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# Estimation of Electrolytes in Human Blood Samples with respect to Different Eating Habits

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**Abstract:**

*Humans contain about 5 liters of blood in their body. The circulation of this blood is important for the normal functioning of all parts. Blood contains Plasma, which in turn contains all the proteins, glucose and other nutrients. The electrolytes play an important part in human health. Calcium, Potassium, Sodium, Magnesium and chloride ions have been analyzed for 50 patients of different age groups, different eating habits and genders. Standard kit methods were used for the analysis. Each of the blood samples were analyzed for Ca, K, Na, Mg and Cl ions and reported in mmol/L. The comparison was done in between vegetarian and non vegetarian patients. Calcium concentration in non vegetarians was found to be higher than that of vegetarian patients. The other ion concentrations in all the patients looked similar.*

**Key words:** Blood Samples (Vegetarian & Non vegetarian), Estimation of Ca, K, Na, Mg, Cl, Absorbance, Spectrophotometer.

## Introduction

Blood is a constantly circulating fluid providing the body with nutrition, oxygen, and waste removal. Blood is mostly liquid, with numerous cells and proteins suspended in it, making blood thicker than pure water **(Franklin, 2009)**. The average person

has about 5 liters (more than a gallon) of blood. When it reaches the lungs, gas exchange occurs when carbon dioxide is diffused out of the blood into the pulmonary alveoli and oxygen is diffused into the blood. This oxygenated blood is pumped to the left hand side of the heart in the pulmonary vein and enters the left atrium. From here it passes through the mitral valve, through the ventricle and taken all around the body by the aorta. Blood contains antibodies, nutrients, oxygen and much more to help the body work Liquid called plasma makes up about half of the content of blood, **(Alberts *et al.,* 2012)**.

Chemically, electrolytes are substances that become ions in solution and acquire the capacity to conduct electricity. Electrolytes are present in the human body, and the balance of the electrolytes in our bodies is essential for normal function of our cells and our organs.

Common electrolytes that are measured by doctors with blood testing include sodium, potassium, chloride, and bicarbonate. The functions and normal range values for these electrolytes are discussed below.

**Sodium** is the major positive ion (cation) in fluid outside of cells. The chemical notation for sodium is $Na^+$. When combined with chloride, the resulting substance is table salt. Sodium regulates the total amount of water in the body and the transmission of sodium into and out of individual cells also plays a role in critical body functions.

If sodium ion less than 135mmol/l in human body is called (Hyponatremia disease)

If sodium ion higher than 155mmol/l in human body is called (Hypernatremia disease)

**Chloride** is the major anion (negatively charged ion) found in the fluid outside of cells and in the blood. Increase chloride in human body up to 106mmol/L is called (Hyperchloremia). Decrease chloride in human body less than 98 mmol/L is called (Hypochloremia), **(Shiel, 2014).**

**Calcium** plays an essential role in many cell functions. It is present in plasma in three forms free, bound to protein or complexed with anions as phosphate, citrate and bicarbonate. Normal range of calcium 2.15-2.58mmol/L, **(Oberst, 1934).**

**Magnesium** is a major intracellular cation. It is an activator of various enzymes, it is also involved in amino acid activation and protein synthesis. The normal range of magnesium (0.46 – 0.60 mmol/L), (**Resnick *et al.,* 1984**).

**Potassium** is the major positive ion (cation) found inside of cells. The chemical notation for potassium is K+. The proper level of potassium is essential for normal cell function.

Low potassium level is as known as (Hypokalemia). High potassium level is as known as (Hyperkalemia), **(Shiel, 2014).**

## Materials and Methods

The material and methods used in the present study of (Estimation of the electrolytes in human blood samples with respect to different eating habits (vegetarian and non-vegetarian)) were as follows:-

Blood analysis was commonly carried out on a sample of blood drawn from the vein of the arm then followed the steps involve for blood analysis in the laboratory as putting the blood's sample in special test tube and Separating the blood by Centrifuge after that Assay the samples of blood by manual ways and getting the results.

Sodium and potassium are major cations of extracellular and intra cellular fluids respectively. Sodium maintains the normal distribution of water and the osmotic pressure in the various fluid compartments. Potassium influences the acid base balance and osmotic pressure including water retention. Increased Sodium levels are found in severe dehydration and excessive treatment with sodium salts. Decreased levels were found in severe poly urea, metabolic acidosis diarrhoea and

renal insufficiency. Increased potassium levels are found in renal fail urea, dehydration shock and adrenal in sufficiency. Decreased levels are found in malnutrition, gastro – intestinal fluid loss, and hyperactivity of the adrenal cortex. Chloride is a major extracellular anion and maintains the cation / anion balance between intra and extra cellular fluids, mostly as salt with sodium. Increased levels are usually found in dehydration, kidney dysfunction, and anaemia. Decreased levels are found in extensive burns, vomiting, diarrhea intestinal obstructions, and salt losing nephritis.

**Table: Normal Reference Values of electrolytes in human blood.**

| | |
|---|---|
| Sodium | 135 – 155 mmol/L |
| Potassium | 3.5 - 5.5mmol/ L |
| Serum / Plasma Chloride | 98 – 106 mmol / L |
| Urine Chloride | 170 – 250 mmol/L |
| Csf Chloride | 120 – 135 mmol/L |

It's recommended that each Laboratory establish its own normal range representing Its Patient population.

