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ASSESSMENT OF WATER QUALITY OF DOWNSTREAM OF MEGHNA RIVER AND FEASIBLE TREATMENT FOR DRINKING AND COMMERCIAL PURPOSE

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ABSTRACT

People on globe are under tremendous threat due to undesired changes in the physical, chemical and biological characteristics of air, water and soil. Due to increased human population, industrialization, use of fertilizers and man-made activity water is highly polluted with different harmful contaminants. The Meghna River is one of the most important rivers in Bangladesh [1]. The Meghna is formed in side Bangladesh by the joining of the Surma and Kushiyara rivers originating from the hilly regions of eastern India. The present study was conducted to evaluate the surface water quality of downstream of the Meghna river using physical, chemical and biological parameters in summer and winter season at five different points.

KEYWORDS: Meghna river, Physical-Chemical-Biological parameters assessment, Treatment by Banana peel carbon and Gamma radiation

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1. INTRODUCTION

Water quality testing is an important part of environmental monitoring. When water quality is poor, it affects not only aquatic life but the surrounding ecosystem as well.

Water quality refers to the chemical, physical, biological, and radiological characteristics of water [2]. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose. It is most frequently used by reference to a set of standards against which compliance, generally achieved through treatment of the water, can be assessed. The most common standards used to assess water quality relate to health of ecosystems, safety of human contact, and drinking water. Physical and Chemical properties of water quality include temperature, Electrical conductivity

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(EC), Total suspended solids (TSS), Transparency or turbidity, Total dissolved solids, Odor, Color, pH, Total hardness (TH), Heavy metals. Biological properties involve Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), Dissolved oxygen (DO) and Biological Indicators. These parameters are relevant not only to surface water studies of the ocean, lakes and rivers, but to groundwater and industrial processes as well.

2. MATERIALS AND METHODS

2.1 Site Selection:

A well-planned field work is carried out by site selection and this is done by using a map. Five sample collection station was a) 22°35'59.6"N 90°57'21.2"E, b) 22°35'12.3"N 90°58'00.3"E, c) 22°31'34.8"N 91°01'33.3"E, d) 22°34'08.3"N 90°54'42.6"E, e) 22°30'14.9"N 91°00'35.5"E

2.2 Assessment of physical & chemical characteristics:

Standard methods were adapted for the analysis of various water quality parameters [3]

Odor: Odor was detected by nose through sniffing. Suitable portion of water was taken in a beaker, checked by smelling and detect water odor and found it is odor free.

Temperature: Temperature of all samples were measured in the field in degree Celsius without any contact of hand to avoid erroneous reading. The temperature was taken by dipping the thermometer in the river and taken the reading.

Electrical conductivity, TDS, pH: A digital multi range conductivity meter, TDS and pH meter was used for the measurement of the electrical conductivity, TDS and pH of the water sample.

Total Hardness, Total Alkalinity & Chloride: It was measured by titrimetric method.

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2.3 Assessment Biological characteristics:

Dissolved Oxygen: It was measured by digital DO meter.

Bio-Chemical Oxygen Demand:

Test Method- APHA 5210 D, Respirometric methods [4] provide direct measurement of the oxygen consumed by microorganisms from an air or oxygen-enriched environment in a closed vessel under conditions of constant temperature and agitation.

Take water sample and put a magnetic stirring bar into each bottle and fill the alkali holder, small container located under bottle cap with an amount of dioxide absorber (Sodium hydroxide). Place the bottle into position in the stirring equipment, than introduce the stirring equipment into the refrigerated thermostat set to 200C for incubation. After 30-40 minutes the apparatus and samples are usually in thermal equilibrium at the chosen temperature. The apparatus is ready to start BOD measurement. Count BOD value after 5 days

Figure 1: VELP scientifica BOD sensor and incubator

Chemical Oxygen Demand:

Test Method: DIN 38409, ISO 15 705 (Sealed tube method) [5]. Open test tube, hold it diagonally and slowly add 2.0 ml test sample to contents without mixing so that two separate layers are formed. Place the tube into the heating block at 1500C for 2 hours. After 2 hours remove test tube from heating block. Then allow to cool sample at room temperature and measure COD value by NANOCOLOR photometers.

