CHAPTER IV

URINE AND Faeces OF HUMAN BEINGS
4.1 INTRODUCTION

Excessive fluoride in drinking water is matter of serious concern, as it causes fluorosis, a disease which affects teeth and bones. This disease is mostly encountered with high fluorine in water and therefore it is endemic. Toxicological effects of prolonged and excessive fluoride intake are well documented. The degree of severity of this disease depends on several factors, e.g. environmental quality etc., Cerklewski (1997) has discussed the clinical aspects of fluorine. Earlier studies reported that fluorine is oligodynamic in nature, i.e. at lower concentration it promotes osteoblastic activity and higher concentration it can promote osteoclastic effects (Zigelbecker and Zigelbecker, 1993; Akiniwa, 1997; Franke, 1979). Toxicological effects of prolonged and excessive fluoride intake are well known in humans, cattle, and sheep (National Academy of Sciences, 1971; Milhaud et al., 1987; Machoy-Mokrzynska, 1990; Ignack and Gumska, 1991). In the south Safi zone effects of fluoride on animals and plants has been discussed by Kessabi et al. (1984). Mobilisation and excretion of part of the fluoride present in the
skeleton after removal from a high fluoride diet have been observed in humans (Likins et al. 1936). The role of fluorine and osteoporosis has been discussed in detail by Marcus et al. (1996). The level of fluoride in human nails has been studied by Machoy-Mokrzsinska (1990). Earlier workers have studied certain biochemical analysis of urine exposed persons viz., urobilinogen, protein, pH, viscosity, blood, ketone body, bilirubin, and glucose (Deshkar et al. 1998).

It has been shown by earlier workers that the dental fluorosis and fluoride content of enamel, plaque, saliva, urine, nails and hair are directly related to fluoride levels of drinking water and dietary fluoride intake (Stanley et al. 1999).

The main objective of the present study is to consider the comparative analysis of the water fluoride in drinking water and excretory level of fluoride in urine samples. Furthermore, the prevalence of fluorosis was assessed since high prevalence is a sign of an over exposure to fluoride. On account of the highest content of fluoride is varying from 0.78 to 6.10 ppm in the well water (Table 3.1) and some of the inhabitants of the area suffer from endemic dental and skeletal fluorosis.

The present work attempts to study the concentration of fluorine associated elements in the urine and faecal material of human beings of endemic fluorosis area of Talupula. A large number of people and animals living in the area of Talupula in Anantapur district of Andhra Pradesh have been suffering fluorosis disease since a very long time. For comparative study the unaffected area of Tirupati is also taken for consideration.
4.2 METHODOLOGY

Composite samples of faecal material and urine from ten male persons of Talupula (F-affected) and ten male members of unaffected, Tirupati were collected. 20 ml of random urine sample was taken into sterile plastic containers. Similarly faecal material is also collected in sterile plastic containers. Care was taken that he hands and clothes were free of contamination. The samples were collected in both winter and summer seasons. All these persons are clinically healthy and are in the age group of 25-35 years. The moisture was eliminated from all the samples at 110°C in hot air oven. The samples were then ashed at 450°C in a muffle furnace for 4 hours. The fluoride was estimated by using Lovibond PC Spectrometer (SN 100537, Germany) following the method of SPANDS colorimetric method. The ash (0.5 gm) was digested in 2M HCl and 5 associated elements viz., Zn, Cu, Mn, Cd and Cr were analysed by atomic absorption spectrometry (AAS) and the data is shown in Table 4.1 and Figures 4.1, 4.2, 4.3 and 4.4.

4.3 RESULTS AND DISCUSSION

The absorption, distribution and excretion of elements have been studied in recent years by several groups of workers (Liu et al. 1994; Zheng et al., 2002). Experiments on several species including human, show that intakes well beyond physiological levels, then those elements are poorly absorbed from gastrointestinal tract and excreted the remaining amounts through the intestinal wall and excreted the remaining amounts through the intestinal wall by several forms like faeces, urine, sweat etc., These routes and forms are interdependent and combine to prove the body with an efficient homeostatic mechanism of regulating the elemental concentration in the tissues.
Table 4.1 Multi-element analysis of human faeces and urine of Talupula and Tirupati areas