## Principle:

Sodium is precipitated as a triple salt with Magnesium and Uranyl acetate. The excess of uranyl ions are reacted with ferrocyanide in an acidic medium to develop brownish colour. The intensity of the colour produced is inversely proportional to the concentration of sodium in the sample:

Uranyl ions + Mg ions + $Na^+$UranylMgNa Precipitate ⟶

Free Uranyl Ions + $K_4Fe(CN)_6$ ⟶ Brown colored Complex

Potassium reacts with sodium tetra-phenyl boron in a specially prepared buffer to form a colloidal suspension.

The amount of the turbidity produced is directly proportional to the concentration of potassium in the sample.

Tetra phenyl Boron + $K^+$White turbidity ⟶ Chloride ions combine with free mercuric ions and release thiocyanate from mercuric thiocyanate.

The thiocyanate released combines with the ferric ions to form a red brown ferric thiocynate complex.

Intensity of the colour formed is directly proportional to the amount of chloride present in the sample.

$$2\,Cl^- + Hg(SCN)_2 \longrightarrow HgCl_2 + 2(SCN)$$
$$3(SCN) + Fe^{3+} \longrightarrow Fe(SCN)$$

Table 3.2 mentions the details of the patients whose blood samples were used to analyze the ions. The patients belonged to different age groups, both vegetarian and non-vegetarian eating habits.

**Table: Sample details of Patients used for the present study**

| Sl. No.- | Sample Name | Age | Gender | NV/V |
|---|---|---|---|---|
| 1 | K1 | 31 | Male | V |
| 2 | K2 | 15 | Male | V |
| 3 | K3 | 49 | Male | NV |
| 4 | K4 | 64 | Male | V |
| 5 | K5 | 79 | Male | NV |
| 6 | K6 | 52 | Female | NV |
| 7 | K7 | 35 | Male | V |
| 8 | K8 | 40 | Female | NV |
| 9 | K9 | 39 | Female | V |
| 10 | K10 | 34 | Female | V |
| 11 | K11 | 7 | Male | NV |
| 12 | K12 | 83 | Male | NV |
| 13 | K13 | 38 | Male | NV |
| 14 | K14 | 33 | Female | V |
| 15 | K15 | 6 | Male | V |
| 16 | K16 | 62 | Male | V |
| 17 | K17 | 22 | Female | NV |
| 18 | K18 | 80 | Male | V |
| 19 | K19 | 21 | Male | V |
| 20 | K20 | 29 | Female | V |
| 21 | K21 | 19 | Female | NV |
| 22 | K22 | 6 | Female | V |
| 23 | K23 | 39 | Female | V |
| 24 | K24 | 30 | Male | NV |

| | | | | |
|---|---|---|---|---|
| 25 | K25 | 35 | Female | NV |
| 26 | K26 | 75 | Male | V |
| 27 | K27 | 60 | Male | NV |
| 28 | K28 | 80 | Female | V |
| 29 | K29 | 30 | Male | NV |
| 30 | K30 | 24 | Female | NV |
| 31 | K31 | 30 | Male | NV |
| 32 | K32 | 18 | Female | V |
| 33 | K33 | 30 | Male | NV |
| 34 | K34 | 27 | Female | NV |
| 35 | K35 | 32 | Male | V |
| 36 | K36 | 14 | Male | V |
| 37 | K37 | 34 | Male | NV |
| 38 | K38 | 37 | Male | V |
| 39 | K39 | 41 | Male | V |
| 40 | K40 | 27 | Female | V |
| 41 | K41 | 29 | Male | V |
| 42 | K42 | 38 | Male | NV |
| 43 | K43 | 19 | Male | NV |
| 44 | K44 | 25 | Male | NV |
| 45 | K45 | 40 | Female | V |
| 46 | K46 | 35 | Male | NV |
| 47 | K47 | 25 | Male | NV |
| 48 | K48 | 71 | Male | V |
| 49 | K49 | 55 | Male | NV |
| 50 | K50 | 49 | Male | NV |

CHLORIDE KIT (Thiocyanate method ) Elyte 2 Kit
($Na^+$ and $K^+$ Colorimetric ) Elyte 3 Kit.
( $Na^+$ / $K^+$ and $Cl^-$ Colorimetric for the determination of $Na^+$ / $K^+$ and $Cl^-$ in Serum for *In-vitro* Diagnostic use Only) Procedure

**Table: Wavelength of maximum absorption ($\lambda_{max}$) for Sodium, Potassium, Chloride, Magnesium and Calcium.**

| | |
|---|---|
| 530nm (Hg 546) green | Wavelength / Filter Sodium |
| 630 nm (Hg 623) red | Wavelength / Filter Potassium |
| 505 nm (Hg 546) green | Wavelength / Filter Chloride |
| 510 nm ( Hg 546 nm ) Green | Wavelength / Filter Magnesium |
| 650 nm (Hg 630 nm) | Wavelength / Filter Calcium |

## Storage Instructions and Reagent Stability:

The reagent and the standard are stable up to the end of the indicated date of expiry on the vial label, if stored at 2 to 8 $^0$C,

protected from light and contamination is avoided. Should not be freezed.

The standard is stable up to the end of the indicated date of expiry on the vial label, if stored at 2 to 8 $^0$C.

