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# Estimation of Fluoride in Water in and around Vriddhachalam Taluk Cuddalore District and Defluoridation using Amla (*Emblica officianalis*) Leaves and Stem Powder

K. MURUGESAN AND M. V. RADHAKRISHNAN*

*Department of Zoology, Annamalai University*
*Annamalainagar 608002, India*
*E-mail : radkisnan@yahoo.co.in*
**Correspondence*

**Abstract**

Unlike other pollutants, fluoride is being contributed to drinking water from natural sources namely the rocks containing the ores of fluoride. Drinking water samples were collected from 40 different stations in and around Vriddhachalam for a time period of 6 months extending from March to December 2007. The fluoride content was found to vary between a minimum of 1.85 ppm to a maximum of 2.85 ppm. Removal of fluoride was tried using the powder of amla leaves and stem. Aqueous fluoride solutions containing 2, 3 and 4 ppm of fluoride were subjected for the experiment. These results show that the stem powder of amla (100 mg/50 ml) has been efficient in removing 45% fluoride at 2 ppm concentration than the leaf powder (21%). The absorption capacity was found to decrease with an increase in fluoride concentration.
**Key words : Fluoride, Defluoridation, Amla, *Emblica officianalis*.**

Ground water is one of the most vital resources, which is contributing a major share in meeting the requirements of domestic, industrial and agricultural needs. Drinking water is particularly sensitive in the context of quantity and quality. Its demand is uniform in time and space. Depletion of ground water level and deterioration of ground water quality are the major problems implementing water supply schemes in rural areas. The increase in development of ground water to satisfy the ever-increasing needs of a growing population has put a severe stress on the limited resources available in many parts of the country. The near-complete utilize of surface water resources in many states and the vagaries of monsoon have resulted in ground water resources being considered as a more dependable source for irrigation, industries and domestic sectors. The indiscriminate development of ground water has led to its over-exploitation in many areas, resulting in drying up of shallow dug wells/tube wells/bore wells, long-term decline of ground water levels leading to increased consumption of power for lifting water from greater depths, threat of saline water ingress in coastal aquifers. It is in this context that the need for conserving ground water resources in the denaturized aquifer zones through suitably designed artificial recharge/ground water conservation structures becomes important (1). The groundwater quality has become an area of increasing environmental concern contrasted with surface water. Groundwater pollution is difficult to control and it may persist for decades if once polluted. Naturally associated in nature with a few types of sedimentary or igneous rocks, fluoride is seldom found in appreciable quantities in surface waters and appears in ground water in only a few geographical regions. Fluoride is toxic to humans and other animals in large quantities, while small concentration can be beneficial. Excessive in take of fluoride can result in discoloration of teeth. A noticeable discoloration called Mottling is relatively common when fluoride concentrations in drinking water exceed 2.0 mg/liter. When concentration is less than 1.5 mg/liter, adult teeth are not affected by fluoride, although both the benefits and liabilities of fluoride during tooth formation through years carry over till adulthood. Excessive dosages of fluoride can also result in bone fluoride and other skeletal abnormalities. Abnormal content in drinking water causes skeletal disorders in different vertebrates including man (2—4). Few controversial reports regarding soft tis-

**Table 1.** Concentration of fluoride in drinking water samples from areas located in north, east, west and south direction of Vriddhachalam from March 2007—December 2007. Values are X ± SE, 10 samples from each area.

| Sampling stations | Concentration of fluoride (ppm) |
|---|---|
| North | 2.24 ± 0.02 |
| East | 1.85 ± 0.03 |
| West | 2.25 ± 0.01 |
| South | 2.85 ± 0.03 |

sues like muscles and gonads damage due to fluoride intoxication is also available (5, 6). The presence of high concentration of fluoride make the ground wates unsuitable for drinking purpose and hence require immediate measures for alternative source or to undertake defluoridation process of the ground waters so as to protect the people from the fluoride effects. Hence the present study was designed to reduce the excess fluoride from the drinking water which will be beneficial to health. Hence an attempt was also made to find out an efficient and economical defluoridizing technique by using the low cost and edible plant material namely amla (*Emblica officinalis*) leaves and stems.

