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Research article

MORINGA OLEIFERA – A POTENTIAL SOURCE FOR HARD WATER TREATMENT

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ABSTRACT: About 10 different drinking water samples of BDU, Tiruchirappalli were collected for the water analysis and treatment with natural product. The physico chemical and biological parameters such as colour, odour, taste, pH, acidity, alkalinity, total hardness, calcium, magnesium, chloride, nitrate, PO_4, SO_4, bacteria, and fungi were examined. The values were compared with Bureau of Indian Standard (BIS) values. The results revealed that the alkalinity, total hardness and chloride content of the water samples tested were more than the standard values. BDU samples were treated with *Moringa oleifera* to remove the hardness. Based the results obtained it was found that *Moringa oleifera* had the tendency to change the total hardness and reduce the microbial load.
Key words: Bureau of Indian Standard, *Moringa oleifera*, total hardness, water treatment, physico chemical nature.

INTRODUCTION

Water is essential for life. Water is one of the indispensable natural resources on earth. The fresh water present on the earth is only 2.8 percent. Out of all the waters on the earth 20 percent of the fresh water constitutes the ground water [1]. There are various sources of water like ponds, lakes, rivers, dams etc. available for the use of industrial, domestic and agricultural purposes. These water bodies get polluted due to the discharge of effluents from the industries, domestic waste, land and agricultural drainage. This results in the degradation of water quality of this water resource [2]. The rain water is also used during times of drought. Rain water systems, particularly those involving storage tanks, can be a relatively safe supply of water. The safe and accessibility of drinking water are major concerns throughout the world. Getting safe drinking water is the basic rights of all human beings. Water is used for several purposes by humans. The level of purity of the water consumed is very crucial since it has a direct effect on health [3]. Safe drinking water is one which does not cause any significant risk to health over a lifetime of consumption [4]. Surface water used for drinking and cooking purposes requires treatment because it is more vulnerable to contamination from activities occurring at the earth's surface. These contaminations are from human waste, livestock and other hazards at the source [5]. Hence purification process of drinking water was made by several researches and was aimed to alter turbidity, odor, colour, bacterial impurities, hardness and toxic elements. Drinking water purification is planned at industry level for domestic use. For the domestic purpose, commonly used water purifying methods include boiling, distillation, filtering, chlorination, passing ultraviolet light, using water softener and ozonenation [6].

The conventional method of water purification using aluminium sulphate and calcium hypochlorite puts pressure on the nation's over-burdened financial resources, since they are imported, thereby making treated water very expensive in most developing countries and beyond the reach of most rural folks. Hence, they resort to sources such as dams, dug outs, streams, rivers and lakes. Water from these sources is usually turbid and contaminated with microorganisms that cause many diseases like jaundice, diarrhoea, guinea worm and bilharzias [3]. According to [7], waterborne diseases are one of the main problems in developing countries particularly India. About 1.6 million people are compelled to use contaminated water and more than a million people die from diarrhoea each year [7].

Earlier research findings of Crapper et al. (1973) [8] and Miller et al. (1984) [9] showed that the chemicals used for water purification can cause serious health hazards if an error occurs in their administration during the treatment process. These reports suggested that a high level of aluminum in the brain is a risk factor for Alzheimer's disease. Hence there is always a search for novel water purification methods for water. Traditionally water is purified either by adding few herbals like *Osimum sanctum* leaf or seed coats of *Elettaria cardamom* or storing water in copper vessel [6].

Vetiveria zizanoides plant was reported for its ability to improve the water quality in terms of clearness and pleasant smell [10]. Herbals like *Strychnos potatorum, Moringa oleifera* and *Zee mays* had been reported for their ability to reduce alum in drinking water through its coagulation property [11]. Literatures of Indian Traditional Siddha Medicine also mention various methods to purify drinking water. One of the claims is that the water treated with the seed of *Moringa oleifera* become safe for drinking and healthy living [12]. Due to the high cost and solid waste produced by chemical and membrane filtration treatment technology for potable water an alternative method is the need of the hour. Such method must be ecofriendly and low cost. Therefore, this study is aimed to find out the role of plant based water treatment. The natural product *Moringa oleifera* seed was used to treat BDU Campus potable water. An attempt was made in this study to access the activity of *Moringa oleifera* on the removal of physio chemical and biological impurities present.