## Storage & Stability

All reagents are stable at R.T till the expiry mentioned.
Reagent Preparation
Reagents are ready to use.
Sample Material
For sodium and potassium: Serum, free from hemolysis serum should be separated from the clot immediately / as soon as possible.
For chloride: Serum, plasma urine and CSF. Dilute urine samples 1+1 with distilled water before the assay chloride is reported to be stable in serum for 7 days at 2-8 C$^o$.

## 1. Sodium Assay

1 – PRECIPITATION: For the precipitation the following reagents were pipetted into clean dry test tubes labeled as standard (S) and Test (T) as shown in table 3.4.

**Table:- Show the component of Sodium Kit**

| component | Volume (ml) |
|---|---|
| L1 : Precipitating Reagent | 35 ml |
| L2 : Acid Reagent | 45 ml |
| L3 : Colour Reagent | 5 ml |

**Table:-Method (I) of Sodium Assay**

| Addition sequence | S (ml ) | T ( ml ) |
|---|---|---|
| Precipitating reagent ( L1 ) | 1.0 | 1.0 |
| $Na^+/K^+$ Standard ( S ) | 0.02 | - |
| Sample | - | o.o2 |

The contents were mixed well and allowed to stand at R. T for 5 min, with shaking well intermittently after that the contents were centrifuge at 2500 to 3000 RPM to obtain clear supernatant.

2 – COLOUR DEVELOPMENT: For the colour development the reagents were pipetted into clean dry test tubes labeled as blank (B), standard (S) and test (T) according to the table 3.6.

**Table:-Method (II) Of Sodium Assay**

| Addition sequence | B ( ml ) | S ( ml ) | T ( ml ) |
|---|---|---|---|
| Acid Reagent ( $L_2$) | 1.0 | 1.0 | 1.0 |
| Supernatant Step 1 | - | 0.02 | 0.02 |
| Precipitation reagent ( $L_{1}$ ) | 0.02 | - | - |
| Colour Reagent ( $L_{3}$ ) | 0.1 | 0.1 | 0.1 |

After development of colour the absorbance was recorded and the sodium ion was estimated as per the following equation.

Calculation:-

Sodium ions in mmol = (Abs. B – Abs. T / Abs.B – Abs.S) * 150

**2. Potassium Assay:**

For the precipitation the following reagents were pipettedinto clean dry test tubes labeled as blank (B) standard (S), and test (T) as shown in table 3.7.

**Table:-The Method of Potassium Assay**

| Addition sequence | B ( ml ) | S ( ml ) | T ( ml ) |
|---|---|---|---|
| Potassium Reagent ( $L_1$) | 1.0 | 1.0 | 1.0 |
| Deionised water | 0.02 | - | - |
| $Na^+$ / $K^+$ Standard ( S ) | - | 0.02 | - |
| Sample | - | - | - |

**Table:-The component of Potassium Kit**

| component | Volume (ml) |
|---|---|
| L1 : Potassium Reagent | 45 ml |
| S:$Na^+$/$K^+$ St (150/5 mmol/L | 5 ml |

The contents were mixed well and incubated at R.T. for 5 min measure after which the Absorbance of the standard (Abs.S) and Test Sample (Abs.T) was measured against Blank within 15 min.

Calculation:-

The amount of Potassium was estimated using the following equation

Potassium ions in mmol / L = (Abs.T / Abs.S) * 5

### 3. Chloride Assay:

For the Chloride estimation the following reagents were pipetted into clean dry test tubes labeled as Blank (B) standard (S) and Test (T) according to Table 3.9

**Table:-Method of Chloride Assay**

| Addition Sequence | B ( ml ) | S ( ml ) | T ( ml ) |
|---|---|---|---|
| Chloride Reagent ( $L_1$ ) | 1.0 | 1.0 | 1.0 |
| Deionised water | 0.01 | - | - |
| Chloride Standard ( S ) | - | 0.01 | - |
| Sample | - | - | 0.01 |

The contents were mixed well and incubated at R.T for 2 min, after that measure the Absorbance of the standard (Abs.S), and Test sample (Abs.T) against Blank, within 60 min.

### Calculation:-

The chloride content was estimated according to the following equation

Chloride ions in mmol / L = (Abs.T/Abs.S) * 100

### 4. Magnesium Assay:

**Principle**:

Magnesium combines with Calmagite in an alkaline medium to form a red coloured complex. Interference of calcium and protein is eliminated by the addition of specific chelating agents and detergents. Intensity of the colour formed is directly proportional to the amount of magnesium present in the sample.

Magnesium + Calcium $\xrightarrow{\text{Alkaline/Medium}}$ Redcoloured complex

**Table:-Contents of Magnesium Assay**

| component | Volume (ml) |
|---|---|
| Buffer Reagent ( $L_1$ ) | 12.5 ml |
| Colour Reagent ( $L_2$ ) | 12.5 ml |
| Magnesium Standard ( S ) | 2 ml |

## Magnesium Kit:

(Calmagite method)
For the determination of Magnesium in serum, urine & CSF.
(For*Invitro* Diagnostic Use Only)
Contents of the kit:

## Procedure:

**Table**:-**Shows the standard wavelength, temperature and path length for Magnesium assay**

| | |
|---|---|
| Wavelength / filter | 510 nm ( Hg 546 nm ) Green |
| Temperature | R.T. |
| Light Path | 1 cm |

For the estimation of magnesium pipette into clean dry test tube labeled as Blank (B), Standard (S), and Test (T) the reagents according to table 3.

