Activated Carbon Fabric By Conventional And Microwave Technique: A Tool For Study Of Water Born Diseases.

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Abstract
Water has major impact on quality of life. However, in both developed and developing countries, the water quality continues to be a major health concern. World Health Organization (WHO) estimates that1.8 million people around the world currently die from water-born diseases such as diarrhoea, dysentery and typhoid. 88% of those deaths can be attributed to unsafe water (Farkas et.al. 2012). This lens focuses on three bacterial water-borne illnesses caused by *E.coli, Salmonella, Shigella* and *Enterococcus*. In this paper we have discussed environment friendly method for these bacterial pathogens. ACF-MW and ACF-MF are efficient for treatment of three pathogenic microorganisms. These are prepared from bio-waste material and manufactured environment friendly
Key words: Water quality, waterborne diseases, Microorganisms, MFT, MW-ACF.

Introduction:

Water has major impact on quality of life. However, in both developed and developing countries, the water quality continues to be a major health concern. The water quality has inspired development of tests designed to measure its suitability for drinking, bathing and released back to environment. Water that looks clear and pure may be contaminated with pathogenic organisms even water that appears "pure" must be tested to insure that it contains no microorganism that might cause diseases. Water is essential to sustain life, and every effort should be made to provide satisfactory supplies of drinking water to all (WHO, 2011).

It is estimated that unsafe water and lake of basic sanitation led do atleast 1.6 million deaths in children under the age of 5years in 2004, and 1.8 million deaths , including adults, occur from diarrhoeal diseases every year.(WHO,2006) so the microbiological contamination of water is a significant global problem.

Nowadays, there are several water treatment technologies for microbial inactivation, which avoid the use of hazardous chemicals, are currently being applied (Fisher et al.2008) Most of the methods are costly so its use is behind the reach of normal people in developing countries.

There is an urgent need to improve the quality of drinking water to ensure the supply of safe water for consumers.

Material and method:

Sample Collection:

Water samples were collected in sterilized bottles, containing 1ml of fresh 0.025N aqueous solution of sodium thiosulfate using standard water collection technique (senior 1996). Water sampling had been done from various representative location of Nagpur region. The details are as given below:

Sample No.	Sample Type	Sampling Location
1	Surface Water	Gandhisagar Lake
2	Surface Water	SonegaonLake
3	Surface Water	Naagnala
4	Ground Water	Tubewell
5	Ground Water	Dugewell
6	Ground Water	Tap water

Preparation of Carbon:

i) ASTM standard activated carbon was purchased from local market of Nagpur from Merck Suppliers and its iodine number was determined.

ii) Preparation of Microwave Activated Carbon for microbial treatment: Activated carbon was prepared from biological waste material by muffle furnace (Huidobro et al, 2001) and modern microwave technique (Ramteke,D.S,1989) . The raw material was processed before activation for moisture removal (Mangun et al ,2001).

Microbial Analysis of Samples:

i) Study of water samples before treatment: Microbial analysis of water samples were carried out (APHA, 1999). In this study we have discussed about Total coliform, Fecal coliform, *Salmonella* and *Shigella*, their significance and methods of analysis. For microbial studies we have used four different media which are as follows- Media used:

- M-Endo agar LES
- M-FC agar base
- Salmonella and Shigella agar
- Slanetz and Bartley agar

Samples were processed by commonly used Membrane Filtration Technique (Geldreich et al, 1965 , Rose et al, 1975 and Ericksen,et al, 1986).

ii) Microbial analysis of water at initial stage (before treatment)

The water samples were analyzed for study of microbial population present at initial stage and nature of the water were also studied. The treatment sequence was followed as detailed below:

Step I : Collection of water samples
Step II : Sterilization of required glass wares and MFT assembly
Step III : Preparation of four different media
Step IV : Microbial analysis of treated water by MFT
Step V : Incubation at 37^{0}C and 44^{0}C as per the respective media
Step VI : Counting of colonies after 24hrs of incubation

iii) Analysis of water and its Lab-Scale treatment with Standard activated carbon: The water samples were analyzed for microbial study with standard activated carbon for comparative study with initial results and nature of the water. The treatment sequence was followed as mentioned below:

