COMPARISON AND STUDY OF SODIUM AND POTASSIUM CONTENT IN ORS POWDERS BY FLAME PHOTOMETRIC METHOD

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ABSTRACT

A study was carried out to determine the content of sodium and potassium in two different brands and government sample of ORS Powder by Flame Photometric Method. The sodium and potassium content was found to be high in private sample compared to that of government supplied sample.

KEYWORDS: Sodium, Potassium, ORS Powder, ORT and Flame Photometry.

INTRODUCTION

Fluid and electrolyte balance is very important & vital for good health at all age groups[1]. In dehydration associated with diarrhoea, gastroenteritis, cholera and dysentery the body is lacking of water and electrolytes. ORT (oral rehydration therapy) is the simple treatment which involves administering a solution of salts and sugars for replenishing electrolyte and water content of the body. Sodium is the major caution found in the extracellular fluid[2]. It regulates the water content of the body and is critical for generation of electrical signals. Similarly, Potassium is the major caution found inside the cells. It is required for regulation of heart beat and function of the muscles. The Sodium and Potassium concentration of ORS must be sufficient to replace their loss and correct hypernatremia/hypokalemia but not so high as to cause or worsen hypernatremia/hyperkalemia which can itself occasionally result in death[3].

Sodium and potassium

The major cation of the extracellular fluid is sodium. The typical daily diet contains 130-280 mmol (8-15 g) sodium chloride. The body requirement is for 1-2 mmol per day, so the
excess is excreted by the kidneys in the urine.

**Reference range for Sodium**

Serum – 136-145mM  
CSF – 130 – 150mM  
Sweat – 10 – 40mM  
Urine (varies with intake) – 40 – 220mmol/day

Hyponatraemia (lowered plasma \([Na^+]\)) and hypernatraemia (raised plasma \([Na^+]\)) are associated with a variety of diseases and illnesses and the accurate measurement of \([Na^+]\) in body fluids is an important diagnostic aid.\(^4\)

Potassium is the major cation found intracellularly. The average cell has 140 mM \(K^+\) inside but only about 10 mM \(Na^+\). \(K^+\) slowly diffuses out of cells so a membrane pump (the \(Na^+\)/\(K^+\)-ATPase) continually transports \(K^+\) into cells against a concentration gradient. The human body requires about 50-150 mmol/day.

**Reference range (intervals) for potassium**

Serum – 3.5 – 1mM  
CSF – about 70% of serum  
Sweat – 4-9.7 mM (men), 7.6 – 15.6mM (women)  
Urine (varies with intake) – 25 - 125mmol/day  
Erythrocytes (intracellular) – 105mM

Hypokalaemia (lowered plasma \([K^+]\)), hyperkalaemia (increased plasma \([K^+]\)) and hyperkaluria (increased urinary excretion of \(K^+\)) are again indicative of a variety of conditions and the clinical measurement of \([K^+]\) is also of great importance \(^2\). Therefore, it is important to quantify the amount of Sodium and Potassium present in the ORS powder. Flame photometry is a branch of Atomic emission spectroscopy. It is suitable for quantitative and qualitative determination of several cautions, especially for metals that are easily excited to higher energy level at a relatively low flame temperature (mainly Na, K, Ca, Rb, Cu, Ba, Cs). A simple Flame photometric method is useful for the determination of Sodium and Potassium content of the ORS powder.\(^5\)
MATERIALS AND METHODS

Instrument- Elico Flame Photometer CL22D

Chemicals- Sodium chloride, Potassium chloride, ORS powders (Six different brands of ORS sachets were purchased and analyzed for their Sodium and Potassium content)

ORS sample 1- CIPLA (Oral Rehydration Salts, I.P): 21 gm
Composition: Sodium chloride- 2.6 gm, Potassium chloride- 1.5 gm, Sodium citrate-2.9 gm, Dextrose- 13.5 gm, Excipient- q.s