MATERIALS AND METHODS

Ten different water samples were collected from Bharathidasan University, Tiruchirappalli, Tamil Nadu from ten different sites (Table 1). The water samples were collected either from sump or bore well of the selected site in polythene bottles and were kept in room temperature till use. The samples were collected for three months viz. January, February and March 2010. The water samples were immediately brought to the laboratory to assess various physicochemical and biological parameters. Water temperature and pH were recorded at the time of sample collection, by using thermometer and pocket digital pH meter respectively. While other parameters such as hardness, chlorides, alkalinity, nitrate were estimated in the laboratory by standard methods as prescribed by APHA, (1998). Biological analysis was done for all the samples for 3 months before and after treatment. Biological characteristics of the collected water samples were analysed as per standard methods.

Table 1 Details of water samples studied

S. No.	Sample source	Code	Sampling site
1	Bore well	AB BW	Administrative block
2	Sump	AB S	Administrative block
3	Bore well	GD BW	Geology Department
4	Sump	GD S	Geology Department
5.	Bore well	H BW	Hostel (Girls)
6	Sump	H S	Hostel (Girls)
7	Bore well	Q BW	Quarters
8	Sump	Q S	Quarters
9	Bore well	BD BW	Botany department
10	Bore well	CDE BW	Center for distance education

Preparation of plant material

Good quality dried *Moringa oleifera (*drumstick) seeds were collected from local shop, Tiruchirappalli. Seed were cleaned and dried under shade. The wings and coat from the seeds were removed. Fine powder was prepared by using mortar and pestle and this powder was stored in air tight container and this was used for further study.

Treatment with *Moringa oleifera*

Water samples for study purpose were collected from bore well and sump water from ten different sites of Bharathidasan University (BDU), Tiruchirappalli. Treatment was given directly to the water by using *Moringa oleifera* powder at concentration of 50g/L and the treatment is for a period of 30 days. The physico chemical and biological parameters were checked before and after treatment.

RESULTS

The results revealed that physical character of BDU water samples collected from ten different sites reminded more or less same ie. the samples were colourless, odourless, and tasteless. The pH ranges between 7 to 7.6. The temperature of the samples were between 31^{o}C to 34^{o}C (Table 2). After treatment with *Moringa oleifera* (50g/l for 30 days) there was no appreciable changes in colour, odour, taste, temperatue and pH and they remaind the same (Table 2). On the other hand there was a change in chemical characters like acidity, alkalinity, total hardness, calcium, magnesium, chloride, nitrate, phosphate and sulphate (Table 3).

The acidity ranges between 150 – 400 mg/l in January 2010; 150 – 370 mg/l in February and 200 – 450mg/l in March 2010. The BD BW was less acidic in January (150 mg/l) and it was enhanced in March (250 mg/l). The sample collected from AB BW was more acidic in January (300mg/l) and it was elevated in March (450mg/l). Acidity was high in AB BW, GD S, and H BW in January (300 mg/l). The acidity of AB BW was maximum in March (450mg/l). On the other hand the alkalinity vary between 500 -900 in January and it was reduced in March (400 – 700 mg/l) (Table 2) from January to March in all the sample ABS BW and GD BW samples are less alkaline in March (400 mg/l) and BD BW it was more (700 mg/l).

Total hardness was maximum in March when compared to January and February. BD BW was less hard in January when compared to all other samples during January and March. CDE BW was maximum hard in January, February and March. Minerals like calcium, magnesium were also more in March compared to January and February. Chloride content was more in January compared to March. There was a minimum change in nitrate, phosphate and sulphate content in all 3 months of all the samples (Table 3).

Compared to the BIS the pH of the water samples analyzed was within the limit. Alkalinity, total hardness, calcium and chloride content of the samples were too high. Compared to BIS magnesium, nirate and sulphate was less. As the total hardness of the samples collected was beyond the limit the water samples were treated with plant product *Moringa oleifera*. The acidity of water was enhanced when the water samples were treated with *Moringa oleifera* and it was more than double in CDE BW and it was enhanced in March. (Table 4). Alkalinity of the samples before treatment was reduced from January to March. But when treated with *Moringa oleifera* it was reduced. Total hardness was reduced after treatment with *Moringa oleifera* and it is the same in the case of chloride also. Whereas minerals like calcium, magnesium and salts like nitrate, phosphate and sulphate were totally remored in samples treated with *Moringa oleifera* (Table 4). Bacterial population was there in all the samples and were as rod shape. Gram Positive bacteria was more than Gram negative (Table 5). After treatment with *Moringa oleifera* bacterial population was reduced to a greater extent. Some of the water samples collected do had fungal contamination in both treated and untreated (Table 7).

