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Physicochemical analysis of water quality of malhania dam in relation to growth of certain algae

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Abstract
In the present study, physicochemical parameters viz. temperature, turbidity, pH, Electrical Conductivity, Total Suspended Solids, Total Dissolved Solids, Phosphate, Chloride, Sulphate, Total alkalinity, Total Hardness, Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Calcium hardness and Magnesium hardness of water of Malhania dam were analyzed in relation to the growth of algae viz. *Scenedesmus obliquus*, *Monoraphidium minutum*. During the study, it was noticed that both the algae have shown excellent growth in the water. Moreover, when CO_2 concentration got increase in the water. Both the algae grown much better in fresh water and can be use to decrease CO_2 concentration in the environment and can be a viable option to solve the problem of global warming. Moreover, production of algae can be a good source of Bio diesel production because of high oil content in it.

Keywords: substituted Li ferrite, magnetostatic and spin waves, microstrip array antenna, X-band frequency range

1. Introduction
Malhania dam is situated in Dewargaon. According to Census 2011 information the location code or village code of Dewargaon village is 437475. Dewargaon village is located in Pendra Road Gorella Tehsil of Bilaspur district in Chhattisgarh, India. It is situated 6 km away from sub-district headquarter Gaurella and 115km away from district headquarter Bilaspur. As per 2009 stats, Devargaon is the gram panchayat of Dewargaon village.
The total geographical area of village is 1416.28 hectares. Dewargaon has a total population of 3,227 peoples. There are about 757 houses in Dewargaon village. Gaurella is nearest town to Dewargaon which is approximately 6km away.
The present aquatic body "Malhaniya dam" was constructed in the year 2002 on local nala of Dewargaon of Pendra road district Bilaspur. It is situated 22°-45'-20" latitude and 81°-96'-36" longitude. The height of the dam is 21.8 mt. and length 2700 mts. Mainly the water of this dam is used for irrigation and fish culturing.
Hence, it has been thought worthwhile to investigate the Hydrobiological Characteristic of Malhaniya Dam with Special Reference to Fish Fauna.
The waste waters inflows in dam keeps perennial to it. The degradation of dam has occurred not only due to waste water effluent inflow but also by siltation, domestic sewage, immersion of idols and other activity around the dam. Thus the dam is subjected to enormous anthropogenic stress. The overall impact has resulted in the deterioration of water quality, accumulation of toxic chemicals and sediments. Hence, now-a-days sewage discharge are a major component of water pollution which are contributing to oxygen demand and nutrient loading of the water bodies, promoting toxic substances, algal blooms and leading to a destabilized aquatic ecosystem (DWAF, 1995; WRC, 2000 and Morriso *et al.* 2001) [1-3]. Moreover, not only surface water resources but ground water resources are also contaminated by various sources like, agricultural discharge and municipal waste water associated with large amount of inorganic and organic toxic pollutants along with harmful pathogens (Okoh, *et al.* 2007) [4]. Besides this, water pollution is also concerned with the release of free CO_2 that is liberated during respiration and decay of organic matter which is highly soluble in natural waste.
The carbon dioxide content of water depends upon the water temperature, depth, and rate of respiration, decomposition of organic matter, chemical nature of the bottom and geographical features of the terrain surrounding the water body (Sakhare and Joshi, 2002) [5]. The increasing concentration of CO_2 in the atmosphere is a major driver of global warming. Microalgae found in the waste water use CO_2 as one of their main building blocks. Hence, in the present study S*cenedesmus obliquus* and *Monoraphidium minutum* algae was grown in water of Malhania dam that can be used as a viable option for utilizing excess amount of CO_2 release by anthropogenic activities to solve the problem of global warming and excess production of algae can be used as biodiesel because these algae are rich in lipid content. Moreover, physicochemical parameters of Malhania dam water concerning to the amount of CO_2 content and algal growth were also analyzed in the present study.

2. Materials and Method
During the study period from April, 2016 to March, 2017, sub-surface water samples were collected in the iodine treated double stoppers plastic bottles in the morning hours of the day, from the south side Spill outlet station of Malhania dam. During the time of collection of water samples highest care was taken to avoid spilling of water and air bubbling. Collected water sample was kept in plastic container for growing algae. The gratis samples of algae viz. S*cenedesmus*

obliquus (Strain No. 276-10) and *Monoraphidium minutum* (Strain No. 243-1) were brought into the Laboratory which were obtained from the Albert Von Haller Institute, George August University Gottingen, Germany.