ORS sample 2- ELECTRAL (Oral Rehydration Salts, I.P): 21.8 gm
Composition: Sodium chloride- 2.6 gm, Potassium chloride- 1.5 gm, Sodium citrate-2.9 gm, Dextrose- 13.5 gm, Excipient- q.s

ORS sample 3- WALYTE (Oral Rehydration Salts, I.P): 21 gm
Composition: Sodium chloride- 2.6 gm, Potassium chloride- 1.5 gm, Sodium citrate-2.9 gm, Dextrose- 13.5 gm, Excipient- q.s

ORS sample 4- Govt. ORS: 20.5 gm
Composition: Sodium chloride- 2.6 gm, Potassium chloride- 1.5 gm, Sodium citrate-2.9 gm, Dextrose- 13.5 gm, Excipient- q.s

ORS sample 5- ELECTROBION (Oral Rehydration Salts, I.P): 4.2 gm
Composition: Sodium chloride- 0.52 gm, Potassium chloride- 0.30 gm, Sodium citrate-0.58gm, Dextrose- 2.7 gm, Excipient- q.s

ORS sample 6- HALEWOOD Govt. ORS: 4.2 gm
Composition: Sodium chloride- 0.52 gm, Potassium chloride- 0.30 gm, Sodium citrate-0.58gm, Dextrose- 2.7 gm, Excipient- q.s

Preparation of standard Sodium chloride solution
2.54 gm of Sodium chloride was dissolved and the volume was made up to 1L with double distilled water. 1ml of the solution was diluted up to 10 ml with double distilled water to get a conc. of 10^5 µg/L (i.e, 100 ppm).
Preparation of standard Potassium chloride solution
1.907 gm of Potassium chloride was dissolved and the volume was made up to 1L with double distilled water. 1 ml of the solution was diluted up to 10 ml with double distilled water to get a conc. of $10^5 \mu g/L$ (i.e, 100 ppm).

Preparation of sample ORS solution for analyzing Sodium
0.205 gm of ORS powder was dissolved in 100 ml of double distilled water to prepare a conc. of $10^5 \mu g/L$ (i.e, 100 ppm) of Sodium.

Preparation of sample ORS solution for analyzing Potassium
0.266 gm of ORS powder was dissolved in 100 ml of double distilled water to prepare a conc. of $10^5 \mu g/L$ (i.e, 100 ppm) of Potassium.

METHOD
Construction of standard curve for Sodium$^6$
The standard Sodium chloride solution ($10^5 \mu g/L$) was diluted up to $10^4$, $2\times10^4$, $3\times10^4$, $4\times10^4$, $5\times10^4$, $6\times10^4$ and $7\times10^4 \mu g/L$ concentration. $10^5 \mu g/L$ was set as highest conc. in flame photometry. Small aliquots of each conc. was taken and their flame intensity was measured (given in table 1). A standard curve was plotted taking conc. in abscissa and flame intensity in percentile in the ordinate. A straight line of $R^2$ value 0.999 was obtained (shown in figure 1).

Table-1: Flame intensity of Na in standard NaCl solution of different conc.

<table>
<thead>
<tr>
<th>CONCENTRATION (µg/L)</th>
<th>FLAME INTENSITY IN PERCENTILE</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10^7$</td>
<td>12</td>
</tr>
<tr>
<td>$2\times10^4$</td>
<td>23</td>
</tr>
<tr>
<td>$3\times10^4$</td>
<td>33</td>
</tr>
<tr>
<td>$4\times10^4$</td>
<td>42</td>
</tr>
<tr>
<td>$5\times10^4$</td>
<td>54</td>
</tr>
<tr>
<td>$6\times10^4$</td>
<td>64</td>
</tr>
<tr>
<td>$7\times10^4$</td>
<td>74</td>
</tr>
<tr>
<td>$10^7$</td>
<td>100</td>
</tr>
</tbody>
</table>
Construction of standard curve for potassium\[^7\]

The standard Potassium chloride solution (10^5 µg/L) was diluted up to 10^4, 2x10^4, 3x10^4, 4x10^4, 5x10^4, 6x10^4 and 7x10^4 µg/L concentration. 10^5 µg/L was set as highest conc. in flame photometry. Small aliquots of each conc. was taken and their flame intensity was measured (given in Table 2). A standard curve was plotted taking conc. in abscissa and flame intensity in percentile in the ordinate. A straight line of R^2 value 0.999 was obtained (shown in Figure 2).

