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Analysis of Potassium Levels in Fruits by Flame Photometry

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Abstract
Potassium is the eight most common elements by mass (0.2%) in the human body, so that a 60kg adult contains a total of about 120gms of potassium. Potassium cations are important in neuron (brain and nerve) function, and in influencing osmotic balance between cells and interstitial fluid, with their distribution mediated in all animals by Na^+/K^+-ATPase pump. Potassium is also important in preventing muscle contraction and in impulse transmission through action potentials. It is the major cations inside animal cell and is thus important in maintaining fluid and electrolyte balance in the body. Potassium "activates "at least 60 different enzymes involved in plant growth. Potassium levels in fruits are analyzed by Flame Photometry. Flame photometry (more accurately called flame atomic emission spectrometry) is the branch of atomic spectroscopy in which the species examined in the spectrophotometer are in the form of atoms. The main objectives of this analysis are to determine the levels of potassium in fruits and discuss the benefits and risk of potassium in diet and this can be used to create awareness among people to prevent the problems like neurological disorders, hypokalemia, hyperkalemia and associated medical complications in future. The samples selected for study are fruits which are assumed to have good amount of potassium. A total of 15 samples were analyzed for potassium content. The analyzed fruits have shown a wide range of potassium levels based on which they were categorized into high medium and low potassium containing fruits. This data can be used by the physician or nutritionist to advise the diet in hyperkalemic or hypokalemic conditions.

Keywords
Potassium, Impulse Transmission, Hyperkalemic, Hypokalemic, Neurological Disorders, Electrolyte Balance.

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INTRODUCTION
Potassium is the chemical element with the symbol K [from Neo-Latin *Kalium]* and atomic number 19. Elemental is a soft silvery-white alkali metal that oxidizes rapidly in air and is very reactive with water, generating sufficient heat to ignite the hydrogen emitted in the reaction.

MELTING POINT: 63.38°C
BOILING POINT :759°C
DENSITY :0.862 g/cm^3

MOST COMMON IONS: K^+

Potassium-soft silvery-white alkali metal

OCCURANCE:

Potassium is formed in the universe by nucleosynthesis from lighter atoms. The stable form of potassium is created in supernovas via the explosive oxygen - burning process.

Elemental potassium does not occur in nature because it reacts violently with water [see section precautions below] .As varies compounds, potassium makes up about 2.6 % of the weight of the Earth's crust and is the seventh most abundant element similar in abundance to sodium at approximately 1.8% of the crust. In sea water, potassium at 0.39g/L [0.039 wt/v%] is far less abundant than sodium at 10.8g/L [1.08wt/v%].

BIOLOGICAL ROLE:

In the potassium is the eighth or ninth most common element by mass [0.2%] in the human body, so that a 60kg adult contains a total of about 120g of potassium. The body has about as much potassium as Sulfur and chlorine, and only the major minerals calcium and phosphorus and more abundant.

BIOCHEMICAL FUNCTION:

Potassium cations are important in neuron [brain and nerve] function, and in influencing osmotic balance between cells and the interstitial fluid, with their distribution mediated in all animals [but not in all plants] by the so-called $Na^+$by k^+ -ATP as pump. This ion pump uses ATP to pump three sodium ions out the cell and to potassium ions into the cell, thus creating an electrochemical gradient over the cell membrane. The action of the sodium—potassium pump is an example of primary active transport. The two carrier proteins on the left are using ATP to move sodium out of the cell against the concentration gradient. The proteins on the right are using secondary active transport to move potassium into the cell.

In addition, the highly selective potassium ion channels [which are tetramers] are crucial for the hyperpolarization, in for example neurons, after an action potential is fired. The most recently resolved potassium ion channel is KirBac3.1, which gives a total of five potassium ion channels [KcsA, kirBac1.1, KirBac3.1, KvAP, and MthK] with a determined structure. All five are from prokaryotic species.

MEMBRANE POLARIZATION:

Potassium is also important in preventing muscle contraction and the sending of all nerve impulses in animals through action potentials. By nature of their electrostatic and chemical properties, K^+ions are larger than Na^+ions, and ion channels and pumps in cell membranes can distinguish between the two types of ions, actively pumping or passively allowing one of the two ions to pass, while blocking the other.

A shortage of potassium in body fluids may cause a potentially fatal condition known as hypokalemia, typically resulting from vomiting, diarrhea, and/ or increased diuresis. Deficiency symptoms include muscle weakness, paralytic ileus, ECG abnormalities, decreased reflex response and in severe cases respiratory paralysis, alkalosis and cardiac arrhythmia.