During the study period, the growth of algae was seen in plastic container. Then, some of the physicochemical parameters of water were analyzed at sampling station while other parameters were analyzed in the laboratory within 6 to 8 hours. The physicochemical parameters of reservoir water were analyzed according to the methods of APHA (1989) [6]. The parameters tested during the study period were temperature, turbidity, pH, Electrical Conductivity, Total Suspended Solids, Total Dissolved Solids, Phosphate, Chloride, Sulphate, Total alkalinity, Total Hardness, Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, Calcium hardness and Magnesium hardness as shown in Table (1).

3. Results and Discussion

In the present study, the temperature of Malhania dam water was recorded 12°C minimum and 26°C maximum. Moreover it was in average of 20°C that is suitable to the development of fresh water algae in the dam. Microalgae are usually more efficient converters of solar energy because of their simple cellular structure (Nester, *et al.* 2004) [7]. Temperature has also been found to have a major effect on the fatty acid make-up of algae. It has been found that as temperature decreases there is an increase in unsaturated fatty acids. Likewise, when the temperature is increased there is an increase in saturated fatty acids. Temperature has also been shown to affect the total lipid content in algae. However, no general trend has been established yet (Hu, *et al.* 2008) [8].

The optimal growth temperature for most species of algae is between 20°C to 30°C (Konopka and Brock, 1978) [9]. Turbidity was in between the range of 7.21-82 NTU and its average value 23 NTU which is in the range of permissible limit and suitable for the photosynthesis of submerged plants and algae. If the turbidity got increase in the lake, the intensity of light got decrease. Hence, algae that are grown at different light intensities show remarkable changes in their gross chemical composition, pigment content and photosynthetic activity (Hu, *et al.* 2008) [8]. PH value of Malhania dam water was in between the range of 7.21-8.71 and average value was 7.93 which indicate that water of the lake is slightly alkaline. The overall pH range of this lake water was within WHO (1984) [10] and BIS (1993) [11] permissible limits (6.5-9.2). During the investigation of water samples electrical conductivity (EC) was found in between the range of 301-830 µhos/Sec and the average value was 614 µhos/Sec. In this study the value of EC was found above the maximum permissible limit of 500µhos/cm, as recommended by WHO (1984) [10] which is not quite satisfactory for algal growth. Total suspended solids was found in the water of Malhania dam in between the range 230-575 mg/L whereas total dissolved solids was found in the range of 192-449 mg/L which is in permissible limit as recommended by WHO (1984) [10]. Phosphate concentration was noticed very low (0.44 to 4.50 mg/L) however, Chloride was found in higher concentration (17.99 to 77.9 mg/L) and the range of Sulphate concentration in between 4.75 mg/L and 62 mg/L and their average values was 50.91 mg/L. It was observed that the chloride and sulphate concentration in all the samples collected was below the recommended concentration of 250mg/L and 150mg/L respectively, hence these content are found in favor of the algal growth.

Total alkalinity was observed during the period was minimum 128 mg/L and maximum 392 Mg/L and average value was 249 mg/L whereas total hardness was minimum 124 mg/L and maximum 330 Mg/L and their average value was 233.8 mg/L. Moreover, calcium hardness was higher (254 mg/L) as compared to magnesium hardness (16.2 mg/L) of the water. Dissolved oxygen was also very low in range (1.60-16.2 mg/L) in the water of Malhania dam which indicates that the water is polluted. Similarly, Awasthi (2011) [12] has reported the higher values of DO in Malhania dam, Pendra road Bilaspur (C.G.). Higher values of dissolved oxygen might be due to lower rate of organic decomposition and joining of surface run off from the catchment area, which increases oxygen solubility which is not suitable for the algal growth. However, similar findings of the parameters were reported by Adoni and Vaishya (1990) [13], Singh & Patil (1991) [14] and Khabade *et al.* (2002) [15]. Hence the biological oxygen demand (BOD) was maximum 20 mg/L**.** BOD is the measure of extent of pollutant in the water body.

