



Defluoridation of Contaminated Groundwater by using *Ocimum Tenuiflorum* (Tulsi) Leaves

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Abstract: It is well known that nature has bestowed upon us a large variety of medicinal herbs which are used to cure many diseases. The entire field of ayurveda revolves around this. *Ocimum tenuiflorum* or *Ocimum Sanctum* (Tulsi or holy basil) also known as “the queen of herbs” has been used from over thousand years in ayurveda for its diverse healing property. The present investigations aimed at to study the adoptability of tulsi leaves to treat fluoride fed ground water. Tulsi in the forms as fresh leaves, dried powder is used in experiments. The results showed that more than 50% of the fluoride is effectively removed with contact time 240 minutes and 50 mg when used in powder form.

Keywords: Tulsi, ayurveda, ground water, defluoridation.

I. Introduction

The earth's surface is composed of 75% water of which approximately 3% constitute ground water. Ground water being the major source of drinking water, it plays a pivotal role as drinking water for all human beings. However, due to various geographical factors and undulation in the surface of earth, the quality of ground water differs from place to place. It may be contaminated with chemical pollutants such as fluoride, chlorides, nitrates, etc. High fluoride concentrations in India, Pakistan, West Africa, Thailand, China, Sri Lanka, and Southern Africa has been reported due to presence of igneous and metamorphic rocks like granites and gneisses [14]. Central ground water Board of India [2] quotes that “The fluoride content in ground water from observation wells in a major part of the country is found to be less than 1.0 mg/l. It is observed that there are several locations in the States of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Rajasthan, Chhattisgarh, Haryana, Orissa, Punjab, Haryana, Uttar Pradesh West Bengal, Bihar, Delhi, Jharkhand, Maharashtra, and Assam where the fluoride in ground water exceeds 1.5 mg/l”. There are many techniques available to reduce concentration of fluoride [1]. Since *Ocimum tenuiflorum* or *Ocimum Sanctum* (Tulsi or holy basil) leaves had been used from ages as a water cleanser [3], some investigators [3] have experimented with it for removal of fluoride. Bhattacharjee [13] utilized natural herbs, tulsi leaf and neem leaf for fluoride content reduction and coliform reduction in water samples by aqueous leaf extract. *Ocimum sanctum* and *Azadirachta indica* showed increase in antimicrobial activity with increase in concentration at specified contact time (18hrs).

II. STUDY AREA

Tumkur district is one among the fluoride fed ground water area [2]. Hence the present investigation has been taken up in that district by selecting three taluks (TQ), namely Madhugiri, Koratagere and Pavagada. Madhugiri (TQ) is located south eastern corner of Karnataka between 13° 39' 30" north latitude and 77° 12' 34" east longitude. Koratagere (TQ) is located south eastern corner of Karnataka state between west 13° 13' 00" north latitude and 77° 14' 30" east longitude. Pavagada (TQ) is located south eastern corner of Karnataka state between west 14° 10' 15" north latitude and 77° 17' 30" east longitude. The total population of the three taluks is 18 lakhs, the employment opportunities in the above taluks are animal husbandry, agriculture and horticulture. The geographical surface in the above three taluks is mainly constituted of igneous rocks. Due to natural geologic formation, the maximum fluoride content in ground water in some of the area is found to be around 4ppm. The Fig. 1 shows the location of study area.