## Methods

The study was made in different areas in and around Vriddhachalam taluk, Cuddalore District, Tamil Nadu. The data were collected during the study period extended from March 2007—December 2007. Immediately after collection, each sample bottle was labeled with marker. The samples were taken to the laboratory as early as possible. The bottles were protected from direct sunlight during transportation. Estimation of fluoride was done by Spadn's method (7). For the removal of fluoride from water, low cost plant material, amla (*Emblica officinalis*) leaves and stem powder were used. The leaves and stems were washed with distilled water to remove the impurities. They were dried separately and powdered, then seived through ASTM 30 to get a uniform size. They were stored in air tight containers. For deflouridation about 50 ml of 2, 3 and 4 ppm of fluoride solutions were taken in 100 ml conical flasks and 100 mg of leaf and stem powder (adsorbents) were added, mixed well and

**Table 2.** Percentage of fluoride removal by amla (*Emblica officianalis*) leaves and stem from 2, 3 and 4 ppm fluoride solutions.

| Adsorbents | Weight of adsorbents (mg/50 ml) | Percentage of fluoride reduction (ppm) 2 | 3 | 4 |
|---|---|---|---|---|
| Leaves | 100 | 21 | 17 | 12 |
| Stem | 100 | 45 | 34 | 31 |

kept for 24 hours. Then the sample was filtered and the amount of fluoride was estimated using Spadn's method (7). The percentage reduction of fluoride was found out using the standard graph.

## Results and Discussion

The drinking water samples were collected from 40 deep bore wells in and around Vriddhachalam (Table 1). The amount of fluoride varied from 1.85 to 2.85 ppm. Similar studies in Tamil Nadu villages have shown the presence of fluoride in a range of 2—6.4 ppm mostly resulting in mild to severe dental fluorosis. (8). Prabhavathi et al. (9) has reported the maximum fluoride concentration of 1.6 ppm and a minimum of 0.1 ppm from 50 water samples of Salem district. The higher values of fluoride (greater than 1.5—3 ppm) could be associated with the presence of high calcium and magnesium salts in drinking water. Similar finding has been reported by Prabavathy et al. (9). Such higher values could also show a change with monsoon too. The annual fluoride concentration of the estuary waters showed the change in concentrations along with monsoon (8). Hence, the higher concentration of fluoride may be attributed due to the nature of rock strata and could show a seasonal variation which leads to fluorosis. It is endemic in areas where the fluoride content of drinking water is high (10). In India, more than 15 status have been declared as endemic for fluorosis by Rajiv Gandhi National Drinking Water Mission (11). Fluorosis in human being has been reported earlier (12—20). Fluoride concentration of 0.5 mg/liter in groundwater can cause yellowing of teeth and dental problems (21). Though various materials such as tea waste, groundnut shell, coffee, husk, rice, husk, activated carbon and alumina has been tried for the defluoridation (22), these material were found to be less efficient. Hence,

utilization of low cost adsorbent such as leaves and stem of amla (*Emblica Officinalis*) could be useful. The amla stem was more efficient in deflouridation than the leaves. The removal percentage was concentration dependent. Edison et al. (22) investigated the leaves and stem of thulasi for its adsorption capacity. The time of contact has been uniformly maintained as 24 h without shaking to make the process simple and could be suggested for rural people too. Similar adsorption has resulted in about 90% fluoride removal when lignite is used as an adsorbent (9). Even the root, leaves and stem of *Eicchornia* species were found to act as biosorbent which has resulted in lesser percentage reduction of fluoride when compared with other plant materials. Adsorption process is usually related with the availability of higher surface area. The efficiency of the checked adsorbents could be further improved by increasing the time of contact, the surface area or by performing treatment with acids or alkalies. The pH and the temperature may also influence the capacity of the adsorbents (23). These results are similar with the removal of heavy metals such as chromium, using various leaf materials such as unprocured *Thersphraesia populnea, Nyctanthes arbortristis, Bongainvillea spectabilis, Eicchornia crassipes, Acacia nilotica* (24). *Prosopis spicigera* (procured and unprocured), *Sorgahum vulgare* spike carbon, were used for the removal of chromium from the effluent (25). Thus the natural plant materials of medicinal importance could be effectively utilized for the removal of ions such as fluoride from drinking water. Such methodologes could be easily implemented even in rural areas at their residence itself to prevent major health hazards. Further investigation is highly essential for the application of this technique at all levels.

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