The untreated discharge of municipal and domestic waste in water bodies increases the amount of organic content and organic load due to allochthonous and autochthonous sources. Shukla (1991) [16] and Kumar (1997) [17] confirm the above results. Chemical oxygen demand (COD) was much more higher (98.2 mg/L) and dissolved oxygen and COD-maximum permissible limit for DO as per WHO is 4.6- 6.0mg/l it was found within the admissible limit in all the water samples. In the present study high COD values were found which depicts the pollution of water source due to pollutants of organic origin. The waste was characterized with respect to pH, dissolved oxygen (DO) content, biological oxygen demand (BOD), chemical oxygen demand (COD) and total organic carbon (TOC) content following the standard protocols of American Public Health Association [18]. Free CO_2 was in between the range 2-12 mg/L with an average value 7.8 mg/L which indicate that lake is highly polluted and produces more carbon dioxide that is utilized by algae. Aquatic algae are major producers of oxygen and important users of carbon dioxide. Free CO_2 was negligible during most of the time in the lake. At high pH a concomitant decrease in free CO_2 is also reported by Hutchinson (1957) [19] and described that free CO_2 was found to be absent, if pH increases above 8. Water rich in free CO_2 is comparatively less alkaline and vice versa as stated by Atkins (1926) [20] and Rao (1955) [21]. On the basis of the above results and discussion, it is quite clear that Malhania dam are in autotrophic mode in nature and suitable for the growth of the algae viz. S*cenedesmus obliquus*, *Monoraphidium minutum*.

Table 1: Physicochemical parameter of water samples of Malhania dam, Pendra Bilaspur (C.G.)

S. No.	Parameters	Minimum	Maximum	Average	SD
1.	Temperature (°C)	12	26	20	9.90
2.	Turbidity (NTU)	8	82	23	52.33
3.	pH	7.21	8.71	7.93	1.06
4.	Conductivity (µhos/Sec.)	301	830	614	374.06
5.	T.S.S. (mg/L)	230	575	411	243.95
6.	T.D.S. (mg/L)	192	449	346	181.73
7.	Phosphate (mg/L)	0.44	4.50	1.82	2.87
8.	Chloride (mg/L)	17.99	77.9	50.91	42.36
9.	Sulphate (mg/l)	4.75	62.0	22.0	40.48
10.	Total alkalinity (mg/L)	128.0	392.0	249.1	186.68
11.	Total hardness (mg/L)	124.0	330.0	233.8	145.66
12.	DO (mg/L)	1.60	16.2	7.36	10.32
13.	BOD (mg/L)	1.30	20	7.70	13.22
14.	COD (mg/L)	9.80	98.2	47.0	62.51
15.	Ca^{++} hardness (mg/L)	108.0	254.0	158.8	103.24
16.	Mg^{++} Hardness (mg/L)	1.6	16.2	7.3	10.32
17.	Free CO_2 (mg/L)	2	12	6.5	7.07

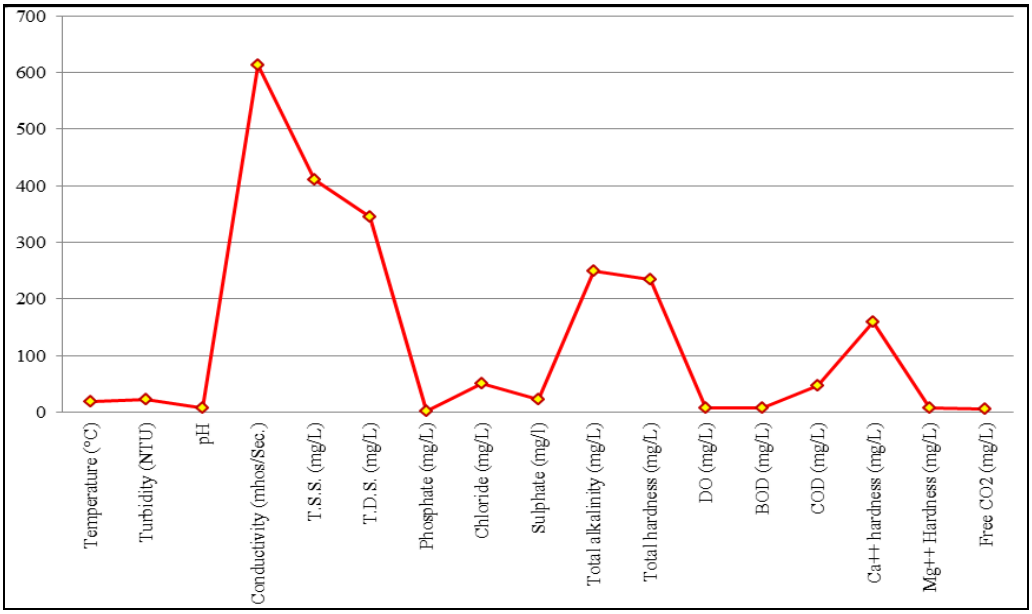

Fig 1: Graphics analysis of average physicohemical parameter of water samples of Malhania dam, Pendra Bilaspur (C.G)

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