Comparative Study of Fluoride Removal from Water by Using Muringa Oleifera and Thulsi (Ocimum Sanctum)

Aleena R Haneef and Nithya Kurup

Abstract—Fluoride is often described as a 'double – edged sword' as inadequate ingestion is associated with dental caries, where as excessive intake leads to dental, skeletal and soft tissue fluorosis –which has no cure. Considering the fact that fluorosis is an irreversible condition and has no cure, prevention is the only solution for this menace. Providing water, with optimal fluoride concentration is the only way by which the generation yet to be born can be totally protected against the disease. De fluoridation was the conventional and widely tested method for supplying safe water to the fluorosis affected by communities. Various techniques and materials were tried throughout the world for defluoridation of water. Among these methods, adsorption is the most effective and widely used method because it is universal, has a low maintenance cost, and is applicable for the removal of fluoride even at low concentrations. Now a day, bio sorption method is very effective technique for removal of fluoride. This technique involves the low cost adsorbents (also called bio sorbents) such as rice husk,bone charcoal, red mud etc. This study was aimed to investigate t the effect of MuringaOleifera and Tulsi leaves on the removal of fluoride from drinking water.

Index Terms—Fluoride, Fluorosis, De fluoridation, Adsorption, Bio sorption, Muringa Oleifera , Thulsi leaves

1. INTRODUCTION

Fluoride in drinking water has both beneficial and harmful effects on human health .Though fluoride in minute amounts is an essential component for bones and for the formation of dental enamel in animals and humans , its high concentration cause irreversible demineralization of bones and tooth tissues which is known as dental and skeletal fluorosis, damage to the brain, liver, and kidney, headache, skin rashes, bone cancer, and even death in extreme cases The maximum permissible limit of fluoride in water is 1.5 mg/l as per WHO standards (WHO 1984, 2004; BIS 1991). A variety of treatment procedures have been reported for the removal of excess fluoride from polluted waters based on precipitation ion exchange, reverse osmosis, nano filtration, membrane-based methods , electrocoagulation, and adsorption on to various adsorbents .

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The choice of the method depends on conditions like area, concentration, availability of resources, etc. Among all these techniques, adsorption methods have more advantages because of their greater accessibility, economical, ease of operation, and effectiveness in removing fluoride from water to the maximum extent. The need for simple, reliable and effective method of water treatment led to the application of plant materials, including seed of *Moringa oleifera* and Thulsi leaves. The root of Vetiveria zizanioides (Vetiver) is an effective adsorbent for the removal of fluoride from aqueous solution up to 80% [1].

Literature survey reveals that *Moriga oleifera*plant is the most inexpensive credible alternative for providing good nutrition and to cure and prevent a lot of disease.[2].Aqueous extract of *Moringa oleifera* showed strong and superior antibacterial activity against bacterial strains such as Staphylococcus aureus, Bacil-lus subtilis, Eschreiashia coli and Pseudomonas aeruginosa [3]. *Moringa oleifera*is the best natural

material that can replace aluminium sulphate (Alum) which is widely used all around the world [4]. Acid extract of natural polyelectrolyte *Moringa oleifera* seed is very effective as a coagulant for removal of fluoride from water [5]. Removal of turbidity and hardness can simultaneously be done by using *Moringa olieferas*eed extract with 1.0M sodium chloride solution (MO-Nacl) [6*]. Moringa olieferas*eed extract against E. coli by TVC method reduced >99.9% E.coli count [7]. Efficient reduction (80.0% to 99.5%) of high turbidity produces an aesthetically clear supernatant, con-currently accompanied by 90.00% to 99.99% bacterial reduction [8].

Thulsi is known for its medicinal value. Thulsi contains a number of beneficial compounds such as phytochemicals which possess antibacterial, antiviral, anti-oxidative and adaptogenic properties. Thulsi is used frequently in Ayurvedic medicine. One of its main uses is against colds and fevers. Thulsi is a mild anesthetic, and so it's great for minor aches, especially in the mouth and throat [9].

This study was an effort to investigate the water treatment potential of indigenous plants *Moringa oleifera* seeds and Thulsi leaves for removal of fluoride.

2. OBJECTIVES

The objectives of this study were

1. To identify the removal efficiency of various fluoride concentration in water using *Moringa oleifera* and Thulsi
2. To determine either *Moringa oleifera* or Thulsi which is most effective for fluoride removal.

3. MATERIALS AND METHODS

Adsorption is defined as the change in concentration at the interfacial layer between the two phases of a system due to surface forces. Adsorption is mass transfer operation in that a constituent in the liquid phase is transferred to solid phase. The adsorbate is substance that is being removed from the liquid phase and transferred to the solid phase. The adsorbent is the solid, liquid, or gas phase onto which the adsorbate accumulates. Factors affecting adsorption methods are i) Surface Area ii) Nature of the adsorbate iii) pH iv) Temperature v) Presence of mixed solutes and vi)Nature of adsorbent. The Moringa Oleifera tree grows in tropical and subtropical regions around the world and its seeds have been used in drinking water treatment in small scale in Sudan and India for generations. It is believed that the seed is an organic natural polymer. The active ingredients are dimeric proteins. The protein powder is stable and totally soluble in water [10].

