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A COMPARATIVE STUDY OF THE WATER QUALITY BEFORE AND AFTER TREATMENT OF CONTAMINATED WATER USING THE PEELS OF *MUSA PARASIDIACA* IN RELATION TO SEASONAL VARIATION

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ABSTRACT

Chromium contamination can alter genetic materials and cause hazardous health effect in life. Bio absorption method relies on the ability of biological materials to remove the heavy metals by binding metal in various ways. The bio-adsorbents consist of dead and metabolically inactive cells. The residues of banana peels can be processed and converted to be adsorbents because they have large surface areas, high swelling capacities, excellent mechanical strengths, and are convenient to use and have great potential to adsorb harmful contaminants such as heavy metals. In the present study, contaminated water was treated using the powdered peels of *Musa parasidiaca,* then the physico-chemical factors and the amount of chromium before and after treatment were compared in relation to winter and summer. The amount of heavy metal chromium concentration was reduced drastically. Based on the results obtained the peels of *Musa parasidiaca* is proved to be a low cost and effective bio-adsorbent in bioremediation of chromium.

KEY WORDS: Contaminated Water, Peels of *Musa paradisiaca*, Chromium.

INTRODUCTION

The industrial waste accumulates in the environment and become potential hazardous. The discharge of huge amounts of metal-contaminated wastewater containing metals like Cadmium, Chromium, Copper, Nickel, Arsenic, Lead, and Zinc are the most hazardous among the chemical industries (Adeyeye *et al*., 2002). According to Michael Nirmal (2015), chromium contamination can alter genetic materials and cause cancer. Bioaccumulation of chromium in chromate industrial workers and complementary chromium toxicology study in rabbit reveals the accumulation of heavy metal chromium (Job Gopinath, 2001). Biosorption method relies on the ability of biological materials to remove the heavy metals by binding metal in various ways. The bio-adsorbents consist of dead and metabolically inactive cells. (Pollard *et al*., 1992), (Tonni *et al*., 2006), Shan-Li Wang (2011), Moriya *et al.* (2008), reported that the residues of banana peels can be processed and converted to be adsorbents because they have large surface areas, high swelling capacities, excellent mechanical strengths, and are convenient to use and have great potential to adsorb harmful contaminants such as heavy metals. The use of an effective and inexpensive banana waste material for the removal of chromium from industrial effluent was found to be very effective. Emaga *et al.* (2007) reported that pectin extracted from banana peel also contains glucose, galactose, arabinose, rhamnose and xylose. Banana peel is recognised to be an economically viable and environmentally sound adsorbent for removal of heavy metals from contaminated water. David N Juurlink *et al*., (2016) studies show that Absorption is the basic phenomenon to treat with activated carbon. It can also be impregnated with

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certain chemicals to enhance property for certain applications. Activated carbon used for municipal drinking water treatment domestic water treatment to the de-chlorinate and de-ozonation. Puliyankannu lake, Ranipet is the major surface water body which was polluted by discharges from various industrial effluents including Tamil Nadu Chromate and Chemicals Limited (TCCL) dumpsite total elevation from South to North range (Vidhya *et al*., 2021) (Edwin *et al*., 2018). The leachate generated from infiltration of rain water has been polluting the ground- water regime in the downstream areas of TCCL (Sankaran *et al*., 2009).

MATERIALS AND METHODS

The study area is Ranipet which is located at 12.56 degree Northern latitude and 79.20 Eastern longitudes and is 93 km west of Chennai, it is geographically 25 km away from the north east of Vellore. Tamil Nadu Chromate Chemicals Limited is an industry located in the Chennai-Bangalore national highway NH4 near Ranipet Industrial area, Ranipet District.The water samples were collected from TCCL industry during winter and summer season and were analyzed for physico chemical factors. Empty distilled water cans were taken, washed and sterilized for the purpose of collection of the water samples. Water samples were collected from 6 stations and checked for pH and temperature using an electronic pH meter at each station. Station 1, 2, 3 were bore well water, station 4 and station 5 were stagnant water inside the TCCL industry and Station 6 was collected from outside of the TCCL industry. The water samples were analyzed for physico chemical factors using APHA (1998) standard and APHA 23rd edition 2017 standard in the laboratory for physical examination and

Table 1. Physico Chemical Characteristics of Samples 4, 5 and 6 before and after the treatment with the peels of *Musa paradisiaca* during Winter Season