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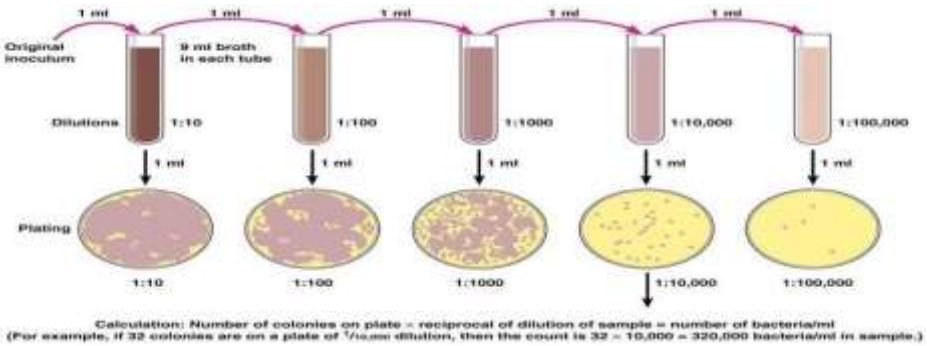
Figure 2: COD vial and VELP thermo reactor for COD test

Microorganisms of water: Counting Bacterial Colonies - Pour Plate Method [6]. There are four major steps in the procedure:

- o preparation of serial dilutions
- o mixing the serial dilutions into agar
- o counting the resulting bacterial colonies
- o calculation of total numbers of viable bacteria from these counts.

Preparation of Serial Dilutions

1. Take a liquid sample containing the bacteria to be counted and mix well.
2. Take 6 x 20 mL McCartney (or universal) bottles, label them10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5} and 10^{-6}.
3. Pipette 9 mL of sterile PBS or sterile Saline (or other isotonic diluent) into each of the bottles.
4. Pipette 1 mL of the undiluted sample into the bottle marked 10^{-1}. Discard the pipette and using a new pipette, mix the contents and pipette 1 mL from the 10-1 bottle into the 10^{-2} bottle.
5. Continue like this until transfers have been completed to the 10^{-6} bottle.
6. Now the following dilutions are the original liquid sample:



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Mixing the dilutions into agar plates

1. Liquefy at least 100 ml of appropriate agar by autoclaving.
2. Place the bottle of molten agar in a 50°C water bath and allow the agar to cool to 50°C.
3. Remove the agar bottle from the 50°C water bath and wipe the outside of the bottle with paper toweling to remove water. Working quickly to avoid cooling of the agar to 42°C (this is the temperature at which it sets) pour about 15 ml of molten agar into each of the six plates. The agar should be approximately 7 mm thick.
4. Pipette 1 ml of each of the dilutions into the base of correctly labelled plates using a separate pipette to avoid carryover errors.
5. Gently swirl each plate to mix the 1 ml of diluted sample into the 15 ml of agar.
6. Leave the plate without moving for at least 13 minutes to allow the agar to set.
7. When the agar is set, incubate the plate as appropriate.

Counting bacterial colonies

1. After an appropriate incubation period examine the plates for colonial growth.
2. Colonies will form on the top of the agar as well as in the agar. Those on top of the agar will be larger but all colonies must be counted.
3. Select plates that appear to have between 30 - 300 colonies in and on the agar as this gives the best statistical representation of the number of bacteria in the undiluted sample.
4. Using a light box or colony counter (if one is available) and marker pen (put a dot above each colony as you count it), count the number of colonies in each of the dilutions having between 30 - 300 colonies. This will become easier with practice.
5. Write the numbers and relevant dilutions down.

Summer Season:

Samples were collected in April from Ramgoti, Laxmipur, Bangladesh. Those samples were used for assessment and treatment of water of summer season.

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Table 1: Physical, Chemical and Biological Parameters of Meghna River Water at Ramgoti in Summer Season.