In the present study synthetic sample is prepared and used for experimental purpose of defluoridation of water.

Thulsi also known as basil leaves, is a fairly common plant in Indian households. Considered holy by many religions, the tulsi plant is revered for its divine properties. Besides praying to the plant, Thulsi leaves can be used for water treatment.

3.1Preparation of MO Seed Powder

Dry MO seeds were collected from Kollam.Pod shells were removed manually; kernels were grounded in a domestic blender and sieved through 600micro meter stain-less steel sieve. Figures 1, 2 show the MO seed and seed powder.

Fig.1. *Moringa oleifera* seeds

Fig.2. *Moringa oleifera* seed powder

3.2 Preparation of Thulsi Leaves Powder

Thulsi leaves were plucked from the plant, washed with tap water and dried at room temperature. Leaves are crushed by using domestic blender and sieved through 600micro meter stain-less steel sieve.

Fig 3. *Thulsi* leaves powder

3.3 Water sample

Synthetic fluoride water sample is used. For preparing synthetic fluoride water sample anhydrous sodium fluoride (NaF) and distilled water were used.

4. ADSORPTION TEST BY USING SPECTROPHOTOMETER

The fluoride standard sample in the range of 1 mg/lit to 5 mg/lit was prepared by taking appropriate quantities of standard fluoride solution with distilled water. Then pipette 5 ml each of SPADNS solution and zirconyl acid solution to each standard and mixed well. Contamination avoided. The spectrophotometer was set to zero absorbance with reference solution and absorbance readings of standard were obtained. Reference solution was used as a blank solution. Spectrophotometer used at 570 nm wavelength was taken as per standard method procedure.

Table 1: Standard curve

ml .std solution	Fluoride ppm
blank	0
1	0.2
2	0.4
3	0.6
4	0.8
5	1

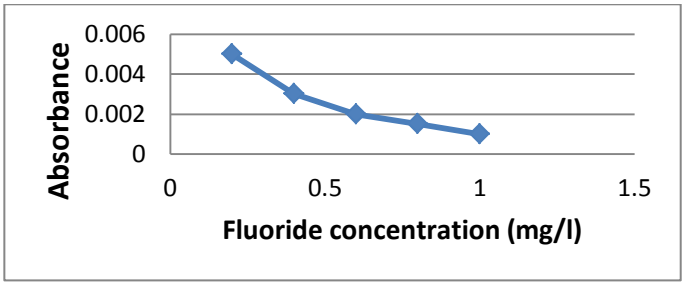

Fig 4. *Standard Curve*

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The fluoride removal studies by adsorption were conducted in 250 ml conical flask using 50 ml of synthetic water sample containing initial concentrations of fluoride ion concentration of 1 mg/l. In these conical flasks adsorbent with varied dosage was added. Then adsorbents and adsorbate are mixed by using a shaker revolving at 180 rpm for 20 minutes. After giving a required contact time, the contents of the flasks were filtered using Whatmann's filter paper number 41. The filtrate was used for fluoride ion estimation using SPADNS method. The above procedure was repeated for The adsorbent dosages used were 0.1 mg/lit to 0.5mg/lit in multiple of 0.1 mg/lit. The sample was checked for fluoride detection in spectrophotometer at wavelength 570nm. Absorbance readings were compared with standard curve and the removal efficiency was found .The parameters were varied to find the maximum fluoride removal efficiency and also to find out which is more effective either muringa or thulsi.

5. RESULTS AND DISCUSSION

It was seen that the removal of fluoride increases with an increase in the amount of adsorbent. For all the experiments, initial fluoride ion concentration was fixed at 1 mg/lit. The amount of adsorbent dose was varied from 0.1 mg/lit to 0.5 mg/lit in aqueous solutions. Results show that for Moringa Oleifera bioadsorbent, the maximum removal efficiency of fluoride was 40 % at 0.5 mg/lit whereas maximum removal efficiency of fluoride was 23% at 0.5 mg/lit by using Thulsi as adsorbent.

Table 2: Efficiency after Adsorption Using Thulsi leaves as Adsorbent

Adsorbent dose mg/l	Initial Fluoride Conc. mg/l	Final Fluoride Conc. mg/l	% Removal Efficiency
0.1	1	0.92	8
0.2	1	0.90	10
0.3	1	0.86	14
04	1	0.81	19
0.5	1	0.77	23

Table 3: Efficiency after Adsorption Using Muringa seed as Adsorbent

Adsorbent dose mg/l	Initial Fluoride Conc. mg/l	Final Fluoride Conc. mg/l	% Removal Efficiency
0.1	1	0.82	18
0.2	1	0.76	24
0.3	1	0.71	29
0.4	1	0.66	34
0.5	1	0.60	40

6. CONCLUSION

Based on the present study following conclusions are drawn.

1. Use of the Moringa Oleifera seed powder and Thulsi leaves as bio adsorbent for removal of fluoride is feasible.
2. Muringa Oleifera seed powder was found better than Thulsi leaves for fluoride ion removal.
3. The removal by adsorption increases with increase in adsorbent dose.

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