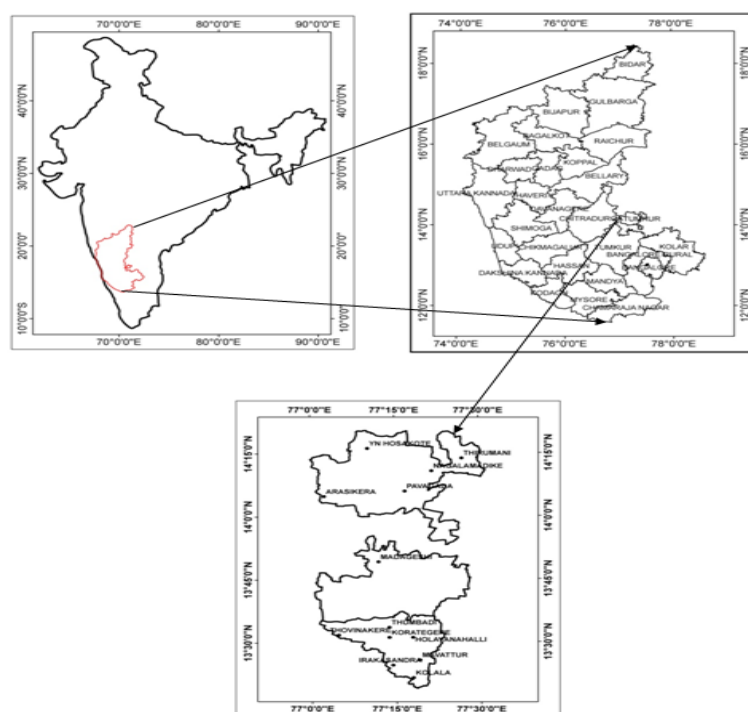


Fig. 1 Location of Study area

III. MATERIALS AND METHODOLOGY:

Ground water samples were collected in clean polythene bottle (brown et al, 1974) [12] from 6 different locations consisting of 2 location from each of the above mentioned taluks. Table 1 gives the location of sample collection and concentration of fluoride in three taluks.

Table 1 Location of sampling Points and Fluoride concentration

Sl No.	Taluk	Sampling Location	Latitude	Longitude	Fluoride concentration (mg/l)
1	Koratagere	Holavanahalli	13.45	76.98	3.6
		Thovanakere	13.25	77.5	3.9
2	Madhugiri	Nitterahalli	13.66	77.25	3
		Reddihalli	13.95	77.18	4.5
3	Pavagada	Nagalamadike	14.6	77.25	4.5
		Rangasamudra	14.25	77.5	3.65

Ocimum tenuiflorum or *Ocimum Sanctum* (Tulsi or holy basil) in the form leaves and powder were considered for the investigation. The studies were carried out with four contact time intervals varying from 60 to 240 minutes. To a 100 ml of sample (raw /bore well water), 100 and 150 mg of tulsi leaves were added for the observation. Similarly the experiments were repeated by adding 50 mg of leaves power for the samples.

IV. RESULTS AND DISCUSSION:

The laboratory scale experiments were conducted to investigate the ability removal capacity of fluoride by *Ocimum tenuiflorum* leaves and leaves powder for the variables as stated above. Figures 2 to 7 show the adsorption capacity of *Ocimum tenuiflorum* leaves on various samples. It can be observed from the variations that, in general, reduction of fluoride increases with contact time. The leaves in powder form show better efficiency than fresh leaves due to availability of high surface area for adsorption. Over all, the analysis shows that the concentration of fluoride ion reduces approximately up to 50% in 4 hours. A close analysis of the graphs shows that the trend of reduction of fluoride is more or less similar in all the study areas with respect. But when it is analysed in a group wise of taluks, the samples collected from Pavagada showed very less variation with respect forms of *Ocimum tenuiflorum* leaves. Reddihalli also deviated little from other trends. Fluoride concentration does not reduce by 50% because of interaction of higher concentration of dissolved salts such as carbonates and bicarbonates of calcium (100.8mg/l) and magnesium (47mg/l). Higher concentration of microorganisms and anions such as calcium sulphate and nitrate would also play a significant role in inhibiting the reduction of fluoride ions. Further investigations are in progress to find the cause.

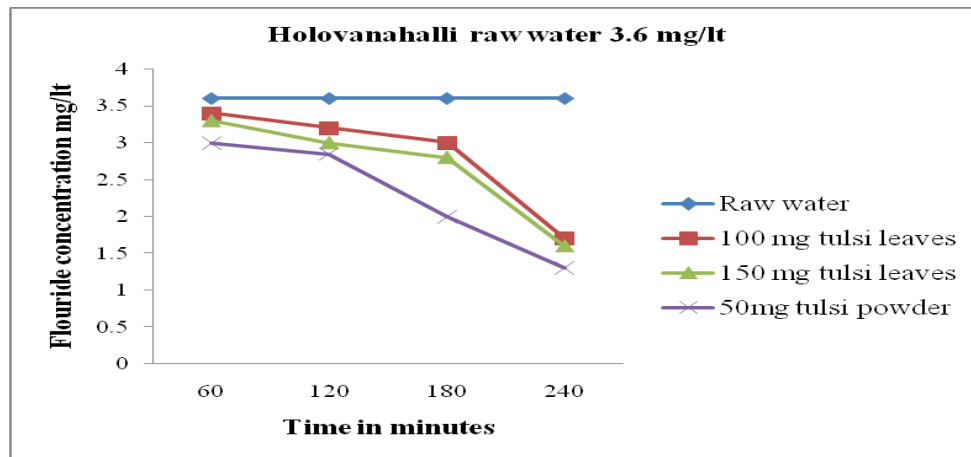


Figure 2 Fluoride concentration in ground water and ground water mixed with thulsi leaves and tulsi powder in Holovanahalli