Sample	Physical and Chemical Parameter								Biological Parameter		
	Temp (^{0}C)	p^H	TDS (mg/l)	Salinity (%)	EC ($\mu S/cm$)	Chloride (mg/l)	Total Alkalinity (mg/l)	Total Hardness (mg/l)	DO (mg/l)	BOD (mg/l)	COD (mg/l)
1	31.2	7.83	129.26	0.5	258.26	34.32	13.35	128.31	1.4	24.2	85
2	31.5	7.79	109.76	0.4	220	22.47	13.35	108.22	1.32	22	78.5
3	31.5	7.69	119.5	0.5	239.06	26.2	16.5	112.23	1.02	28	69.3
4	31.4	7.8	106.26	0.4	212.64	24.85	15	104.21	1.40	29	64
5	31.5	7.85	111.5	0.4	223.2	28.4	19.5	103.22	1.20	23.5	77

Winter season

Samples were collected in December from Ramgoti, Laxmipur, Bangladesh. Those samples were used for assessment and treatment of water of winter season.

Table 2: Physical, Chemical and Biological Parameters of Meghna River Water at Ramgoti in Winter season.

sample	Physical and Chemical Parameter								Biological Parameter		
	Temp (^{0}C)	p^H	TDS (mg/l)	Salinity (%)	EC ($\mu S/cm$)	Chloride (mg/l)	Total Alkalinity (mg/l)	Total Hardness (mg/l)	DO (mg/l)	BOD (mg/l)	COD (mg/l)
1	23	7.22	96	0.4	187.7	28.20	10.15	127.2	1.50	30.5	89.8
2	25.1	7.43	87	0.4	176.9	20.71	10.21	107.4	1.44	37.5	96.5
3	24	7.3	89	0.4	176.2	20.2	14.5	117.4	1.31	32.8	77.2
4	25.6	7.25	92	0.3	183.5	21	14.2	103.23	1.37	41.4	83.8
5	26.5	7.78	95	0.3	178.8	22.4	17.5	110.5	1.39	39.7	86.9

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3. RESULT & DISCUSSION:

All water sample parameters were compared with Bangladesh Drinking Water Standards [7] and World Health Organization Drinking Water Standards and presented in table 3

Parameter	Unit	Bangladesh standard	WHO standard
Temp	ºC	20-30	-
pH	-	6.5 – 8.5	8.2-8.8
TDS	mg/l	1000	250
Chloride	mg/l	150 – 600*	-
Total Hardness	mg/l	200 – 500	-
DO	mg/l	6	-
BOD	mg/l	0.2	-
COD	mg/l	4	-
Coliform (total)	n/100 ml	0	Absent

We try to make easy possible way to treat river water and make feasible for drinking purpose. 1% ,2 %, 3% H_2O_2 and 2.5 mg/l, 3.75 mg/l Alum and 2.5 mg/l, 5 mg/l Banana peel carbon and 3 kgy, 5 kgy radiation doses was applied and results are showed below.

3.1 pH

pH value in both seasons remain almost similar. When we treated by H_2O_2 and Alum pH value goes to Acidic by increasing dosing. But by applying Banana Peel carbon and radiation dosing pH value goes to basic medium after increasing dosing. Result showed in figure 3.

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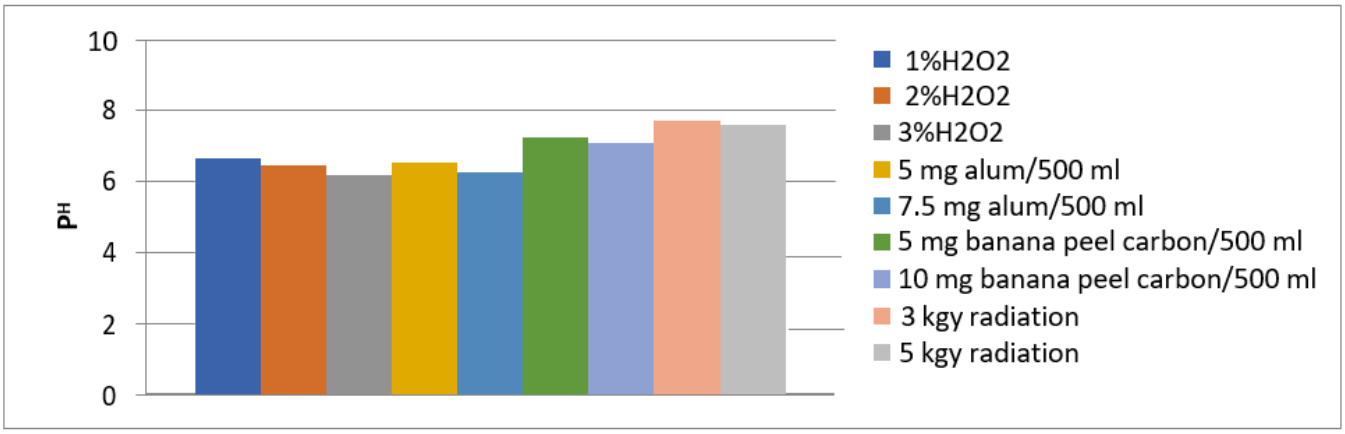