S. No	Parameters	Acceptable limit	Maximum permissible limit	Before Treatment			After Treatment with banana peels		
				Sample 4	Sample 5	Sample 6	Sample 4	Sample 5	Sample 6
				Physical examination					
1	Appearance			Turbid	Turbid	Turbid	Clear	Clear	Clear
2	Colour			Yellowish	Yellowish	Yellowish	Colourless	Colour less	Colour less
3	Odour	Agreeable	Agreeable	Odour some	Odour some	Odour some	None	None	None
4	Turbidity	1	5	2	2	2	1	1	1
5	Total Dissolved Solids (TDS)	500	2000	332	923	1233	320	881	1092
6	Electrical Conductivity			474	1319	1762	450	1195	1526
				Chemical examination					
7	pH	6.5-8.5	6.5-8.5	7.36	9.23	9.54	7.01	7.03	7.02
8	TotalAlkalinity	200	600	132	380	536	120	291	492
9	TotalHardness	200	600	90	148	96	81	126	80
10	Calcium	75	200	18	29	19	17	25	17
11	Magnesium	30	100	11	18	12	10	17	10
12	Iron	0.3	1.0	0.00	0.00	0.00	0.00	0.00	0.00
13	Manganese	0.1	0.3	0.00	0.00	0.00	0.00	0.00	0.00
14	FreeAmmonia	0.5	0.5	3.64	4.78	4.54	1.08	1.06	1.05
15	Nitrite			0.12	0.21	0.28	0.11	0.19	0.25
16	Nitrate	45	45	11	17	20	9	15	19
17	Chloride	250	1000	22	48	54	20	45	50
18	Fluoride	1.0	1.5	1.2	1.2	1.2	1.1	1.1	1.1
19	Sulphate	200	400	14	31	31	13	30	29
20	Phosphate			0.13	0.24	0.31	0.00	0.00	0.00
21	Chromium			701.311	782.047	849.569	-0.499	-0.528	0.016
22	BOD		20	21	36	18	20	34	16
23	COD		250	192	576	176	190	472	166

Note : Note: All values are expressed in mg/l, Temperature in degree and EC in µS/cm.

chemical examination (Edwin *et al.*, 2018). It was then compared with WHO standard, IS 3025 1983:2009, BIS 10500: 2012 at CVR labs Chennai, Tamil Nadu, India. The Total Chromium content of the samples before and after treatment were analyzed using Atomic Absorption Spectrometry (Smith 1983), (Lokhande *et al.*, 2011) using Varian AAS Model 240 at Vellore Institute of Tehnology - TBI lab, Vellore, Tamil Nadu. The peels of *Musa paradisiaca* were removed and washed thoroughly in distilled water to remove the external dirt. The peels were cut into small pieces and kept in hot sun at 60 °C for 3 days. Then the dried peels were rinsed with distilled water and kept in orbital shaker for 35 minutes at 350 rpm after which the moist peels were sun dried for one day and also kept in the hot air oven for 2 hours at 80 ° C to remove the moist content. The dried banana peels were ground into powder sieved using 250 micron sieve and stored in plastic container for further experiment (Morshdy *et al.*, 2018). 8 grams of powdered peels of *Musa paradisiaca* was added to 100 ml of the sample mixed well using a magnetic stirrer. The setup was left for 24 hours and filtered using whatman filter paper. Then the sample was again filtered using sand filter. The remediated water sample was sent for AAS analysis for determining the Absorption.

RESULTS AND DISCUSSION

The result of the analysis of physico chemical parameters during winter and summer season revealed that the appearance of samples 1, 2, 3 were clear. Hence it is clear that no contamination were found, but the sample 4, 5 and 6 were turbid in nature, this was due to contamination. The colour of samples 4, 5 and 6 which were collected from TCCL were yellow in colour due to the presence of metals but the samples from other stations were found with absence of metals. The analysis of the physico chemical characteristics was compared between winter season and summer season to understand the difference in seasonal changes and its influence on the amount of heavy metal contamination and also the efficiency of the bio-adsorbent. All parameters such as turbidity, TDS, EC, pH, total alkalinity, hardness, calcium, magnesium, ammonia, nitrites, nitrates, chlorides, fluorides, sulphates, phosphates, BOD and COD showed a decrement values when compared to the initial concentration before the remediation during winter and summer season. Table 1 shows the results of the analysis of physico-chemical characteristics of samples 4, 5 and 6 before and after treatment with peels of *Musa paradisiaca* during winter season and represented in Fig 1, 2 and **3** respectively. The influence of season depends on the atmospheric conditions such as air pressure, temperature and humidity. During summer the concentration of chromium was found high compared to winter, which may be due to evaporation process. During winter the rain water dilutes the concentration of the water that leads to comparatively lesser concentration of chromium as shown in Table 2. Fig 4, 5 and 6 shows the analysis of physico-chemical characteristics of samples 4, 5 and 6 respectively before and after treatment with peels of *Musa paradisiaca* during summer season. The amount of heavy metal chromium concentration was reduced drastically from 701.311 mg/l to -0.499 mg/l in the sample 4, from 782.047 mg/l to -0.528 mg/l in the sample 5, from 849.569 mg/l to 0.016 mg/l in the sample 6 while exposed to treatment with bio-adsorbents peels of *Musa paradisiaca* during winter season (Vidhya *et al*., 2021). Heavy metal