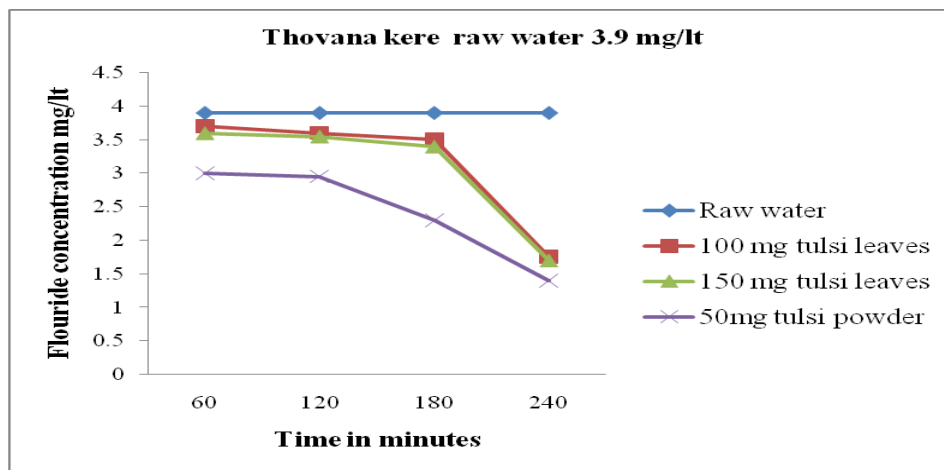


Figure 3 Fluoride concentration in ground water and ground water mixed with thulsi leaves and tulsi powder in Thovanakere

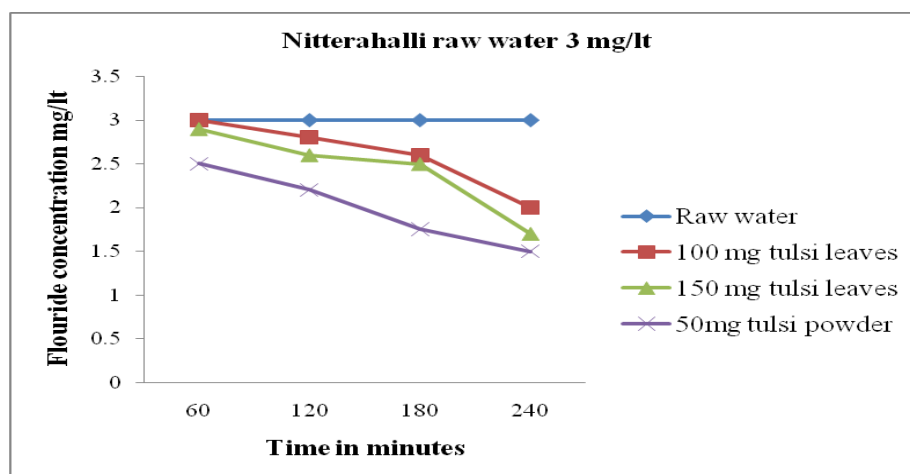


Figure 4 Fluoride concentration in ground water and ground water mixed with thulsi leaves and tulsi powder in Nitterah

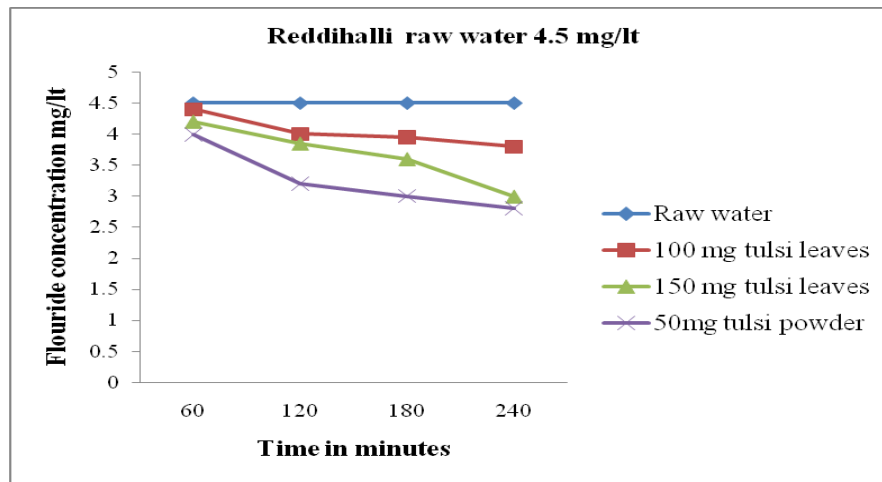


Figure 5 Fluoride concentration in ground water and ground water mixed with tulsi leaves and tulsi powder in Reddihalli