Figure 3: Graph showing the effect of various treatments on pH of water in summer season

3.2 TDS (mg/l)

During summer season TDS value was higher than winter season. When we treated by H_2O_2, Alum, Banana Peel carbon TDS value was reduced by increasing dosing but applying radiation dose TDS value slightly increased. Result showed in figure 4.

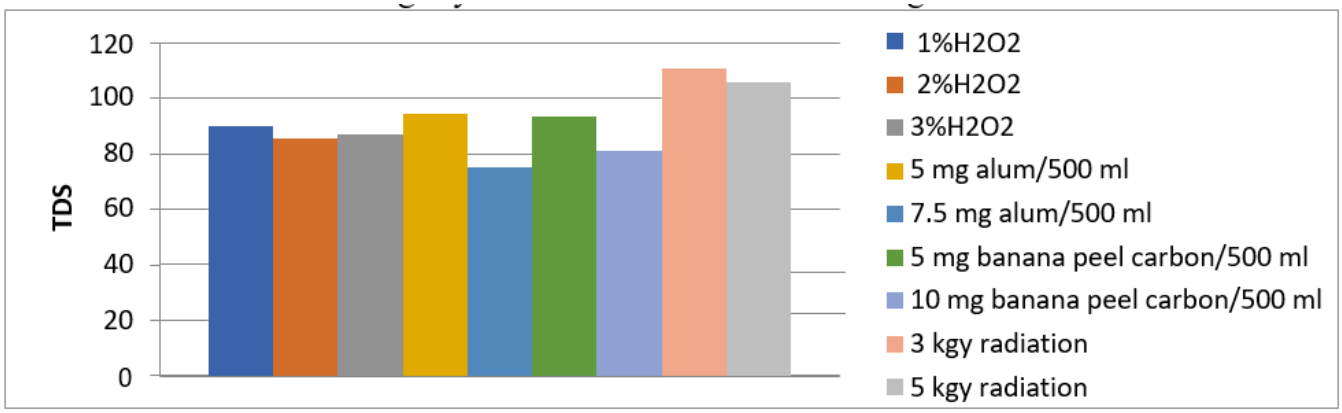

Figure 4: Graph showing the effect of various treatments on TDS of water in summer season

3.3 Salinity (%) Salinity value in both seasons remain almost similar. When treated by alum Salinity value was reduced by increasing dosing of alum. Result showed in figure 5.