Step I : Collection of water samples
Step II : Sterilization of required glass wares and MFT assembly
Step III : Preparation of four different media
Step IV : Sample treatment with ASTM standard activated carbon
Step V : Microbial analysis of treated water by MFT
Step VI : Incubation at 37^{0}C and 44^{0}C as per the respective media
Step VII : Counting of colonies after 24hrs of incubation
Step VIII : Final analysis of water after treatment

iv) Analysis of water and its Lab-Scale treatment with Microwave activated carbon: The water samples were treated with microwave activated carbon in aseptic condition and analyzed for microbial study .The treatment sequence was followed as described below:

Step I : Collection of water samples
Step II : Sterilization of required glass wares and MFT assembly
Step III : Preparation of four different media
Step IV : Sample treatment with Microwave activated carbon
Step V : Microbial analysis of treated water by MFT
Step VI : Incubation at 37^{0}C and 44^{0}C as per the respective media
Step VII : Counting of colonies after 24hrs of incubation
Step VIII : Final analysis of water after treatment

v) Comparison of commercial and microwave activated carbon: The comparison of commercial and microwave activated carbon was done on the basis of CFU obtained from respective culture plates of water sample. The efficiency of MW-ACF was studied by comparative study with standard carbon.

Result and discussion:

After incubation of 24hrs at 37^{0}C and 44.5^{0}C, colonies were obtained. The colonies were counted by colony counter. The CFU obtained are given as follows-

Microbial analysis of water at initial stage (before treatment)S

Sample No.	Total coliform	Faecal coliform	Bacterial Genus		
			Salmonella	*Shigella*	*Enterococci*
	CFU/100ml		CFU/ml		
1	4190	TNTC	65	32	18
2	TNTC	TNTC	28	15	19
3	6500	TNTC	90	43	100
4	TNTC	1058	1	ND	3
5	2040	TNTC	43	22	10
6	1120	TNTC	2	ND	ND

Table 1- CFU obtained after 24hrs of incubation on different media before treatment.

ND- Not detected, TNTC- Too numerous to count

i) Analysis of water and its Lab-Scale treatment with Standard activated carbon: Water samples first treated with Standard activated carbon and result in terms of CFU/100ml and CFU/1ml are as follows-

Sample No.	Total coliform	Faecal coliform	Bacterial Genus		
			Salmonella	*Shigella*	*Enterococci*
	CFU/100ml		CFU/ml		
1	3100	TNTC	14	9	11
2	1870	TNTC	7	2	4
3	TNTC	TNTC	22	13	TNTC
4	310	1000	8	6	13
5	510	760	80	24	ND
6	895	157	15	ND	ND

Table 2- CFU obtained after 24hrs of incubation on different media after treatment with standard activated carbon

ii) Analysis of water and its Lab-Scale treatment with Microwave activated carbon: Water samples after processing with MW-ACF gives following results-

Sample No.	Total coliform	Faecal coliform	Bacterial Genus		
			Salmonella	*Shigella*	*Enterococci*
	CFU/100ml		CFU/ml		
1	3280	TNTC	6	1	7
2	2150	TNTC	4	ND	7
3	2390	TNTC	18	ND	70
4	1000	1000	ND	ND	ND
5	120	760	11	7	ND
6	ND	432	4	ND	ND

Table 3- CFU obtained after 24hrs of incubation on different media after treatment with ACF

iv) Comparison of commercial and microwave activated carbon

Sample No.	Initial	Treatment with standard	Treatment with MW-ACF
1	4190	3100	3280
2	TNTC	1870	2150
3	6500	TNTC	2390
4	TNTC	310	1000
5	2040	510	120
6	1120	895	ND

