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Effectiveness of herbs in community water treatment

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The primary objective of this study is to identify the most appropriate herbal plants for the removal of contaminants from water and also to develop a water treatment kit at an affordable cost for rural folk. Nearly seven herbs namely Neem, Moringa Oleifera, Vettiver, Nirmali, Luffa cylindrica and orange peel were chosen for this study. The effectiveness of these herbs in the removal of turbidity, total hardness, total dissolved solids (TDS), fluoride, chloride, calcium and magnesium has been investigated. The results obtained from this study satisfy the drinking water standards prescribed by World Health Organization (WHO).

Keywords: Herbs, dosage, turbidity, total dissolved solids, water treatment.

INTRODUCTION

Sustainability of good health of living organisms depends upon the purity of water. Because of its inherent dissolution capacity, water naturally picks up minerals and salt present in the earth crust during the runoff and percolation process. Water is used for several purposes by human beings and the level of purity of water consumed is very crucial as it has a direct and telling effect on health. Nearly 1.6 million people are constrained to use contaminated water and more than a million people die from diarrhea every year due to water borne diseases especially in developing countries (Postnote, 2002). In the conventional method of water purification, aluminium sulphate (alum) and calcium hypochlorite are used as water coagulants. These coagulants are more expensive and financially they prove to be an over-burden. The chemicals used for water purification can cause serious health hazards if they are erroneously administered in during the treatment process (Crapper et al., 1973; Miller et al., 1984) Another report says that the use of these chemicals may lead to neurological diseases (Martyn et al., 1989).

Moringa oleifera seed is an organic material that has proven effectiveness in treating water and successfully adopted for use in developing countries (Sutherland et al., 1989; Amagloh et al., 2009). The heavy metals and chemical contaminants are effectively removed by fruit peel (Wanna et al., 2009; Okieimen and Oneenkpa, 1989) and melon seed husk (Sunil Kumar et al., 2007; Robert Mathews et al., 2009). Neem oil (Michael et al., 2009). neem and luffa cylindrica extract (Robert Mathews et al., 2009) have also shown satisfactory results in the destruction of microorganisms.

The primary objective of this study is to identify the appropriate herbs for the removal of contaminants from water and to develop a water treatment kit which is economically viable, physically feasible and socially acceptable.

MATERIALS AND METHODS

Coagulants used

The herbs such as neem, moringa oleifera seed, moringa kernel, luffa cylindrica, nirmali and orange peel have been used in this experiment. The collected herbs are washed with formaldehyde wash and acid –alkaline wash (Jamode et al., 2004) in order to remove dust and other impurities (Sunil Kumar et al., 2007). Finally the washed herbs were prepared in powder form (Ghebremichael et al., 2005; Amagloh et al., 2009). They were the coagulants from herbs.

Experimental set-up

The jar test method was followed in this study. Raw sample was taken in a beaker of one litre volume. The herbal coagulant Moringa oleifera kernel was added **to** a beaker in varying quantities from 1 gm to 10gms (1gm, 2gm,4gm, 6gm and 8gm) This solution was mixed rapidly for 2 min followed by 15 min of gentle

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SI.No	Parameter	Raw water
1	Turbidity	32
2	рН	9.4
3	TDS	606
4	Total Hardness	116.035
5	Total Alkalinity	195
6	Chloride	234.04
7	Calcium	22.044
8	Magnesium	93.991
9	Iron	0.111
10	Fluoride	0.213

Table 1. Characteristics of Raw water sample

All are expressed in mg/l except pH

mixing. The suspensions were allowed to stand untill without any disturbance for a period of 1.5 hrs before determining the optimum dosage. Finally, the supernatant was filtered through Whatman filter paper for analysis. Similar procedure was carried out for other herbal coagulants like, Orange peel, Vetiver, Moringa oleifera seed, Luffa cylindrica, Neem and Nirmali and data were tabulated.

Measurements and analysis

The filtered water was subjected to pH, turbidity, total dissolved solids, total hardness, iron, fluoride, chloride, calcium, magnesium and alkalinity measurements. All analysis was carried out according to standard methods (APHA-AWA-WPCF, 1992).