**Table: Method of Magnesium Assay.**

| Addition Sequence | B ( ml ) | S ( ml ) | T ( ml ) |
|---|---|---|---|
| Buffer Reagent ( $L_1$ ) | 0.5 | 0.5 | 0.5 |
| Colour Reagent ( $L_2$ ) | 0.5 | 0.5 | 0.5 |
| Distilled Water | 0.01 | - | - |
| Magnesium Standard ( S ) | - | 0.01 | - |
| Sample | - | - | 0.01 |

All the reagents were mixed well and incubate at RT ($25^0$ C) for 5 min. Then the absorbance of Standard (Abs.S), and Test Sample (Abs .T) were measured against the Blank, within 30 min.

Calculations:

The amount of magnesium was calculated according to following equation

Magnesium ions in mEq/L = (Abs.T / Abs.S )* 2

## 5 Calcium Assay:

**Principle**:-

Calcium with Arsenazo III [2, 7– (bis (2- arsonophenyfazo)-1,8-dihydroxynaphtaienc-3,6 – disulphoric acid] At neutral pH yields a blue colouredcomplex , whose intensity is proportional to the calcium concentration. Interference by magnesium is eliminated by addition of 8- Hydroxyquinoline- 5 – sulfonic acid.

REAGENTS:

**Table:-Components and Concentrations:**

| COMPONENTS AND CONCENTRATIONS : | | |
|---|---|---|
| Imidazole Buffer | 100 mmol /L | |
| 8- HydroxyQuinoline | 5 mmol /L | |
| Arsenazo III | 120 µmol / L | |
| Preservative & Stabilizer | | |
| Standard : | 10.0mg /dl | ( 2.50 mmol/ L ) |

## Assay Procedure:

**Table:- The standard wavelength, path length and temperature for calcium determination**

| | |
|---|---|
| Wavelength /filter | Hg 630 nm, 650 nm |
| Optical path | 1cm |
| Temperature | 37 $C^0$ |
| Mode | End point |

Bring all the contents of the kit to Room Temperature prior to use.

Read absorbance of sample against reagent blank.

**Table:-Method of Calcium Assay.**

| Addition Sequence | B(ml) | S (ml) | T (ml ) |
|---|---|---|---|
| Reagent | 0.1 | 0.1 | 0.1 |
| Deionised Water | 0.01 | - | - |
| Standard | - | 0.01 | - |
| Sample/ Control | - | - | 0.01 |

The contents were mixed and incubated at R.T. for 2 minutes after that the absorbance (A) of the standard (Abs.S), and Test sample (Abs.T) against Blank, within 60 min.

Calculation:
The amount of Calcium was calculated according to following equation:
conc of sample = ( concentration of St /Abs.of St – Abs.of Reagent blank ) * Abs.of unknown sample- Abs.of Bla

## Results and Discussion

As discussed in the materials and methods chapter, 50 patients of different age groups and different eating habits (Vegetarian and Non Vegetarian) and both male and female were analyzed. The blood samples from these patients were analyzed for Calcium, Sodium, Potassium, Chlorides and Magnesium ions. The absorbance for each sample was read on a spectrophotometer (Sartorius Stedium Biotech). The absorbance readings were directly proportional to the concentration of the ions of samples. These absorbance readings were then used to calculate the overall concentration each ion in each sample. The results were tabulated in the following tables.