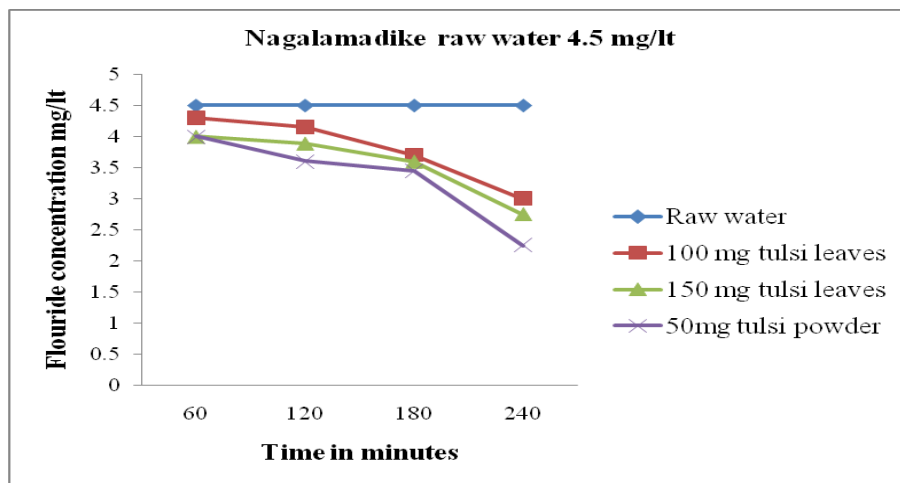


Figure 6 Fluoride concentration in ground water and ground water mixed with tulsi leaves and tulsi powder in Nagalamadike

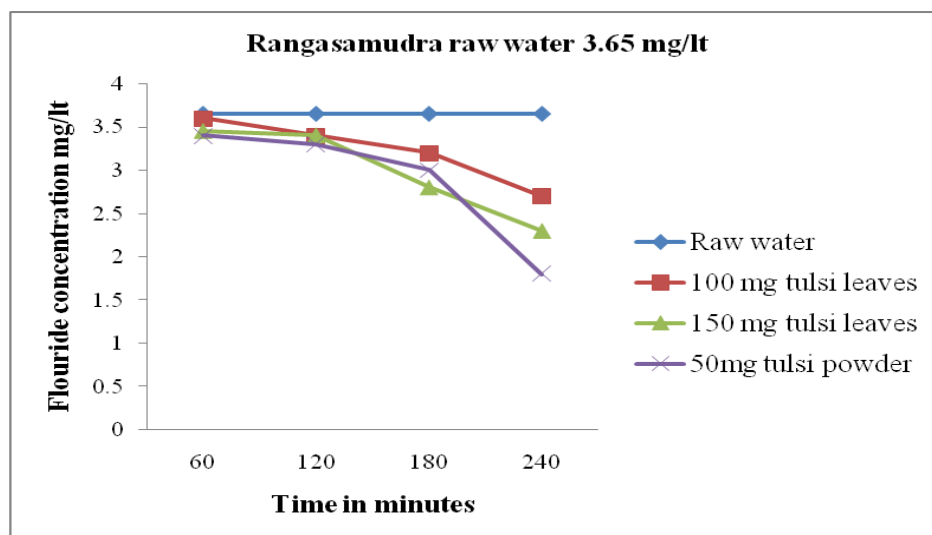


Figure 7 Fluoride concentration in ground water and ground water mixed with tulsi leaves and tulsi powder in Rangasamudra

The following conclusions can be drawn from our study.

1. *Ocimum tenuiflorum* leaves are found to be effective adsorbent to reduce fluoride from ground water.
2. Around 50% of reduction was achieved with adsorbent as powder form
3. Possible interference from other constituents of ground water could be the reason in some of the samples for less efficiency
4. Overall, this method is cost efficient and easily accessible to the common man.

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