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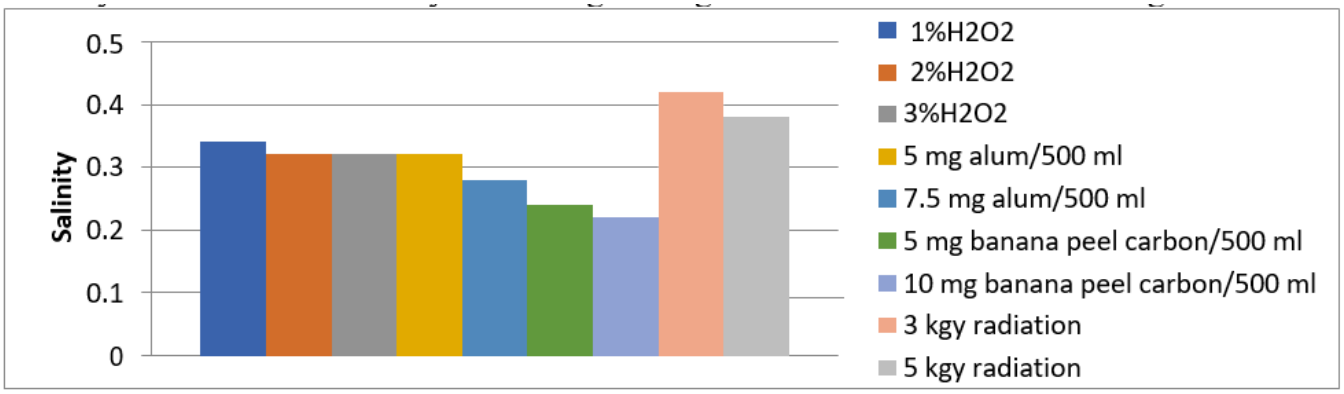

Figure 5: Graph showing the effect of various treatments on salinity of water in summer season

3.4 EC (µS/cm)

During summer season Electrical Conductivity value was higher than winter season. When we treated by H_2O_2, Alum, Banana Peel carbon EC value was reduced by increasing dosing but applying radiation dose EC value slightly increased. Result showed in figure 6.

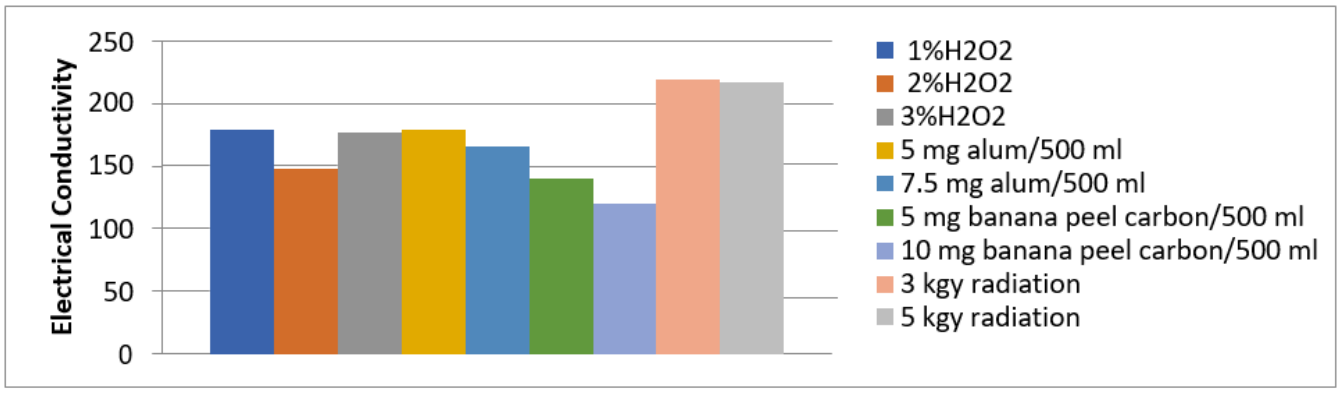

Figure 6: Graph showing the effect of various treatments on electrical conductivity in summer season

3.5 Chloride (mg/l)

Chloride value in both seasons remain almost similar. When we treated by H_2O_2, Alum, Banana Peel carbon Chloride value was reduced by increasing dosing. Chloride value was remain closer to before treatment by applying radiation dose. Result showed in figure 7.