Table 4- comparison of Standard and MW-ACF colonies obtained on M-Endo Agar

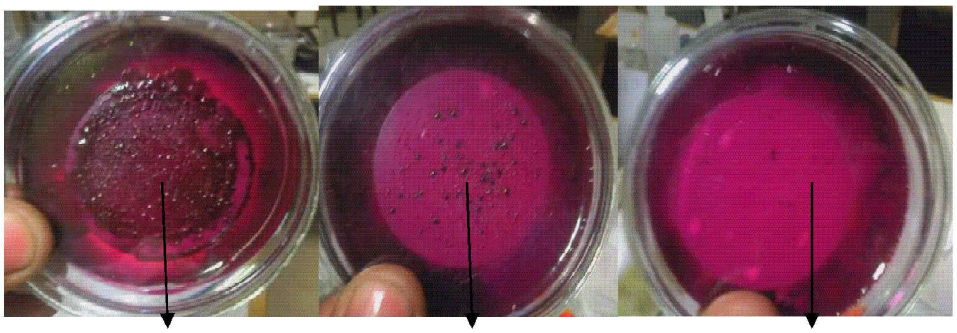

Figure1- Comparison of initial, standard and MW-ACF colonies on M-Endo Agar

bove figure shows CFU /100 ml in ACF-treatment was less as compared to treatment with standard.

Sample No.	Initial	Treatment with standard	Treatment with MW-ACF
1	TNTC	TNTC	TNTC
2	TNTC	TNTC	TNTC
3	TNTC	TNTC	TNTC
4	1058	1000	1000
5	TNTC	760	760
6	TNTC	157	432

Table 5 - comparison of Standard and MW-ACF colonies obtained on M-Fc Agar

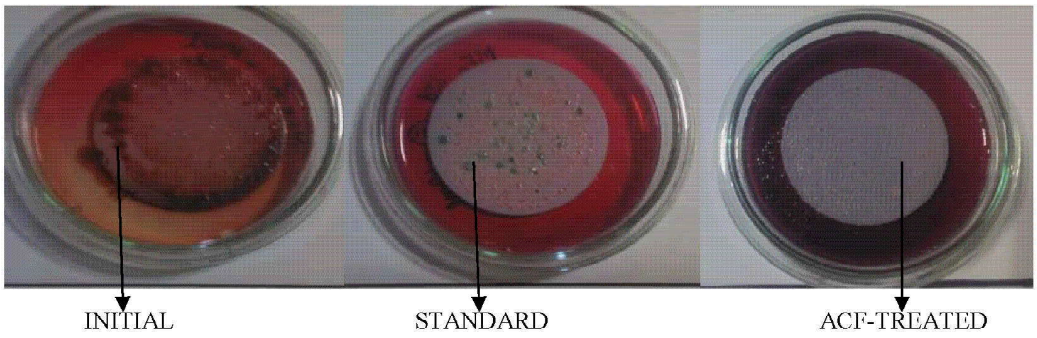

Figure2- Comparison of initial, standard and MW-ACF colonies on M-Fc Agar

Above figure show, ACF treatment was more effective than standard and show reduced no. of colonies than both initial and standard.

Sample No.	Initial	Treatment with standard	Treatment with MW-ACF
1	32	14	6
2	15	7	4
3	43	22	18
4	ND	8	ND
5	22	18	11
6	ND	15	4

