

A study on removal of fluoride from water using natural coagulants

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ABSTRACT

The ground water in India is contaminated by fluoride that creating health problems in many people including children. In India, many states are affected by high concentration of fluoride that cause dental, skeletal and/or non-skeletal fluorosis. The concentration of fluoride beyond desirable amounts of 0.5 to 1.5 mg/l in ground water cause major problem in the world. In Tamil Nadu, the concentration of fluoride is assessed throughout the State twice in a year – during pre-monsoon and post monsoon periods. This study focus on one of the fluoride contaminated area in Tamil Nadu-Salem district. In this paper, the initial concentration of fluoride from groundwater is measured and it has been treated with using Moringa Oleifera seeds and Rice Husk as coagulants. The efficiency of treated ground water with Rice Husk has been compared with Moringa Oleifera seeds and results were brought out in this study.

Keywords: Fluoride, Skeletal fluorosis, Coagulants, Moringa Oleifera and Rice husk.

1. INTRODUCTION

Ground water plays an important role in augmenting water supply to meet the ever increasing demands for various domestic, agricultural and industrial uses. Though the distribution and quality aspect of ground water is uncertain, its advantage is that it is almost available in all places and needs little treatment to make it free from pollutants. Almost 90% of Indian population depends on ground water for their daily needs. The increased population and industrial growth has not only increased the exploitation of groundwater but have also contributed towards the declining water quality. Therefore the preservation and the improvement of ground water qualities are vital importance for human wellbeing and also for the sustainability of clean environment.

Study Area: Salem district has tropical climate and its mean annual temperature ranges from 24.3° C to 32.9° C. The humidity level range from 65 to 84%. Thadanur, Palampatti, Maiyanur, Veerapandi and Thirumalagiri were chosen to collect water samples.

Table.1.Location of collected samples

Name of the sample location	Latitude	Longitude
Salem- Thadanur	11° 32' 15"	78° 50' 10"
Salem –Palampatti	11° 48' 19"	78° 25' 42"
Salem – Maiyanur	11° 22' 35"	78° 31' 05"
Salem- Veerapandi	11° 55' 53"	78° 12' 16"
Salem –Thirumalagiri	11° 15' 42"	78° 44' 29"

Collection of Samples: Clean white (5000 Litre capacity) leak proof container is used to collect the samples. Before sample collection, the container was rinsed with the water to be sampled three times. A polythene sheet was placed over the cap and tied with a rubber band to avoid any leaks. The location from where the sample was collected was written on the container.

2. MATERIALS AND METHODS

This paper suggests certain low cost materials as effective coagulant for fluoride removal. The natural coagulants primarily screened were *Moringa oleifera* and Rice husk. Initially, 1gm of each adsorbents are added in 100 ml of Fluoride solution. The following procedure is adopted for the preparation of natural coagulants before the experimental testing.

Rice Husk: Rice husk was partially carbonized at 250°C to 300°C in oven for a duration of 4 to 5 hours. And then it is completely carbonized in muffle furnace at temperature 500°C to 600°C then it was cooled to room temperature. Post that it was then washed repeatedly with hot boiling water so as to open the pores of carbon. Completely carbonized rice husk was further treated by acid treatment. Rice husk biomass, mixed with IN HNO₃ (nitric acid) in 1: 1 ratio, was taken in a 1000 ml conical flask. The mixture then moulded and heated to 600°C to 700°C in muffle furnace. Treated biomass was washed with distilled water. Washing was done until maximum colour was removed and clear water obtained.

Moringa oleifera: Dried *Moringa oleifera* seeds were kept in an oven at 500°C for 12 hrs. The seeds were made into powder and passed through 75 µ sieve to get uniform size. In order to obtain an extract of Moringa Oleifera nut powder first 10 g of Moringa powder was suspended in HCl and NaOH solution of normality and observed visually for dissolution of Moringa Oleifera powder. It was observed that 0.5N HCl was more effective in dissolving Moringa Oleifera powder.

Treatment with *Moringa oleifera* and rice husk: The processed rice husk was powdered and a known quantity i.e. 1gm, 2gm, 3gm, 4gm, 5gm was weighed and added to 250ml of collected water sample each. This was stirred continuously at 50rpm for about 30min. After that it was allowed to settle for about duration of 1hr. it was filtered using filter paper and was tested for final concentration of fluoride and other parameters.

A processed *Moringa oleifera* seed was weighed into 1.44gm, 1.48gm, 1.52gm, 1.56gm and 1.6 gm. This was added in 250ml of our collected water samples. This was stirred continuously at 50rpm for about 30 minutes. After that the solution was allowed to stand of about 1hr for settlement then it was filtered using filter paper. The filtrate was tested and measure the concentration of fluoride after treatment with *Moringa oleifera* seed.

