Diatoms distinctive cell walls contains silica, distinguish them as a fascinating study group. Even though their modest dimensions, diatoms and cyanobacteria hasa big impact on the environment, this isbecause of their plenty and efficiency. Their unusual physical alterations and physiological methods, which are suited to the rigid cell membrane limits, as well as the range of environments they inhabit, have consistently aroused established researchers' interest.

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