Table 6- comparison of Standard and MW-ACF colonies obtained on SS Agar

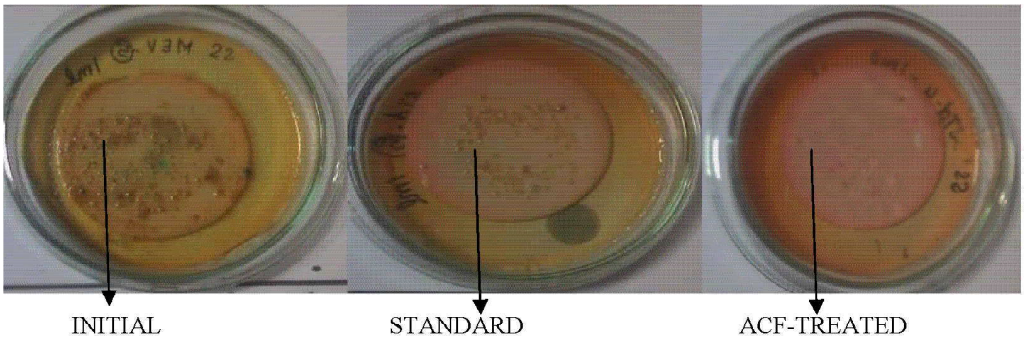

Figure3- Comparison of initial, standard and MW-ACF colonies on SS Agar

From above figure it was observed that, MW-ACF treatment was more effective as colonies constantly reduced from Initial to MW-ACF.

Sample No.	Initial	Treatment with standard	Treatment with MW-ACF
1	18	11	7
2	19	4	7
3	TNTC	TNTC	70
4	13	3	ND
5	10	ND	ND
6	ND	ND	ND

Table 7- comparison of Standard and MW-ACF colonies obtained on SNB Agar

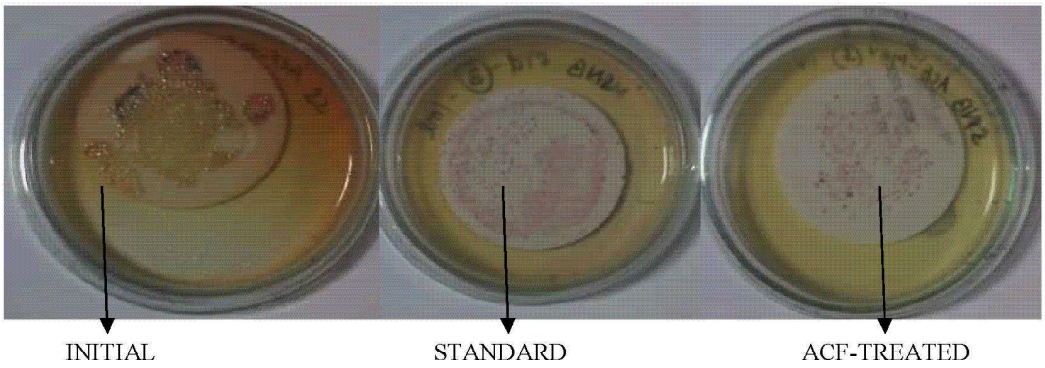

Figure4- Comparison of initial, standard and MW-ACF colonies on SNB Agar

Above figure shows CFU/ml was very less in MW-ACF than standard and initial.

Microbial analysis was carried out by MFT and selective media were used for study of indicator microorganism present in water. From the initial results, it was observed that all samples are contaminated with total coliform, fecal coliform, Salmonella, Shigella and Enterococci (See Table 1). These water samples are not safe for drinking.

When samples were treated with standard carbon and MW-ACF, the number of colonies was reduced as compare to initial number of colonies. (See table2and3). Comparative studies were carried out between standard carbon and MW-ACF. It was found that MW-ACF can effectively remove microbes of contaminated water samples. The activity of ACF is less as compared to standard in certain cases but reduces the no. of colonies as compare to initial. In some cases, especially for *Salmonella* and *Shigella* is very effective for reduction. (See table 4, 5, 6, 7)

Conclusion:

It is observed that Activated carbon Fabric is efficiently reduces various microbial contaminants such as total colifrom, faecal coliform, *Salmonella spp.* and *Shigella spp* of waterborne disease causing microorganisms from surface as well as ground water resources.

MW-ACF is capably removes *Salmonella, Shigella* and *Enterococci*.

It powerfully removes all microbial contaminants from groundwater as compared to surface water.

Recommendation:

Further treatment and modification of ACF-MW can help to enhance the quality of drinking water more effectively.

It is cost effective and Eco-friendly.

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Web Resources-

http://www.epa.gov/microbes/ (EPA methods on pathogens, parasites and indicator organisms)

http://www.cdc.gov/ (Center for disease control and prevention)