ELECTROLYTE BALANCE:

Potassium is an essential mineral micronutrient in human nutrition; it is the major cation [positive ion] inside animal cells, and it is thus important in maintaining fluid and electrolytic balance in the body. Potassium makes up most of the cell fluid cations at about 150nmol/L [4.8g]. Plasma is filtered through to glomerulus of the kidney in enormous amounts, about 180 liters per day. 33g of potassium are filtered each day. Sodium pumps in the kidney must always operate to conserve sodium. Potassium must sometimes be conserved also, but, as the amount of potassium in the blood plasma is very small and the pool of potassium in the cells is about thirty times as large, the situation is not so critical for potassium. Since potassium is moved passively in counter flow to sodium in response to an apparent [but not actual] Donnan equilibrium, urine can never sink below the concentration of potassium is serum except sometimes by actively excreting water at the end of the processing. Potassium is secreted twice and reabsorbed three times before the urine reaches the collecting tubules.

At that point, it usually has about the same potassium concentration as plasma. At the end of the processing, potassium is secreted one more time if the serum levels are too high.

If potassium were removed from the diet, there would remain a minimum obligatory kidney excretion of about 200 mg per day when the serum declines to 3.0-3.5 mmol/L in about one week, and can never be cut off completely, resulting in hypokalemia and even death.

ROLE OF POTASSIUM IONS IN HUMAN HEALTH:

BLOOD PRESSURE:

The large international study of electrolytes and blood pressure [Inter salt] showed that potassium intake, as judged by 24hour urinary potassium excretion, was an important independent determinant of population blood pressure [He FJ, MacGregor GA, 1999]. A 30-45 nmol increase in potassium intake was associated with an average reduction in population systolic blood pressure of 2-3 mm Hg[Dyer AR, Elliott P, Shipley M,1994] Many clinical trials have shown that increasing potassium intake lowers blood pressure both in people with high blood pressure and, to a lesser extent, in those with normal blood pressure. Most of these trials have used slow release potassium chloride, which is convenient for a double-blind study. However, the best way to increase potassium intake is to increase consumption of foods high in potassium, particularly fresh fruit and vegetables.

Two areas of controversy remain about the relation between potassium intake and blood pressure. One is whether sodium and potassium intake, which have opposite effects on blood pressure, have additive effects when potassium intake is increased, and sodium intake is reduced. The inter salt study showed that blood pressure was directly related to sodium intake and inversely and independently related to potassium intake. Some small clinical trials have indicated that increasing potassium intake had less effect on blood pressure when sodium intake had been reduced. However, the dietary approaches to stop hyper tension study, in which fruit and vegetable consumption was increased with a consequent increase in potassium intake from 37 mmol/day to 71 mmol/day, showed a large fall in blood pressure despite sodium intake being fixed at a low intake of 130 mmol/day. A recently published study by the same group clearly showed an additive effect of increasing potassium and reducing sodium intake.

The other area of controversy is whether potassium chloride has a greater or lesser effect on blood pressure than other potassium slats. Potassium in fruits and vegetables is present with phosphate, sulphate, citrate, and organic anions including proteins rather than as potassium chloride. However, a comparison of the dietary study with clinical trials of potassium chloride indicates that the fall in blood pressure obtained by the increasing intake of fruits and vegetables is similar to that found by increasing potassium chloride intake.

STROKE:

The main risk factor for stroke is increased blood pressure. As increasing potassium intake lowers blood pressure, it is difficult to separate the effects of potassium on stroke that are mediated by blood pressure and thus that might be mediated by a direct effect of potassium. However, studies in rats found that a high potassium intake caused a large reduction in deaths from stroke even when blood pressure was precisely matched between those on the high and low potassium intakes. This strongly supports a direct protective effect of potassium on stroke.

HYPERCALCIURIA, KIDNEY STONES AND OSTEOPOROSIS

Increasing potassium intake reduces urinary calcium excretion and causes a positive calcium balance **[Osorio AV, 1997]**. Increasing potassium intake may therefore help manage hypercalciuria. Eleven children with idiopathic hypercalciuria who were treated with potassium in the form potassium citrate [two patients], potassium gluconate [one patient], potassium chloride [seven patients], or a high potassium diet [one patient] all had a significant reduction in there urinary calcium: creatinine ratio after two weeks. By reducing calcium excretion, a high potassium intake may also reduce the risk of kidney stones.