**Table:-Details of patients selected for the study and the concentration of ions in their blood.**

| Sl. No. | Sample Name | Age | Gender | NV/V | Calcium (mmol/L) | Magnesium (mmol/L) | Sodium (mmol/L) | Potassium (mmol/L) | Chloride (mmol/L) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | K1 | 31 | Male | V | 0 | 0 | 140.2 | 19.67 | 97.05 |
| 2 | K2 | 15 | Male | V | 2.42 | 2.6295 | 100 | 59.07 | 119.7 |
| 3 | K3 | 49 | Male | NV | 1.95 | 2.85 | 139.4 | 26.6 | 90.64 |
| 4 | K4 | 64 | Male | V | 5.4 | 0 | 145 | 30.4 | 79.7 |
| 5 | K5 | 79 | Male | NV | 0.06 | 1.52 | 141.58 | 46.46 | 86.65 |
| 6 | K6 | 52 | Female | N V | 0.86 | 1.98 | 142.28 | 34.57 | 89.6 |
| 7 | K7 | 35 | Male | V | 0.51 | 1.79 | 143.6 | 39.88 | 80.24 |
| 8 | K8 | 40 | Female | N V | 3.88 | 4.26 | 134 | 44.76 | 85.78 |
| 9 | K9 | 39 | Female | V | 1.05 | 1.982 | 145.5 | 24 | 84.9 |
| 10 | K10 | 34 | Female | V | 2.16 | 2.93 | 130.49 | 26.65 | 82.8 |
| 11 | K11 | 7 | Male | NV | 1.12 | 1.9 | 136.88 | 28.5 | 85.96 |
| 12 | K12 | 83 | Male | N V | 1.35 | 0.3 | 197.1 | 31.2 | 84.05 |
| 13 | K13 | 38 | Male | N V | 12 | 6.8 | 168.4 | 45.3 | 105 |
| 14 | K14 | 33 | Female | V | 4.23 | 4.81 | 179.2 | 43.1 | 87.5 |
| 15 | K15 | 6 | Male | V | 3.7 | 4.8 | 164.07 | 42.2 | 92.2 |
| 16 | K16 | 62 | Male | V | 0.645 | 0.379 | 95.3 | 53.3 | 97.2 |
| 17 | K17 | 22 | Female | N V | 1.023 | 0.8 | 94.6 | 44.3 | 102.8 |
| 18 | K18 | 80 | Male | V | 0.65 | 0.25 | 69.8 | 39.88 | 88.9 |
| 19 | K19 | 21 | Male | V | 1.63 | 1.9 | 89.3 | 50.84 | 110.2 |
| 20 | K20 | 29 | Female | V | 2.113 | 0.559 | 84.02 | 64.3 | 96.8 |
| 21 | K21 | 19 | Female | N V | 1.37 | 0.6 | 29.78 | 56.53 | 98 |
| 22 | K22 | 6 | Female | V | 2.78 | 0.134 | 89.36 | 39 | 90.8 |
| 23 | K23 | 39 | Female | V | 3.01 | 5.39 | 108.2 | 58.8 | 162.5 |
| 24 | K24 | 30 | Male | NV | 14.6 | 0 | 86.5 | 70.19 | 185.09 |
| 25 | K25 | 35 | Female | NV | 1.19 | 2.72 | 129.2 | 47.9 | 106.5 |
| 26 | K26 | 75 | Male | V | 1.911 | 3.72 | 117.2 | 58.6 | 112.6 |
| 27 | K27 | 60 | Male | NV | 4.8 | 5.28 | 119.7 | 54.7 | 154 |
| 28 | K28 | 80 | Female | V | 2.93 | 0 | 86.7 | 67.76 | 202.2 |
| 29 | K29 | 30 | Male | N V | 2.26 | 3.218 | 126.7 | 72.19 | 107.9 |
| 30 | K30 | 24 | Female | N V | 1.56 | 2.76 | 114.48 | 58.9 | 111.6 |
| 31 | K31 | 30 | Male | N V | 0.25 | 0.34 | 127.25 | 53 | 85.09 |
| 32 | K32 | 18 | Female | V | 5.28 | 0 | 104.3 | 59.6 | 254.5 |
| 33 | K33 | 30 | Male | N V | 1.9 | 4.73 | 123.6 | 57 | 125.6 |
| 34 | K34 | 27 | Female | NV | 0.45 | 0.259 | 132 | 37.88 | 99.1 |
| 35 | K35 | 32 | Male | V | 1.08 | 0.198 | 116.25 | 48.2 | 91.33 |
| 36 | K36 | 14 | Male | V | 1.58 | 1.63 | 100 | 49.32 | 111.09 |
| 37 | K37 | 34 | Male | N V | 2.6 | 2.39 | 93.75 | 60.78 | 120 |
| 38 | K38 | 37 | Male | V | 0.75 | 0.288 | 124.5 | 36.4 | 93.9 |
| 39 | K39 | 41 | Male | V | 0.48 | 0.7 | 124.25 | 45.38 | 93.06 |
| 40 | K40 | 27 | Female | V | 0.04 | 1.2 | 114.75 | 46.8 | 105.9 |
| 41 | K41 | 29 | Male | V | 0.61 | 1.758 | 96.75 | 42.5 | 107.3 |
| 42 | K42 | 38 | Male | N V | 0.43 | 1.029 | 116.25 | 50.07 | 96.7 |
| 43 | K43 | 19 | Male | N V | 1.05 | 0.145 | 131 | 40.92 | 85.09 |
| 44 | K44 | 25 | Male | N V | 0.34 | 0.14 | 123.25 | 43.61 | 92.7 |
| 45 | K45 | 40 | Female | V | 1.32 | 0.26 | 108.2 | 33.9 | 85.78 |
| 46 | K46 | 35 | Male | N V | 3.12 | 1.17 | 96.8 | 31.5 | 94.6 |
| 47 | K47 | 25 | Male | N V | 0.57 | 2.41 | 60.7 | 69.5 | 154 |
| 48 | K48 | 71 | Male | V | 0.79 | 0.63 | 96.5 | 55.6 | 106.4 |
| 49 | K49 | 55 | Male | N V | 2.67 | 0.81 | 86.39 | 36.7 | 96.36 |
| 50 | K50 | 49 | Male | N V | 1.12 | 3.12 | 89.2 | 50 | 88.04 |

**Table: Normal Ranges of ions for comparison**

| | |
|---|---|
| Sodium | 135 – 155 mmol/L |
| Potassium | 3.5 - 5.5mmol/ L |
| Serum / Plasma Chloride | 98 – 106 mmol / L |
| Calcium | 1.84-2.76 mmol/L |
| Magnesium | 0.46 – 0.60 mmol/L |