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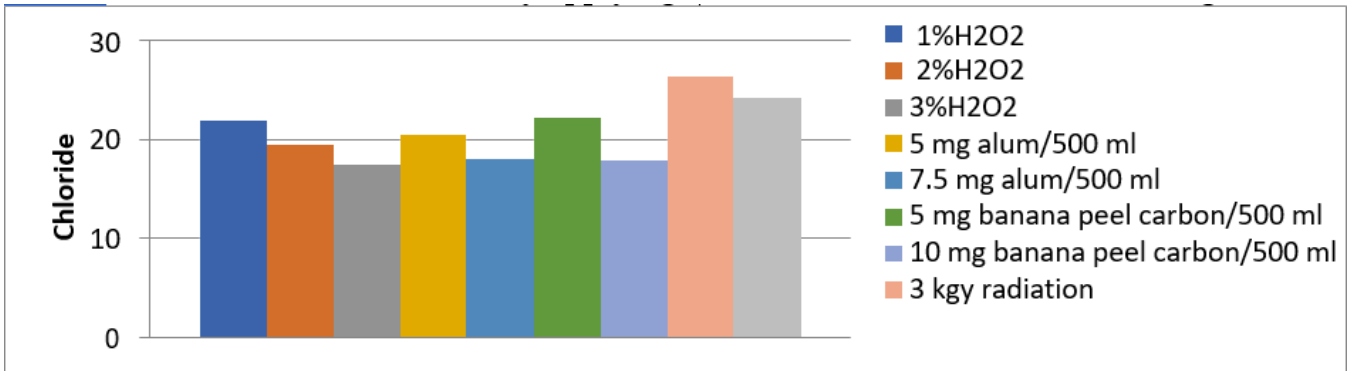

Figure 7: Graph showing the effect of various treatments on chloride in summer season

3.6 Alkalinity (mg/l)

Alkalinity value in both season remain almost similar. When we treated by H_2O_2, Alum and Banana Peel carbon alkalinity value decrease by increasing dosing. Alkalinity value was remain close to before treatment by applying radiation dose. Result showed in figure 8

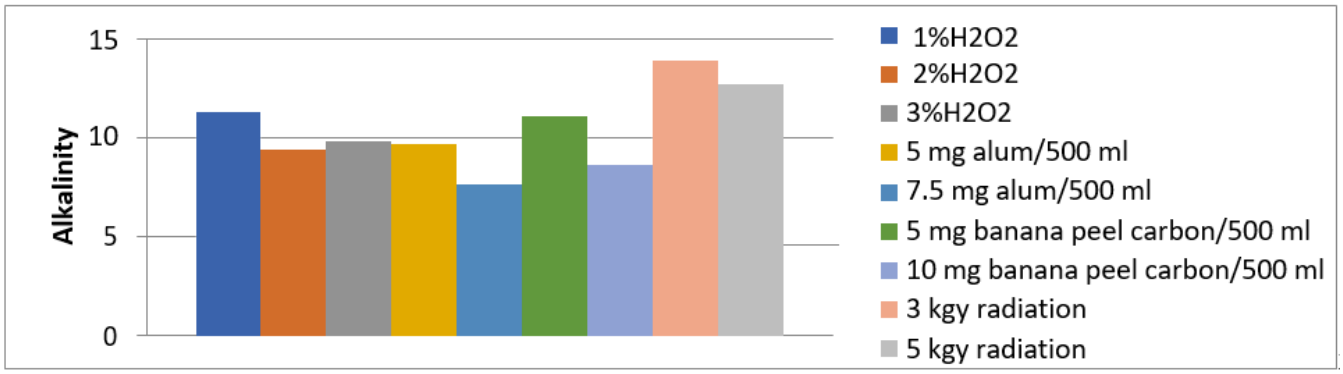

Figure 8: Graph showing the effect of various treatments on alkalinity in summer season

3.7 Hardness (mg/l)

Hardness value in both season remain almost similar. When we treated by H_2O_2, Alum and Banana Peel carbon alkalinity value decrease by increasing dosing. Alkalinity value was remain close to before treatment by applying radiation dose. Result showed in figure 8