RESULTS AND DISCUSSION

The performances of the herbals were studied on removal of water contaminants. In the first phase of the study, the herbals were used in raw form and their effectiveness was studied. The result of this study showed poor performance. In the second phase, the raw herbals are processed properly as per procedure. In this phase, herbal coagulants were added to raw water in different combinations and varying doses. The outcome of this study was elaborately presented and discussed in detail as explained in the following patterns.

(a) Use of appropriate herbal and its dosage

(b) Effectiveness of herbal coagulants on water contaminants removal

(c) Cost of herbals

The characteristics of raw sample used in this study are given in Table 1.

Effectiveness of Herbals on Turbidity

Turbidity removal from raw water by *moringa olifera kernel* under optimal condition was very high as compared with conventional coagulant such as aluminum salts (McConnachie et al., 1994) and other natural herbs used in this study. The effectiveness of herbs on reduction of turbidity is presented in figure 1. This figure shows that the *moringa olifera kernal* reduced the turbidity upto 90% with an optimum dosage of 4gm/lit. Using alum is likely to lead to cost reduction in the conventional water treatment and no threat to human life in the case of overdose as stated in the another finding (Crapper et al., 1973).

Effectiveness of Herbals on Hardness

The effectiveness of herbs on reduction of hardness is presented in figure 2. This figure shows that vettiver reduced the hardness more than 78% with an optimum dosage of 4gm/lit. The result from this study is clearly indicated that the moderate dose of *vettiver* is more effective in softening raw water. A comparison with previous study (Suleyman et al., 1995) the softening property of *vettiver* which was discovered in that study is the only one documented to date. The present study was therefore carried out to explore the potential use of *vettiver* for the removal of hardness from raw water.

Effectiveness of Herbals on Calcium

The effectiveness of herbs on reduction of calcium is presented in figure 3. This figure shows that *moringa olifera seed* has reduced calcium nearly 73% with an optimum dosage of 8 gm/lit. The results of this study has shown that *moringa olifera seed* has considerable potential to be used for the removal of calcium in small



Figure 1. Effectiveness of Herbals on Turbidity (Acid Alkaline Wash)



Figure 2. Effectiveness of Herbals on Hardness (Acid Alkaline Wash)



Figure 3. Effectiveness of Herbals on Calcium (Acid Alkaline Wash)



Figure 4. Effectiveness of Herbals on Magnesium (Acid Alkaline Wash)



Figure 5. Effectiveness of Herbals on Chlorides (Acid Alkaline Wash)

scale facilities. This seed as water purifiers may not constitute a serious health hazard (Berger et al., 1984).

Effectiveness of Herbals on Magnesium

The graphical representation on effectiveness of herbs on reduction of magnesium is given in figure.4. This figure shows that *vettiver* has reduced 90% of magnesium with an optimum dosage of 4 gm/lit. In the recent past an analytical study has also shown its unheard ability to absorb and to tolerate extreme levels of nutrients (Wagner et al., 2003) by *vettiver was* high.

Effectiveness of Herbals on Chlorides

The herbal coagulants used in this have less potential on removal of chlorides. The effectiveness of herbs on reduction of chloride is presented in figure 5. This figure shows that *luffa cylindrica* has reduced nearly 7.6% of chloride with an optimum dosage of 8 gm/lit. The interaction of seeds with chlorides is not fully understood and the product of interaction is not at all known. The result of this study revealed that further studies would therefore have to be carried out to provide insight into the interaction between *luffa cylindrica* and the constituents of raw water which are imparting alkalinity in raw water.

Effectiveness of Herbals on Alkalinity

This study has indicated that the *orange peel* is the most effective on the reduction of alkalinity over other herbals. This is graphically represented in figure.6. This figure shows that *orange peel* has reduced 80% of alkalinity with an optimum dosage of 8 gm/lit. Orange peel waste can be an alternate and favourable adsorbent for pollutants such dyes, heavy metals (Namasivayam et al., 1996). The present study reports that the possibility of using this herbs for the removal of alkalinity.

Effectiveness of Herbals on Iron

The effectiveness of herbals on reduction of iron is



Figure 6. Effectiveness of Herbals on Alkalinity (Formaldehyde Wash)



Figure 7. Effectiveness of Herbals on Iron (Formaldehyde Wash)

presented in figure 7 This figure shows that *Moringa oleifera kernel* has reduced 94% of iron with an optimum dosage of 1 gm/L. Because this seed contains lower molecular weight water-soluble proteins which carry a positive charge (Schwarz, 2000). According to the results presented in this figure, with minimum dosage of this herbal, the maximum removal of iron has been absorbed.