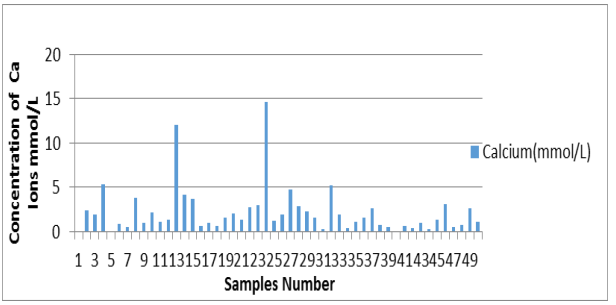


**Fig: Graph showing the calcium ion level (mmol/L) for the samples**

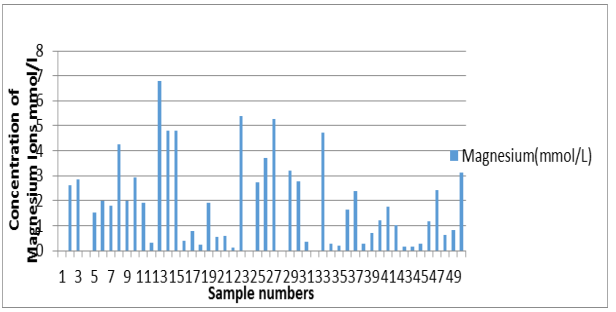


**Fig: Graph showing the Magnesium ion level (mmol/L) for the samples**

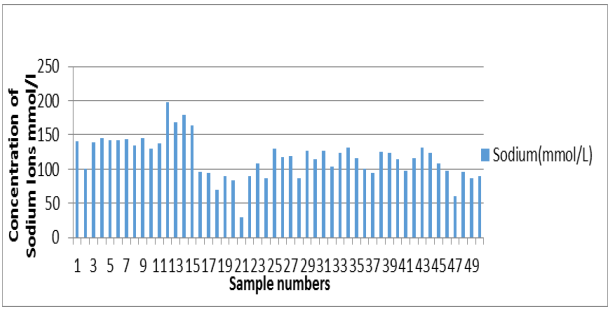


**Fig: Graph showing the Sodium ion level (mmol/L) the samples.**

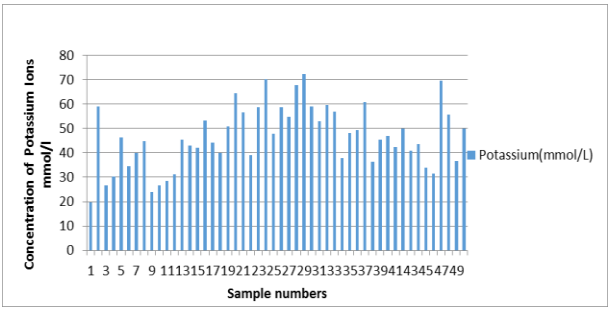


**Fig: Graph showing the Potassium ion level ( mmol/L )for the samples.**

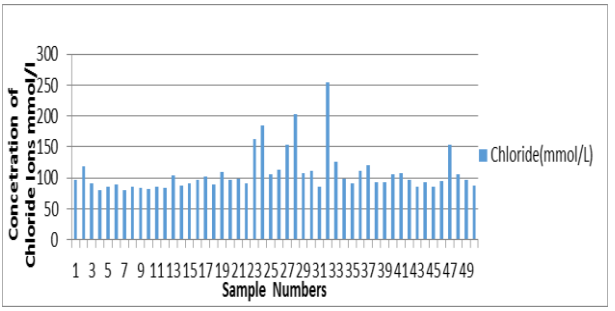


**Fig: Graph showing the Chloride ion level (mmol/L) for the samples.**

**Table: Ion analyses for Vegetarian Patients**

| Sample Name | Age | Gender | Calcium (mmol/L) | Magnesium (mmol/L) | Sodium (mmol/L) | Potassium (mmol/L) | Chloride (mmol/L) |
|---|---|---|---|---|---|---|---|
| K1 | 31 | Male | 0 | 0 | 140.2 | 19.67 | 97.05 |
| K2 | 15 | Male | 2.42 | 2.6295 | 100 | 59.07 | 119.7 |
| K4 | 64 | Male | 5.4 | 0 | 145 | 30.4 | 79.7 |
| K7 | 35 | Male | 0.51 | 1.79 | 143.6 | 39.88 | 80.24 |
| K9 | 39 | Female | 1.05 | 1.982 | 145.5 | 24 | 84.9 |
| K10 | 34 | Female | 2.16 | 2.93 | 130.49 | 26.65 | 82.8 |
| K14 | 33 | Female | 4.23 | 4.81 | 179.2 | 43.1 | 87.5 |
| K15 | 6 | Male | 3.7 | 4.8 | 164.07 | 42.2 | 92.2 |
| K16 | 62 | Male | 0.645 | 0.379 | 95.3 | 53.3 | 97.2 |
| K18 | 80 | Male | 0.65 | 0.25 | 69.8 | 39.88 | 88.9 |
| K19 | 21 | Male | 1.63 | 1.9 | 89.3 | 50.84 | 110.2 |
| K20 | 29 | Female | 2.113 | 0.559 | 84.02 | 64.3 | 96.8 |
| K22 | 6 | Female | 2.78 | 0.134 | 89.36 | 39 | 90.8 |
| K23 | 39 | Female | 3.01 | 5.39 | 108.2 | 58.8 | 162.5 |
| K26 | 75 | Male | 1.911 | 3.72 | 117.2 | 58.6 | 112.6 |
| K28 | 80 | Female | 2.93 | 0 | 86.7 | 67.76 | 202.2 |
| K32 | 18 | Female | 5.28 | 0 | 104.3 | 59.6 | 254.5 |
| K35 | 32 | Male | 1.08 | 0.198 | 116.25 | 48.2 | 91.33 |
| K36 | 14 | Male | 1.58 | 1.63 | 100 | 49.32 | 111.09 |
| K38 | 37 | Male | 0.75 | 0.288 | 124.5 | 36.4 | 93.9 |
| K39 | 41 | Male | 0.48 | 0.7 | 124.25 | 45.38 | 93.06 |
| K40 | 27 | Female | 0.04 | 1.2 | 114.75 | 46.8 | 105.9 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| K41 | 29 | Male | 0.61 | 1.758 | 96.75 | 42.5 | 107.3 |
| K45 | 40 | Female | 1.32 | 0.26 | 108.2 | 33.9 | 85.78 |
| K48 | 71 | Male | 0.79 | 0.63 | 96.5 | 55.6 | 106.4 |