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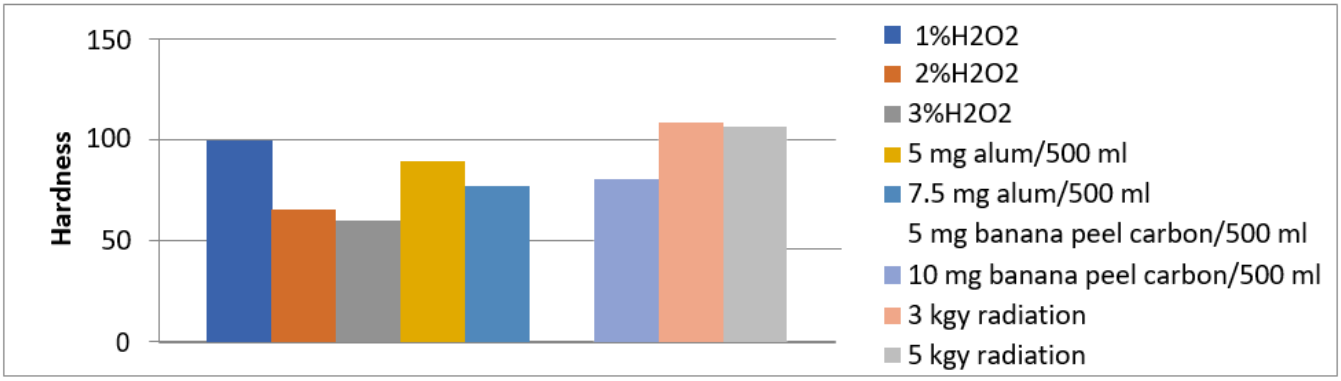

Figure 9: Graph showing the effect of various treatments on hardness in summer season

3.8 Effect of gamma radiation at Total Bacterial Count measuring by Pour Plate Method: After applying gamma radiation we have found that microbial content is absent here and it is feasible for drinking purpose. Result is showed in Table 3 and figure 10&11.

Table 4: Effect of gamma radiation of 3 & 5 kgy on total microbial count of water sample

Dilution of medium	Before treatment Total Microbial Count (cfu/ml)	After "γ" (GAMMA) treatment, 3 kgy Total Microbial Count (cfu/ml)	After "γ" (GAMMA) treatment, 5 kgy Total Microbial Count (cfu/ml)
10^{-1}	TNTC	02	01
10^{-2}	54	Absent	Absent
10^{-3}	29	Absent	Absent
10^{-4}	10	Absent	Absent
10^{-5}	Absent	Absent	Absent

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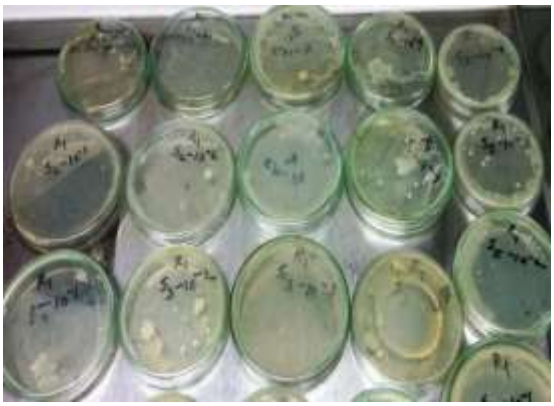

Figure 10: Total Microbial Count before radiation gamma radiation

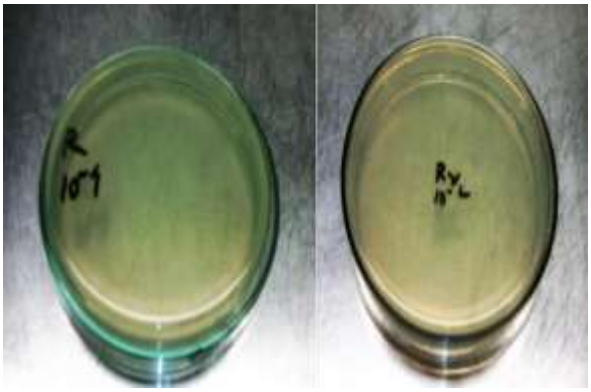

Figure 11: Total Microbial Count after gamma

CONCLUSION:

All the water quality parameters indicate that the quality of Meghna river water is not so good. The electrical conductivity, TDS and hardness are little bit high that can be recoverable but DO level is too lower than the standard. BOD and COD values are in the range of standard in summer season but in winter BOD exceeds the range (30 mg/L). Too many bacterial count is measured by pour plate method which is unhygienic for general use this water like drinking or domestic purpose. Gamma radiation is so very effective to minimize the bacterial count. So, after the combination of proper physical treatment and sterilization of this river water can be used for domestic use unless it could be a potential thread for human health.

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