Table 2: Physical characters of BDU water samples

S.No	Sample Code	Physical Characters before treatment									Physical Characters after treatment with *Moringa oleifera*								
		Colour	Taste	Odour	Temp.			pH			Colour	Taste	Odour	Temp.			pH		
					Jan.	Feb.	Mar.	Jan.	Feb.	Mar.				Jan.	Feb.	Mar.	Jan.	Feb.	Mar.
1	AB BW	Colour less	Taste less	odourless	31°C	33°C	34°C	7.1	7.2	7.5	Colour less	Taste less	odourless	31°C	33°C	34°C	7.3	47.3	7.3
2	A S	Colour less	Taste less	odourless	31°C	33°C	34°C	7.4	7.4	7.4	Colour less	Taste less	odourless	31°C	33°C	34°C	7.4	7.4	7.4
3	GD BW	Colour less	Taste less	odourless	31°C	33°C	34°C	7.4	7.4	7.4	Colour less	Taste less	odourless	31°C	33°C	34°C	7.4	7.4	7.4
4	GD S	Colour less	Taste less	odourless	31°C	33°C	34°C	7.5	7.5	7.5	Colour less	Taste less	odourless	31°C	33°C	34°C	7.5	7.5	7.5
5	H BW	Colour less	Taste less	odourless	31°C	33°C	34°C	7.4	7.4	7.4	Colour less	Taste less	odourless	31°C	33°C	34°C	7.5	7.5	7.5
6	H S	Colour less	Taste less	odourless	31°C	33°C	34°C	7.4	7.4	7.4	Colour less	Taste less	odourless	31°C	33°C	34°C	7.5	7.5	7.5
7	Q B	Colour less	Taste less	odourless	31°C	33°C	34°C	7.5	7.5	7.5	Colour less	Taste less	odourless	31°C	33oC	34°C	7.4	7.4	7.4
8	Q S	Colour less	Taste less	odourless	31°C	33°C	34°C	7.5	7.5	7.5	Colour less	Taste less	odourless	31°C	33 oC	34°C	7.5	7.5	7.5
9	BD BW	Colour less	Taste less	odourless	31°C	33°C	34°C	7.6	7.6	7.6	Colour less	Taste less	odourless	31°C	33°C	34°C	7.6	7.6	7.6
10	CDE BW	Colour less	Taste less	odourless	31°C	33°C	34°C	7.5	7.5	7.5	Colour less	Taste less	odourless	31°C	33°C	34°C	7.5	7.5	7.5

Table 3: Chemical characters of BDU water samples – Before treatment

S.No	Sample Code	Chemical characters																										
		Acidity(mg/l)			Alkalinity (mg/l)			Total Hardness (mg/l)			Calcium (mg/l)			Magnesium (mg/l)			Chloride (mg/l)			Nitrate (mg/l)			Phosphate (mg/l)			Sulphate (mg/l)		
		Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar
1	AB BW	300	350	450	700	700	600	240	500	600	33	33	106	16	50	96	394	150	110	0.6	0.6	0.6	0.06	0.06	0.25	2.5	2.7	2.6
2	AB S	200	350	360	700	550	400	250	260	340	41	48	106	32	44	53	541	60	0.6	0.7	0.7	0.7	0.07	0.06	0.71	2.5	2.8	2.7
3	GD BW	250	250	300	600	550	400	220	260	340	41	52	114	26	44	61	46	45	40	0.7	0.7	0.8	0.07	0.06	0.71	2.5	2.8	2.7
4	GD S	300	260	300	700	550	500	200	280	360	49	48	82	27	37	44	98	120	120	0.6	0.7	0.7	0.11	0.11	0.11	2.8	3.0	2.9
5	H BW	300	370	200	500	600	600	260	520	620	49	56	82	40	51	106	438	100	90	0.9	0.8	0.7	0.59	0.06	0.60	2.8	3.1	3.0
6	H S	250	360	400	900	650	600	220	440	560	41	56	147	25	43	71	293	90	90	0.9	0.7	0.8	0.92	0.09	0.92	2.4	2.5	2.5
7	Q BW	250	250	300	900	650	600	200	220	280	49	56	90	30	37	42	130	90	70	0.6	0.6	0.9	0.63	0.65	0.65	2.9	2.9	3.0
8	Q S	200	250	300	900	700	500	240	280	320	41	56	188	40	48	62	102	100	100	0.7	0.9	0.8	0.38	0.03	0.39	2.9	3.0	3.0
9	BD BW	150	150	250	900	800	700	180	280	280	41	41	90	34	44	56	190	130	130	0.6	0.7	0.7	0.8	0.8	0.79	2.6	2.5	2.2
10	CDE BW	200	250	250	900	650	500	460	500	680	73	41	93	34	84	98	486	160	140	0.5	0.6	0.7	0.06	0.05	0.59	2.7	2.7	2.5