3. RESULTS

The amount of fluoride present in the collected sample before and after treatment with various dosage coagulants (Rice husk and *Moringa oleifera*) has been tabulated in Table 2 and Table 3.

Table.2. Removal Efficiency of fluoride using processed rice husk

Location of Sample	Initial Fluoride concentration in mg/l		Quantity of processed Rice husk added as coagulant per 250ml sample				
			2 gm	3 gm	4 gm	5 gm	6 gm
Sample.1: Thadanur	2.03	Final Fluoride concentration in mg/l	1.49	1.38	1.12	0.46	0.31
		% Removal	27%	32%	45%	77%	85%
Sample.2: Palampatti	1.75	Final Fluoride concentration in mg/l	1.42	1.29	0.88	0.39	0.19
		% Removal	19%	26%	50%	78%	89%
Sample.3: Maiyanur	2.32	Final Fluoride concentration in mg/l	1.72	1.42	1.26	0.25	0.37
		% Removal	26%	39%	46%	89%	84%
Sample.4: Veerrapandy	1.92	Final Fluoride concentration in mg/l	1.6	1.34	1.05	0.26	0.22
		% Removal	17%	30%	45%	86%	89%
Sample.5: Tirumalagiri	1.73	Final Fluoride concentration in mg/l	1.31	1.4	0.97	0.19	0.05
		% Removal	24%	19%	44%	89%	97%

The above table shows that the concentration of fluoride before treatment for all the samples is not within the desirable limit (i.e.0.5-1.5mg/l). It is also seen that after processing with variable dosage of rice husk the fluoride concentration is considerably reduced but only 3 grams and 4 grams of dosage per 250ml of sample was found to be more efficient in reducing the fluoride concentration within 1.5 mg/l and maintained a minimum concentration of 0.5mg/l.

Table.3. Removal Efficiency of fluoride using processed *Moringa oleifera*

Location of Sample	Initial Fluoride concentration in mg/l		Quantity of processed <i>Moringa oleifera</i> added as coagulant per 250ml sample				
			1.44 gm	1.48 gm	1.52 gm	1.56 gm	1.6 gm
Sample.1: Thadanur	2.03	Final Fluoride concentration in mg/l	1.51	1.46	1.03	0.28	0.16
		% Removal	26%	28%	49%	86%	92%
Sample.2: Palampatti	1.75	Final Fluoride concentration in mg/l	1.55	1.44	0.95	0.31	0.13
		% Removal	11%	18%	46%	82%	93%
Sample.3: Maiyanur	2.32	Final Fluoride concentration in mg/l	1.53	1.47	1.07	0.25	0.07
		% Removal	34%	37%	54%	89%	97%
Sample.4: Veerrapandy	1.92	Final Fluoride concentration in mg/l	1.56	1.43	0.98	0.23	0.09
		% Removal	19%	26%	49%	88%	95%
Sample.5: Tirumalagiri	1.73	Final Fluoride concentration in mg/l	1.5	1.48	0.91	0.21	0.12
		% Removal	13%	14%	47%	88%	93%

The above table shows that the initial amount of fluoride for the samples is not within the desirable limit (i.e.0.5-1.5mg/l). It is also seen that after processing with variable dosage of *Moringa Oleifera*, the concentration of fluoride

is considerably reduced but only 1.48 grams and 1.52 grams of dosage per 250ml of sample was found to be more efficient in reducing the amount of fluoride within 1.5 mg/l and maintained a minimum concentration of 0.5mg/l.

4. CONCLUSION

From the study of groundwater in the 5 locations in Salem, it can be concluded that the amount of fluoride in the ground water is higher than the permissible limit (i.e.0.5-1.5mg/l) for drinking water. Direct consumption of this water by the local people may lead to skeletal fluorosis. This water has to be treated such that the fluoride concentration is reduced within the permissible limit before consumption. In the tests conducted, it was found that the natural products (rice husk and *Moringa oleifera*) are suitable in reducing fluoride concentration. Also it was observed that both the products left residual fluoride of 0.5mg/l which is necessary in drinking water to prevent dental fluorosis. Comparing both materials used, it has been found that *Moringa oleifera* was more efficient in reducing the fluoride concentration from the ground water sample, showing a efficiency of 52.87% which compared to the efficiency of Rice Husk having 49.71%. It was also observed that the treated water using natural coagulant materials such as rice husk and *Moringa oleifera* maintained other drinking water characteristics such as colour, turbidity, pH, odour within the drinking water quality standards.

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