<table>
<thead>
<tr>
<th>S. No</th>
<th>Element</th>
<th>Season</th>
<th>Talupula</th>
<th></th>
<th></th>
<th>Tirupati</th>
<th>Urine</th>
<th>Feaces</th>
<th>Urine</th>
<th>Feaces</th>
<th>Urine</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Mean±S.E</td>
<td>Min</td>
<td>Max</td>
<td>Mean±S.E</td>
<td>Min</td>
<td>Max</td>
<td>Mean±S.E</td>
</tr>
<tr>
<td>1</td>
<td>F (mg/l)</td>
<td>W</td>
<td>0.79</td>
<td>1.32</td>
<td>1.10 ± 0.05</td>
<td>1.75</td>
<td>2.50</td>
<td>2.23 ± 0.06</td>
<td>0.67</td>
<td>0.85</td>
<td>0.73 ± 0.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S</td>
<td>0.67</td>
<td>1.03</td>
<td>0.92 ± 0.04</td>
<td>1.60</td>
<td>2.30</td>
<td>2.06 ± 0.06</td>
<td>0.60</td>
<td>0.79</td>
<td>0.69 ± 0.02</td>
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<tr>
<td>2</td>
<td>Zn (mg/l)</td>
<td>W</td>
<td>1410</td>
<td>1870</td>
<td>1630 ± 43.65</td>
<td>28</td>
<td>43</td>
<td>37 ± 1.56</td>
<td>1540</td>
<td>1925</td>
<td>1738 ± 37.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S</td>
<td>1230</td>
<td>1750</td>
<td>1545 ± 49.18</td>
<td>25</td>
<td>39</td>
<td>33 ± 1.61</td>
<td>1460</td>
<td>1840</td>
<td>1681 ± 37.17</td>
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<tr>
<td>3</td>
<td>Cu (mg/l)</td>
<td>W</td>
<td>480</td>
<td>760</td>
<td>640 ± 23.05</td>
<td>26</td>
<td>33</td>
<td>30 ± 0.75</td>
<td>570</td>
<td>845</td>
<td>745 ± 26.05</td>
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<td></td>
<td></td>
<td>S</td>
<td>515</td>
<td>715</td>
<td>614 ± 19.22</td>
<td>19</td>
<td>30</td>
<td>26 ± 1.16</td>
<td>530</td>
<td>810</td>
<td>705 ± 27.03</td>
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<tr>
<td>4</td>
<td>Mn (mg/l)</td>
<td>W</td>
<td>1060</td>
<td>1480</td>
<td>1287 ± 38.95</td>
<td>4</td>
<td>8</td>
<td>6 ± 0.37</td>
<td>680</td>
<td>1275</td>
<td>922 ± 57.65</td>
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<td></td>
<td>S</td>
<td>995</td>
<td>1340</td>
<td>1176 ± 34.03</td>
<td>4</td>
<td>6</td>
<td>5 ± 0.21</td>
<td>635</td>
<td>1080</td>
<td>854 ± 45.50</td>
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<tr>
<td>5</td>
<td>Cd (mg/l)</td>
<td>W</td>
<td>3</td>
<td>6</td>
<td>5 ± 0.28</td>
<td>4</td>
<td>6</td>
<td>5 ± 0.20</td>
<td>4</td>
<td>6</td>
<td>5 ± 0.22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>6</td>
<td>Cr (mg/l)</td>
<td>W</td>
<td>12</td>
<td>20</td>
<td>16 ± 0.72</td>
<td>12</td>
<td>20</td>
<td>16 ± 0.67</td>
<td>17</td>
<td>25</td>
<td>21 ± 0.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td>S</td>
<td>11</td>
<td>16</td>
<td>14 ± 0.57</td>
<td>10</td>
<td>17</td>
<td>13 ± 0.66</td>
<td>13</td>
<td>22</td>
<td>18 ± 0.89</td>
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Fig 4.1 Concentration of Faces for fluoride and the other trace elements (Talupula area)
Fig 4.2 Concentration of urine for fluoride and the other trace elements (Talupula area)
Figure 4.3: Concentration of faces for flocule and the other face elements (Tupula area).

- Concentration of Mn
- Concentration of Fluoride
- Concentration of Cd
- Concentration of Zn
- Concentration of Cr
- Concentration of Ru

Tupula
Fig 4.4 Concentration of urine for fluoride and the other trace elements (Timpati area)
From the data presented in Table 4.1 the following observations are made:

1. In both the areas all elements in the faecal material and urine are higher during winter than in the summer season. This is due to higher excretion by sweat in the summer.

2. The distribution of F in urine and fecal material is variable. In the F-affected area of Talupula, higher concentrations of F were observed in the urine (2.50 ppm) relative to faecal material (1.05 ppm).

3. All the three metals Zn, Mn, and Cu are excreted through the faecal material at higher concentrations than in urine in both study areas.

The absorption, distribution and excretion of elements have been studied in recent year by several groups of workers. Experiments on several species including humans, show that when intakes are well beyond physiological levels, then those elements are poorly absorbed from the gastrointestinal tract and unabsorbed are excreted in faeces, urine and sweat etc. These routes and forms are independent and combine to provide the body with an efficient homeostatic mechanism of regulating the elemental concentrations in tissues.