Table 4: Chemical characters of water samples treated with *Moringa oleifera*

S.No	Sample Code	Chemical characters																										
		Acidity (mg/l)			Alkalinity (mg/l)			Total Hardness (mg/l)			Calcium (mg/l)			Magnesium (mg/l)			Chloride (mg/l)			Nitrate (mg/l)			Phosphate (mg/l)			Sulphate(mg/l)		
		Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar
1	AB BW	350	350	650	500	500	500	-	140	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-
2	AB S	250	450	460	600	600	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	GD BW	470	450	400	500	400	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	GD S	350	370	500	400	300	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	H BW	470	460	450	600	500	400	-	140	-	-	-	-	-	-	-	80	-	-	-	-	-	-	-	-	-	-	-
6	H S	250	400	650	600	600	500	-	140	-	-	-	-	-	-	-	60	-	-	-	-	-	-	-	-	-	-	-
7	Q BW	350	450	650	600	400	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Q S	300	450	550	600	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	BD BW	250	260	350	700	600	600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	CDE BW	450	500	600	600	600	500	200	200	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-

Table 5: Bacteriological population of water samples before treatment

S.No	Sample code	Total No. of. isolates			No. of isolates analyzed			Gram's nature						Shape					
								Positive			Negative			Positive			Negative		
		Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar
1	AB BW	TNTC	21	15	10	5	5	1	0	0	0	2	0	1	0	0	0	2	0
2	A S	23	20	10	11	8	3	0	2	2	2	1	1	2	3	3	0	0	0
3	GD BW	59	30	10	25	13	6	1	1	1	0	2	0	1	3	1	0	0	0
4	GD S	TNTC	23	17	10	11	10	3	2	1	0	0	0	3	2	1	0	0	0
5	H BW	TNTC	TNTC	33	20	12	11	0	2	1	1	0	0	0	2	1	1	0	0
6	H S	TNTC	102	20	33	25	11	1	1	1	2	0	0	3	1	1	0	0	0
7	Q BW	50	20	10	21	9	2	2	0	0	0	0	0	2	0	0	0	0	0
8	Q S	82	42	24	40	10	7	1	1	1	0	0	0	1	1	1	0	0	0
9	BD BW	64	33	15	15	10	6	1	1	0	0	0	0	1	1	0	0	0	0
10	CDE BW	TNTC	45	12	25	12	9	1	1	1	0	1	0	1	2	1	0	0	0

Note: TNTC = Too Numerous to count; 0 = Absence

Table 6: Bacteriological population of water samples after treatment with *Moringa oleifera*

S.No	Sample code	Total No. of. isolates			No. of isolates analyzed			Gram's nature						Shape					
								Positive			Negative			Positive			Negative		
		Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar	Jan	Feb	Mar
1	AB BW	34	14	1	1	1	1	1	0	0	0	2	0	1	0	0	0	2	0
2	A S	20	12	6	4	1	2	0	2	2	2	1	1	2	3	3	0	0	0
3	GD BW	40	25	3	3	5	2	1	1	1	0	2	0	1	3	1	0	0	0
4	GD S	23	10	5	3	2	1	3	2	1	0	0	0	3	2	1	0	0	0
5	H BW	30	12	2	1	3	1	0	2	1	1	0	0	0	2	1	1	0	0
6	H S	20	9	6	3	1	1	1	1	1	2	0	0	3	1	1	0	0	0
7	Q BW	24	6	4	2	1	1	2	0	0	0	0	0	2	0	0	0	0	0
8	Q S	30	8	5	0	2	1	1	1	1	0	0	0	1	1	1	0	0	0
9	BD BW	13	5	2	2	2	1	1	1	0	0	0	0	1	1	0	0	0	0
10	CDE BW	64	30	20	1	2	0	1	1	1	0	1	0	1	2	1	0	0	0