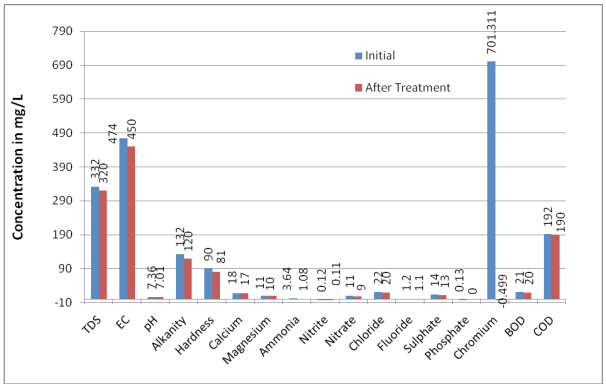

Fig. 1. Physico-chemical characteristics of Sample 4 before and after treatment with peels of Musa paradisiaca during Winter Season

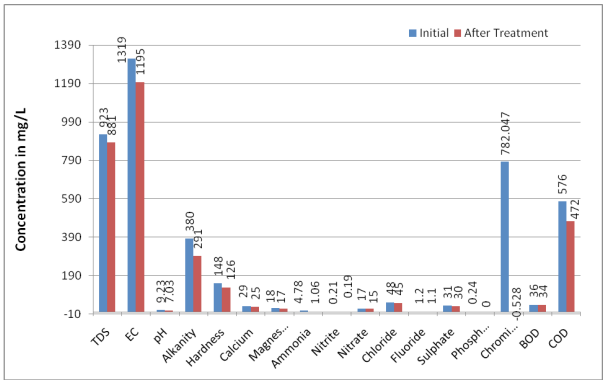

Fig. 2. Physico-chemical characteristics of Sample 5 before and after treatment with peels of *Musa paradisiaca* during Winter Season

chromium concentration was reduced drastically from 962.941 mg/l to -0.401mg/L in the sample 4, from 972.863 mg/l to -0.418 mg/l in the sample 5, from 981.940 mg/l to 0.006 mg/l in the sample 6 on treatment with bio- adsorbents peels of *Musa paradisiaca* during summer season (Kanniyappan Vidhya *et al*., 2022).

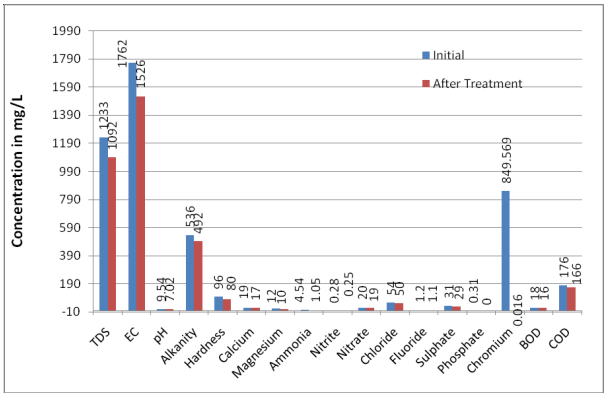

Fig. 3. Physico-chemical characteristics of Sample 6 before and after treatment with peels of *Musa paradisiaca* during Winter Season

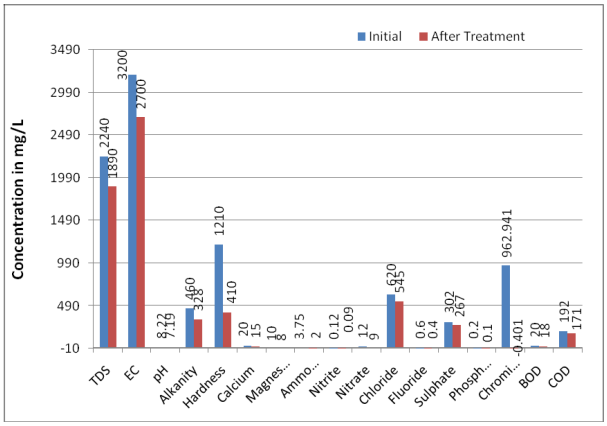

Fig. 4. Physico-chemical characteristics of Sample 4 before and after treatment with peels of *Musa paradisiaca* duringSummer Season