**Table:- Ion analyses for Non-Vegetarian Patients**

| Sample Name | Age | Gender | Calcium (mmol/L) | Magnesium (mmol/L) | Sodium (mmol/L) | Potassium (mmol/L) | Chloride (mmol/L) |
|---|---|---|---|---|---|---|---|
| K5 | 79 | Male | 0.06 | 1.52 | 141.58 | 46.46 | 86.65 |
| K6 | 52 | Female | 0.86 | 1.98 | 142.28 | 34.57 | 89.6 |
| K8 | 40 | Female | 3.88 | 4.26 | 134 | 44.76 | 85.78 |
| K11 | 7 | Male | 1.12 | 1.9 | 136.88 | 28.5 | 85.96 |
| K12 | 83 | Male | 1.35 | 0.3 | 197.1 | 31.2 | 84.05 |
| K13 | 38 | Male | 12 | 6.8 | 168.4 | 45.3 | 105 |
| K17 | 22 | Female | 1.023 | 0.8 | 94.6 | 44.3 | 102.8 |
| K21 | 19 | Female | 1.37 | 0.6 | 29.78 | 56.53 | 98 |
| K24 | 30 | Male | 14.6 | 0 | 86.5 | 70.19 | 185.09 |
| K25 | 35 | Female | 1.19 | 2.72 | 129.2 | 47.9 | 106.5 |
| K27 | 60 | Male | 4.8 | 5.28 | 119.7 | 54.7 | 154 |
| K29 | 30 | Male | 2.26 | 3.218 | 126.7 | 72.19 | 107.9 |
| K30 | 24 | Female | 1.56 | 2.76 | 114.48 | 58.9 | 111.6 |
| K31 | 30 | Male | 0.25 | 0.34 | 127.25 | 53 | 85.09 |
| K33 | 30 | Male | 1.9 | 4.73 | 123.6 | 57 | 125.6 |
| K34 | 27 | Female | 0.45 | 0.259 | 132 | 37.88 | 99.1 |
| K37 | 34 | Male | 2.6 | 2.39 | 93.75 | 60.78 | 120 |
| K42 | 38 | Male | 0.43 | 1.029 | 116.25 | 50.07 | 96.7 |
| K43 | 19 | Male | 1.05 | 0.145 | 131 | 40.92 | 85.09 |
| K44 | 25 | Male | 0.34 | 0.14 | 123.25 | 43.61 | 92.7 |
| K46 | 35 | Male | 3.12 | 1.17 | 96.8 | 31.5 | 94.6 |
| K47 | 25 | Male | 0.57 | 2.41 | 60.7 | 69.5 | 154 |
| K49 | 55 | Male | 2.67 | 0.81 | 86.39 | 36.7 | 96.36 |
| K50 | 49 | Male | 1.12 | 3.12 | 89.2 | 50 | 88.04 |

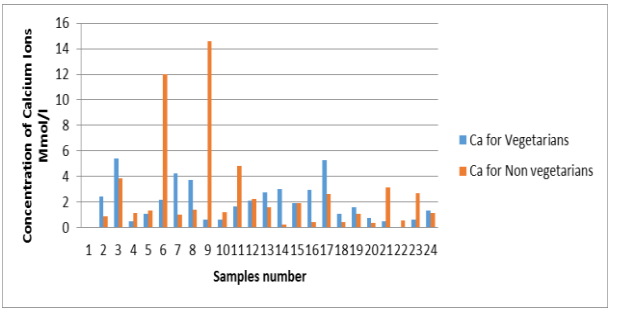


**Fig: Graph showing the Calcium ion level (mmol/L) for both Vegetarian and Non-Vegetarian samples in comparison.**

Calcium values were found to be higher in non vegetarian patients compared to vegetarian patients. The highest value found to be over 3mmol/L for non vegetarians and around 2 mmol being the highest for vegetarians.

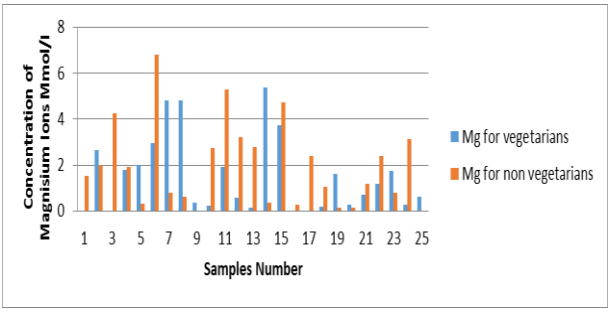


**Fig: Graph showing theMegnesium ion level (mmol/L) for both Vegetarian and Non-Vegetarian samples in comparison.**

Magnesium values were found to be similar for both non vegetarian patients and vegetarian patients.