Note: TNTC = Too numerous to count; 0 = Absence

Table 7: Fungal population of water samples before treatment

S.No	Sample Code	No. of fungal colonies			Colony morphology		
		Jan	Feb	Mar	Jan	Feb	Mar
1	AB BW	2	1	-	Dark green colour, round colonies	Grass green colour colony	-
2	AB S	-	-	-	-	-	-
3	GD BW	-	-	-	Green colour, round colony	-	-
4	GD S	-	1	-	-	White spongy, round colony	-
5	H BW	-	-	-	-	-	-
6	H S	-	-	-	-	-	-
7	Q BW	1	-	-	White spongy, round colony	-	-
8	Q S	-	-	-	-	-	-
9	BD BW	1	-	-	White puffy, round colony	-	-
10	CDE BW	1	-	-	White cotton like structure	-	-

Table 8: Fungal population of water samples after treatment with *Moringa oleifera*

S.No	Sample Code	No. of fungal colonies			Colony morphology		
		Jan	Feb	Mar	Jan	Feb	Mar
1	AB BW	-	1	-	-	Round white colour colony	-
2	AB S	-	-	-	-		-
3	GD BW	1	6	-	Dark green colour, round colony	Black colour, round colony, White cotton like structure.	-
4	GD S	-	1	-	-	Pale orange colour, round colony	-
5	H BW	-	-	-	-	-	-
6	H S	1	-	-	-	Black colour, round colony	-
7	Q BW	1	-	-	Round grass green colony	-	-
8	Q S	-	-	-	-	-	-
9	BD BW	-	-	-	-	-	-
10	CDE BW	-	-	-	-	-	-

Table 9: Bureau of Indian Standard) Values for the drinking water (BIS)

S.No	Parameters	Values
1	Colour	-
2	Odour	Nil
3	pH	6.5 – 8.5
4	Acidity	-
5	Alkalinity (mg/l)	50 – 200
6	Total hardness (mg/l)	300
7	Calcium (mg/l)	200
8	Magnesium (mg/l)	100
9	Chloride (mg/l)	250
10	Nitrate (mg/l)	20
11	Phosphate (mg/l)	-
12	Sulphate (mg/l)	400

DISCUSSION

The present investigation was carried out to analyse the ground water quality of ten different samples of Bharathidasan University campus, Tiruchirappalli, Tamil Nadu, India for a period of 3 months that is January, February and March 2010. Various physico chemical parameters like colour, odour, taste, temperature, pH, acidity, alkalinity, total hardness, calcium, magnesium, chloride, nitrate, phosphate, sulphate and biological parameters such as bacteria and fungi were examined. The results were compared with standard values prescribed by the Bureau of Indian Standard (BIS). The higher level of some physico chemical parameters such as alkalinity, total hardness and chloride may have ill effect and therefore an attempt was made in this study to reduce these parameters using bioproduct. The natural product of biological origin was selected in this study to reduce the hardness and biological impurities. The selected natural product is *Moringa oleifera* seed, as it is commonly practiced for drinking water treatment in many African countries [13] and in rural areas in India. Pure water is colourless. But water takes colour, when foreign substances such as organic matter of soil, vegetation, minerals and aquatic organisms are present along with it [14]. Most of the trade wastes discharged into water system have pronounced colours due to organic dyes and inorganic complexes. Water also becomes intensely coloured due to interaction between naturally occurring components in water and trade effluents which make it unsuitable for various purpose [15]. All the samples of this study was colourless. Coloured water is not aesthetically acceptable to the general public and luckily all our samples were colourless. Similar results have been reported [16] and [17]. Odour of water is caused both by chemical agents like hydrogen sulphide, free chlorine, ammonia, phenols, alcohols, esters, hydrocarbons and biological agents such as algae, fungi, microorganisms etc. [15]. All the BDU samples collected and analysed were odourless. Similar result was showed [18]. Unpleasant earthy or musty taste and odour are produced by industrial effluent containing iron, manganese, free chlorine, phenols and aquatic actinomycetes. The decomposed organic matter, algae, fungi, bacteria and pathogens impart peculiar taste [15]. But all the samples of this study was tasteless. Similar results were recorded [17]. Based on the physical characteristics of the water samples analyzed, the BDU water samples are recommended for potable purposes. pH is a measure of the hydrogen ion concentration, or more precisely the hydrogen ion activity. The desirable pH range of drinking water given by BIS is 6.5 – 8.5. The pH of the BDU samples tested was within the accepted level and hence these water samples are potable. Acidity may also arise due to the presence of mineral acids produced by the hydrolysis of salts of certain heavy metals such as $FeCl_2$ or Al_2 (So_4) [19]. There is no limit for acidity as per BIS, but it is indirectly controlled by the limits of pH values. The ranges of acidity in this study samples were between 150-470mg/L. Alkalinity is the measure of water's ability to neutralize acids or an expression of buffering capacity [14]. In this study, the alkalinity of all the samples exceeded the standard range. It may be due to the discharge of unwanted waste water and seepage from septic tanks and the dissolution of carbonates and bicarbonates. The values of alkalinity of water of all the samples were so high.