Table 2. Physico-chemical characteristics of samples 4, 5 and 6 before and after the treatment with peels of *Musa paradisiaca* during Summer Season

S. No.	Parameters	Acceptable limit	Maximum permissible limit	Before Treatment			After Treatment with banana peels		
				Sample 4	Sample 5	Sample 6	Sample 4	Sample 5	Sample 6
				Physical Examination					
1	Appearance			Turbid	Turbid	Turbid	Clear	Clear	Clear
2	Colour			Yellowish	Yellowish	Yellowish	Colourless	Colourless	Colourless
3	Odour	Agreeable	Agreeable	Odour some	Odour some	Odour some	Odour less	Odour less	Odour less
4	Turbidity	1	5	2	2	2	1	1	1
5	Total Dissolved Solids (TDS)	500	2000	2240	2275	2219	1890	1911	1897
6	Electrical Conductivity			3200	3250	3170	2700	2730	2710
				Chemical Examination					
7	pH	6.5-8.5	6.5-8.5	8.22	9.37	9.64	7.19	7.24	7.52
8	Total Alkalinity	200	600	460	468	420	328	340	332
9	Total Hardness	200	600	1210	1230	850	410	430	440
10	Calcium	75	200	20	30	25	15	26	20
11	Magnesium	30	100	10	19	11	8	16	8
12	Iron	0.3	1.0	0	0	0	0	0	0
13	Manganese	0.1	0.3	0	0	0	0	0	0
14	Free Ammonia	0.5	0.5	3.75	4.21	4.42	2.0	2.11	2.10
15	Nitrite			0.12	0.22	0.29	0.09	0.19	0.17
16	Nitrate	45	45	12	19	23	9	17	17
17	Chloride	250	1000	620	630	610	545	565	550
18	Fluoride	1.0	1.5	0.6	0.6	0.6	0.4	0.4	0.4
19	Sulphate	200	400	302	317	338	267	280	276
20	Phosphate			0.20	0.25	0.29	0.10	0.19	0.15
21	Chromium			962.941	962.941	962.941	-0.401	-0.401	-0.401
22	BOD		20	20	37	20	18	30	12
23	COD		250	192	580	180	171	425	143

Note : Note: All values are expressed in mg/L, temperature in degree and EC in µS/cm.

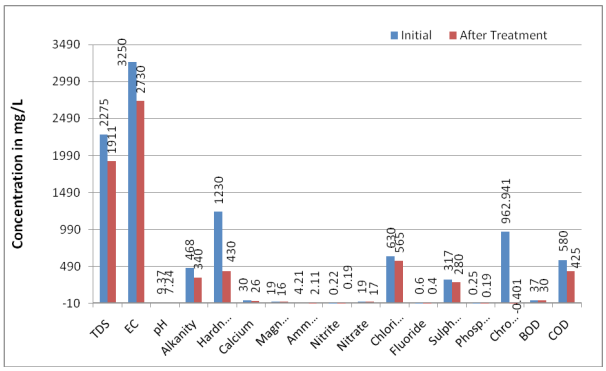

Fig. 5. Physico-chemical characteristics of Sample 5 before and after treatment with peels of *Musa paradisiaca* during Summer Season

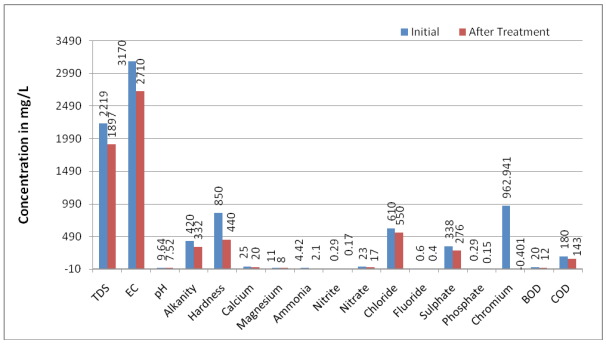

Fig. 6. Physico-chemical characteristics of Sample 6 before and after treatment with peels of *Musa paradisiaca* during Summer Season

CONCLUSION

Based on the results obtained the peels of *Musa parasidiaca* is proved to be a low cost and effective bio-adsorbent in bioremediation of chromium.

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Conflict of interest: Nil

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