Effectiveness of Herbals on Fluoride

Fluoride is a cumulative poison. Chronic fluoride toxicity leads to bony and dental lesions that develop over a period of time (Ranjan et al., 2009). The effectiveness of herbs on reduction of fluoride is presented in figure 8. This figure shows that *Neem* has reduced 94% of fluoride with an optimum dosage of 2 gm/L. This study indicates that removal of fluoride from raw water is very high as compared with other works carried out (Sunil Kumat et al., 2007). It can be concluded that *neem* has some potential elements to mitigate the toxic effects of excess fluoride.

Effectiveness of Herbals on pH

The results obtained show that all herbal coagulants contain some coagulating properties. The pH values (7.29 to 7.89) obtained for the treatments were in the recommended standard set bv World Health Organization (WHO). The effectiveness of herbals on adjustment of pH is presented in figure 9. This figure shows that Moringa oleifera kernel has adjusted the pH of 7.63 with an optimum dosage of 1 gm/L. This offers support to earlier findings of the use of powder processes from Moringa as a coagulant in water purification system with an optimum dosage of 12 gm/L (Francis and Amos, 2009). This work has done a same job with very minimum dosage. This proved to be a positive outcome.

Effectiveness of Herbals on Total Dissolved Solids

onductivity which is a measure of total dissolved solids (TDS) in water varies considerably in different geographical regions owing to differences in the solu-



Figure 8. Effectiveness of Herbals on Fluoride (Acid Alkaline wash)



Figure 9. Effectiveness of Herbals on pH (Acid Alkaline Wash)



Figure 10. Effectiveness of Herbals on Total Dissolved Solids (Formaldehyde wash)

bility of minerals (Francis and Amos, 2009). As suggested by WHO (2006), there is no permissible value for it but high levels of it in drinking water may be objectionable to consumers. The experimental results showed that the performance of *luffa cylindrica was* highly significant on reduction of TDS. The effectiveness of herbals on reduction of total dissolved solids is presented in figure 10. This figure shows that *luffa cylindrica* has reduced 60% of total dissolved solids with an optimum dosage of 8gm/lit. The work has been done to investigate the potential existence of this herbal on an antimicrobial effects (Michael templeton et al., 2009) but no information on reduction of TDS in raw water. This study has found that *luffa* has achieved on TDS removal significantly besides its disinfecting property.

CONCLUSION

In the present study, the evaluation of herbals as a coagulant aid has been done to determine their efficacy in community water treatment. The following are the important findings of this work.

> The Acid-Alkaline washed *Moringa oleifera kernel* has removed 90% of turbidity with an optimum dosage of 4 gm/L.

> The Formaldehyde washed *luffa cylindrica* has removed 60% of TDS with an optimum dosage of 8 gm/L.

> The Acid-Alkaline washed *Moringa oleifera kernel* has improved the pH level nearly 7.63 with an optimum dosage of 1gm/L.

The Acid-Alkaline washed Vettiver was more effective on reduction of hardness more than 78% with an optimum dosage of 4gm/L

The Acid-Alkaline washed Moringa oleifera seed has removed 73% of Calcium with an optimum dosage of 8gm/L

> The Acid-Alkaline washed *Vettiver* has removed 90% of Magnesium with an optimum dosage of 4gm/L.

The Acid-Alkaline washed Luffa cylindrica has removed 7.6% of Chloride with an optimum dosage of 8gm/L.

> The Formaldehyde washed *orange peel* has removed nearly 80% of Alkalinity with an optimum dosage of 8gm/lit.

The Formaldehyde washed Moringa oleifera kernel has reduced 94% of Iron with an optimum dosage of 1gm/L.

The Acid-Alkaline washed Neem has removed 95% of Fluoride with an optimum dosage of 2gm/L

The herbs identified in this study can be highly recommended for domestic water purification in developing countries where people are drinking contaminated water. These herbs do not guarantee that the raw water ends up completely (100%) free from pathogenic microorganisms. They clean the water and make it drinkable but water is not completely purified. However they drastically reduce the number of suspended and dissolved particles.

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