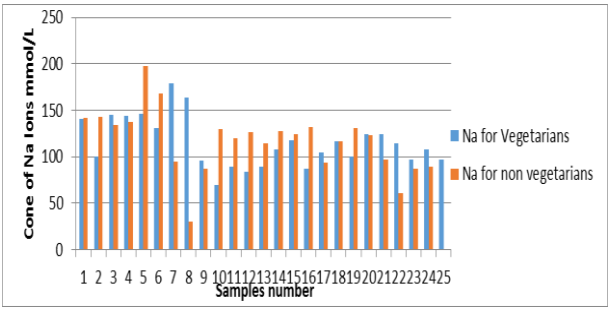


**Fig: Graph showing the Sodium ion level (mmol/L ) for both vegetarians and non vegetarians samples in comparison.**

Sodium values were found to be similar for both non vegetarian patients and vegetarian patients.The highest value observed was 200 and lowest one was 25.

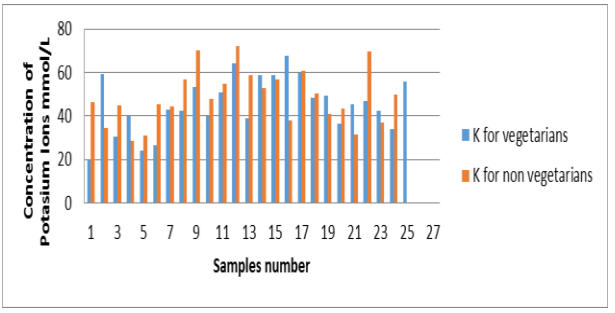


**Fig: Graph showing the Potassium ions level (mmol/L) for both vegetarians and non-vegetarians samples in comparison.**

Potassium values were found to be similar for both non vegetarian patients and vegetarian patients. The highest observed value was 70 and the lowest one was observed 10.

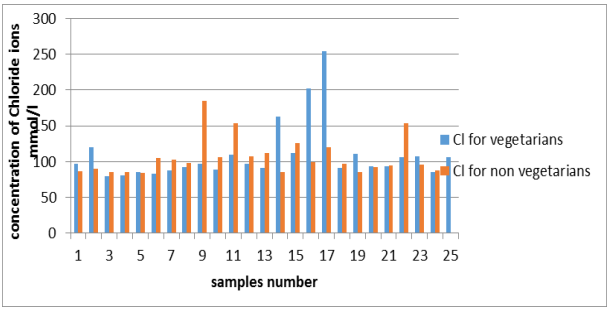


**Fig: Graph showing the Chloride ion level (mmol/L ) for both vegetarians and non-vegetarians samples in comparison.**

Chloride values were found to be similar for both non vegetarian patients and vegetarian patients.

## Summary and Conclusion

In the present study, the effects of vegetarian food and non vegetarian food on electrolytic level in the blood of 50 individuals has been checked. Calcium, Sodium, Potassium, Chloride and Magnesium ions in the blood were checked. Research material consists of blood samples taken from people who only eat vegetables and those of eating both vegetables and meat. This study was done in Bangalore at Credura Life Science centre on Biochemistry section. The blood samples of 50 human beings from different ages, gender and eating habits were drawn from the vein of the arm at Laboratory. After that all the blood samples divided into two portions ( 25 Vegetarian and 25 Non-Vegetarian ) comparison after that all the addition sequence steps for each electrolytic analysis was done and the results were determined by Spectrophotometer which were proportional to the concentration of ions ( $Na^+$ , $K^+$ , $Ca^{++}$ , $Mg^{++}$ and $Cl^-$ ) in the blood samples.

Human body is considered flexible for both meat and vegetables at the same time it needs to check the requirement of the body. Researchers have proved that vegetarians are slimmer, leatherier, with lower risk of cardiovascular disease like blood pressure, cancer and diabetes. However vegetarians suffer from low blood pressure, lower level of cholesterol and lower IBM values. At the same time researchers found that health related risks are more with the non vegetarians. Disease like cancer, high blood pressure, high IBM values. Therefore it tells us different biochemistry of individuals having different food habits. Bearing these differences in mind I was curious to know the electrolytic levels of both vegetarians and non-vegetarians.

It was observed that almost all non-vegetarians have high calcium level in blood as compared to that of vegetarians. While there was not much variation of Na, K, Cl and Mg ions. The variation of these ions has a striking effect on human health. The prominent among them are hair loss, tooth decay, weakening of bones, muscle aches, abdominal cramps, mental disorders and dizziness. This need an early dose of deficient electrolyte otherwise the delay in compensating the deficiency can lead into severe disorders and diseases. Therefore after careful investigation of 50 samples of both vegetarian and non-vegetarians on estimation of electrolytes and their exact need for a particular individual we come to the conclusion that a person should take both the foods in an adequate amount in order to maintain the electrolytic level of the body and prevent it from different deficiency diseases.

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