The samples of AB BW, CDE BW, H BW and H S showed high total hardness. Hardness, especially with the presence of magnesium sulphate can lead to the development of laxative effect on new consumers and cause scaling in pipelines. Calcium salts tend to cause incrustations on cooking utensils and water heaters. Hence is essential to soften the portable water [14].

Calcium is an essential element and human body requires it. Calcium is essential for normal plant growth and is desirable in water for irrigation [20]. All the samples of this study had the calcium levels within the standard. So these samples need not undergo treatment. Magnesium is an essential element for human beings. Magnesium is relatively non toxic to human. It is essential for normal plant growth [20]. All the samples under the study were suitable for drinking, since the value obtained does not exceed the standard level and hence the samples need not be treatment for magnesium. The BIS standard of chloride is 250 mg/L. Some of the samples of this study like AB BW, H BW, H S and CDE BW had concentration of chloride ions higher than the BIS standard values, that is, 394 mg/L, 438 mg/L, 293 mg/L and 486 mg/L respectively for the month of January. The reason could be the mixing of the water by sewage, infiltration, dissolution of chloride from soil and leaching of solid waste during rainfall. Hence it must be treated. Howard and Donald (1985) [21] also printed out the same.

Large amount of nitrate in drinking water is reported to be the cause for methamoglobinemia, a blood disorder which affects the infants under six months of age in particular. Researchers have also linked nitrate to stomach cancer, birth defects, hypertension, enlarged thyroid gland and lymphoma [21]. In this study the samples analyzed had nitrate and it was disappeared after treatment with *Moringa oleifera*. In aquatic environments, phosphorous is found in the form of phosphate. Major sources of phosphorous include phosphates in detergents, fertilizer and municipal waste water discharges [15]. The phosphorus content of this study samples were lower than that of BIS level before treatment and it went off after treatment with *Moringa oleifera.* Sulfur is required for the synthesis of proteins. The sulphate ions occurs naturally in most water supplies and is also present in waste water. Hydrogen sulphide in interceptor system can cause severe corrosion to pipes and appurtenances. In certain concentrations, it is also a deadly toxin, [14]. The sulphate content of all the samples of this study were well below the BIS values and disappeared after treatment with *Moringa oleifera*. BDU water samples were treated with *Moringa oleifera* and the bacterial and fungal population were analyzed and the results revealed that the bacterial and fungal load was reduced after treatment with *Moringa oleifera*. The reduction observed in the bacterial population of water treated with *Moringa oleifera* seed can be attributed by the antibacterial properties of the bioactive ingredient [13]. Narashima Rao et al (1984) [22] recorded similar observations with a component of pterygospermin present in flower. A number of bioactive agents that have been isolated from different parts of the *Moringa oleifera* may account for the reduction of microbial load. Raveendra Babu and Malay Chaudhri (2005) [23] also reported that the seeds of the plant species *Strychnous potatorum* and *Moringa oleifera* contain natural polyelectrolyte which can be used as coagulant to clarify turbid waters.

CONCLUSION

Overall results of the present study revealed that all the BDU water samples analyzed had higher alkalinity, total hardness and chloride content and was beyond the BIS standard values. The treatment of water using natural product *Moringa oleifera* seed resulted in the reduction of total hardness, bacteria and fungi. *Moringa oleifera* was effective in the removal of chemical impurities from the water samples. Likewise, *Moringa oleifera* was effective in the inhibition of fungal contamination. Since, the natural products are of low cost and are easily available they can be used to soften the water. From this study it can be concluded that the *Moringa oleifera* treatment is suitable for the removal of chemical impurities and microbial contaminations like bacteria and fungi.

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