### Table-2: Flame intensity of K in standard KCl solution of different conc.

<table>
<thead>
<tr>
<th>CONCENTRATION (µg/L)</th>
<th>FLAME INTENSITY IN PERCENTILE</th>
</tr>
</thead>
<tbody>
<tr>
<td>10^4</td>
<td>10</td>
</tr>
<tr>
<td>2x10^4</td>
<td>20</td>
</tr>
<tr>
<td>3x10^4</td>
<td>30</td>
</tr>
<tr>
<td>4x10^4</td>
<td>40</td>
</tr>
<tr>
<td>5x10^4</td>
<td>49</td>
</tr>
<tr>
<td>6x10^4</td>
<td>60</td>
</tr>
<tr>
<td>7x10^4</td>
<td>70</td>
</tr>
<tr>
<td>10^5</td>
<td>100</td>
</tr>
</tbody>
</table>

### RESULTS AND DISCUSSION

The concentration of Sodium and Potassium was calculated (given in Table 3) from the flame intensity of the sample ORS solutions of six brands. Although the content of NaCl and KCl in six ORS sachets was same, but in comparison it was found that the Cipla sample contained more Sodium (194.76×10^3 µg/L) than other ORS powders (Halewood contained 190.78×10^3 µg/L, Electoral contained 162.92×10^3 µg/L, Govt.sample contained 161.93×10^3 µg/L, Walyte contained 160.93×10^3 µg/L, Electrobin contained 157.34×10^3 µg/L of sodium). Similarly Cipla contained more amount of Potassium 158×10^3 µg/L than others (Electrobin...
contained $105 \times 10^3 \mu g/L$, Govt.sample contained $102 \times 10^3 \mu g/L$, Electral contained $96 \times 10^3 \mu g/L$, Walyte contained $87 \times 10^3 \mu g/L$ & Halewood contained $86 \times 10^3 \mu g/L$) of potassium.

![Figure-2: Standard curve for potassium](image)

**Table-3: Calculation of Na and K conc. in sample ORS solution**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Cipla</th>
<th>Electral</th>
<th>Walyte</th>
<th>Govt.sample</th>
<th>Electrobin</th>
<th>Halewood (Govt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flame intensity for Na(y)</td>
<td>198</td>
<td>166</td>
<td>164</td>
<td>165</td>
<td>158</td>
<td>194</td>
</tr>
<tr>
<td>Flame intensity for K(y')</td>
<td>158</td>
<td>96</td>
<td>87</td>
<td>102</td>
<td>105</td>
<td>86</td>
</tr>
<tr>
<td>Conc. of Na in µg/L (x)*</td>
<td>$194.76 \times 10^3$</td>
<td>$162.92 \times 10^3$</td>
<td>$160.93 \times 10^3$</td>
<td>$161.93 \times 10^3$</td>
<td>$154.96 \times 10^3$</td>
<td>$190.78 \times 10^3$</td>
</tr>
<tr>
<td>Conc. of K in µg/L (x')**</td>
<td>$158 \times 10^3$</td>
<td>$96 \times 10^3$</td>
<td>$87 \times 10^3$</td>
<td>$102 \times 10^3$</td>
<td>$105 \times 10^3$</td>
<td>$86 \times 10^3$</td>
</tr>
</tbody>
</table>

* $y = 1.0052x + 2.2263$

* $y' = x$

**CONCLUSION**

The Flame photometric method is relatively free of interferences from other elements\(^8\). Therefore it is an accurate and sensitive method which can measure the concentration of Na, K in ppm magnitude also and can be used for routine analysis of ORS powders.

**REFERENCES**

New Delhi, India, 2008; pp. 72.