Urinary fluoride does not arise only from the fluoride in the feed and water. It may also come from the release of the element from skeletal sources. Most of the absorbed fluoride which escapes retention by the bones and teeth is rapidly excreted in the urine. Much smaller amounts are excreted in perspiration, except excessive sweating. Similarly, Ignack and Guminiska (1991) have also noticed increased excretion of fluorides
in urine of the workers of inhabitants of Chroz and Oacute areas. With soluble fluorides the urine is the main route of excretion and the level in the urine rises with increasing intakes. With the less soluble or slowly soluble forms, such as solid calcium fluorides added to the diet, a lower percentage appears in the urine, because of lower absorption. Average individuals on normal diets and not exposed to unusual fluoride intake from the food, water or atmosphere excrete 80% or more of their ingested fluoride in the urine (Machle and Largent, 1949). Higher urinary fluoride levels can therefore, reflect either current ingestion or previous exposure to high intakes.

Rao et al (1974) out fluoride analysis on urine and faecal materials of fluorosis-affected patients of areas where drinking waters have high fluoride (more than 6 ppm), and observed their faecal fluoride excretion to be about 0.20 to 1.56 mg/day and their urinary fluoride fluoride as 3.0 to 40.0 ppm. These patients were treated with oral administration of a solution consisting of 50 mg of finely powdered serpentine in 100 ml of distilled water twice daily. By this treatment higher amounts of fluoride (1.2 to 4.5 mg/day) were released, through faeces and urine, with levels in the range of 3.3 to 6.9 ppm. This study revealed that serpentine serves as de-fluoridating agent for the treatment of fluorosis-affected patients.

The faecal concentration of trace elements consists of mostly of unabsorbed dietary ones, with small amounts of endogenous origin. Sufficient quantities of Zn can be lost in the sweat, especially in hot climates like the present study areas, where the volume
of sweat may rise up to 5 or more lit/day. Prasad et al. (1963) have also found the sweat of normal individuals to contain on an average 1.15 ± 0.30 μg Zn/ml, most of which was present in the aqueous phase i.e., not associated with cellular elements.

Most ingested Cu appears in faeces. It has been estimated that of 2-5 mg Cu ingested daily by an adult man, 0.6-1.6 mg (32%) is absorbed and rest will be excreted as 0.5 -1.3 mg in the bile, 0.1 – 0.3 mg passes directly in the bowl and 0.01 – 0.06 mg appears in the urine (Cartwright and Wintrobe, 1964).

Under ordinary conditions the bile flow is the main route of excretion of Mn and is the principle regulatory mechanism, and very little Mn is excreted in the urine. The urinary Mn excretion by nephritis should be higher than normal as is urinary Cu and Zn in such patients (Kosai and Boyle, 1956).

Absorbed or injected chromium is excreted mainly in the urine. In diabetic patients, urinary Cr is increased after glucose load. Evidence is accumulating that Cr is involved in glucose tolerance in humans.

The normal Cd concentration of human urine is very low and variable. The urinary Cd concentration of hypertensive individuals is significantly higher than normal (Perry and Schroeder, 1955).

Living organisms, plants and animals including men are conditioned to a greater or lesser degree by the chemistry of their environment. Excess quantities of trace elements present in soils may be toxic to plants and/or animals or may affect the quality
of food stuffs for human consumption. These potentially toxic elements include As, B, Cd, Cu, F, Pb, Hg, Mo, Ni, and Se and Zn (Thornton, 1983).

The excretory organs control electrolyte contents in the same manner, eliminating excess rapidly; or retaining ions in the body fluids when the supply of salts is deficient. The excretory organs (kidneys, lungs, sweat glands, and skin) eliminate the end products of decomposition of organic substance form the body and maintain a constant and balanced level of water and electrolyte (Babsky, 1985).

It is stated that the role of elements as nutrient or toxic, is in a state of confusion because of changing views of the investigators on the metabolic role of trace elements (Gough et al., 1979). Substantiating the above statement, Crounse et al (1983) state that studies of geochemistry and health are very complex, many arguments are unresolvable and elemental concentrations are overwhelming. It is reported that the link between human health and geology is complex, since diet varies widely both in consumption and place of origin. Atmospheric pollution, particularly in urban areas, is widespread (Webb, 1964). Trace element deficiencies and toxicities in humans are more difficult to relate to the geochemical environment than they are in grazing animals because the geographical, and hence the geochemical, sources of human foods and beverages are ever widening, so that the overall diet usually contains materials grown and produced on a range of soil types (Underwood, 1984).