If increasing potassium intake reduce calcium excretion and causes a positive calcium balance, it may be associated in the longer term with a higher bone mass. In a cross sectional study of 994 healthy premenopausal women aged 45-49 years, bone mineral density in the lumbar spine and femoral neck increased with increasing potassium intake A study of 62 healthy women aged 45 to 55 years found that a higher potassium intake was associated not only with a higher bone mass but also with lower excretion of pyridinoline and deoxypyridinoline. Administration of potassium bicarbonate to 18 postmenopausal women for 18 days reduced urinary calcium and hydroxyproline excretion and increased serum osteocalcin concentration, indicating a reduction in reabsorption of bone and an increase in the rate of bone formation. Urinary calcium excretion is also associated directly with sodium intake and affected by acid -base homeostasis. To try to clarify the separate effects of potassium, sodium and the accompanying anions, Lemann et al Compared the effects of administering potassium chloride, potassium bicarbonate, sodium chloride, and sodium bicarbonate [90 mmol/day] in 10 healthy adults of fixed metabolic diets. Each supplement was given for four days in random order. They also studied the effects of a reduction in potassium chloride and potassium bicarbonate in eight people. Giving potassium bicarbonate had the greatest effect on reducing calcium excretion, but potassium chloride also reduces the fasting the urinary calcium creatinine ratio significantly. Sodium bicarbonate did not effects calcium excretion, whereas sodium chloride increased calcium excretion. A reduction in potassium chloride and bicarbonate caused an increase in calcium excretion and fasting urinary calcium: creatinine ratio to similar extents. These results show that potassium has an independent effect on reducing urinary calcium excretion and that potassium bicarbonate has a greater effect than potassium chloride. An increase in potassium bicarbonate combined with a reduction in sodium intake would probably have an additive effect.

GLUCOSE INTOLERANCE:

Glucose intolerance may occur in clinical condition where there is severe hypokalemia and a deficit in potassium balance such as primary or secondary aldosteronism or after prolonged treatment with diuretics. Correcting the underlying cause or increasing potassium intake usually improves he glucose intolerance. Reduced potassium intake produced a significant fall in serum potassium and total body potassium concentrations, and this was associated with a significant decline in the amount of glucose metabolized and in the plasma insulin response to sustained hyperglycemia.

Adequate Intake:

A potassium intake sufficient to support life can in general be guaranteed by eating a variety of foods. Clear cases of potassium deficiency (as defined by symptoms, signs and a below-normal blood level of the element) are rare in healthy individuals. Foods rich in potassium include parsley, dried apricots, dried milk, chocolate, various nuts (especially almonds and pistachios), potatoes, bamboo shoots, bananas, avocados, soybeans, and bran, although it is also present in sufficient quantities in most fruits, vegetables, meat and fish.

Optimal Intake:

Epidemiological studies and studies in animals subject to hypertension indicate that diets high in potassium can reduce the risk of hypertension and possibly stroke (by a mechanism independent of blood pressure), and a potassium deficiency combined with an inadequate thiamine intake has produced heart diseases in rats. There is some debate regarding the optimal amount of dietary potassium. For example, the 2004 guidelines of the Institute of Medicine specify a DRI of 4,000 mg of potassium (100mEq), though most Americans consume only half that amount per day, which would make them formally deficient as regards this particular recommendation. Likewise, in the European Union, in particular in Germany and Italy, insufficient potassium intake is somewhat common. Italian researchers reported in a 2011 meta-analysis that a 1.64 g higher daily intake of potassium was associated with a 21% lower risk of stroke.

<u>IN DIET</u>

RDA Values for potassium:

LIFE STAGE	AGE	MALES (mg/day)	FEMALES (mg/day)
Infants	0-6 months	400	400
Infants	7-12 months	700	700
Children	1-3 years	3000	3000
Children	4-8 years	3800	3800
Children	9-13 years	4500	4500
Adolescents	14-18 years	4700	4700
Adults	19 years and older	4700	4700
Pregnancy	14-50 years	-	4700
Breast Feeding	14 – 50 years	-	5100

POTASSIUN IN SELECTED FOODS:

Values Are Averages and May Depend on Type and Cooking Method

High potassium foods:

Sample	Mg per 100 grams
Spinach	**1166**
Soybeans	**972**
Apricots	**850**
Dates	**750**
Yogurt	**531**

Medium potassium foods

Chicken	458
Milk	426
Banana	422
Green pepper	349
Peas	314
Black grapes	300
Tomato	290
Papaya	257
Pine apple	250
Cabbage	240
Strawberry	240
Pomegranate	236
Almonds	219

LOW POTASSIUM FOODS:

Chickoo	193
Mango	190
Green grapes	191
Peanuts	191
Orange	180
Watermelon	170
Apple	107
Grape juice	80

Medical Supplementation and Diseases

Supplements of potassium in medicine are most widely used in conjunction with loop diuretics and thiazides, classes of diuretics that rid the body of sodium and water but have the side-effect of also causing potassium loss in urine. A variety of medical and non-medical supplements are available. Potassium salts such as potassium chloride may be dissolved in water, but the salty /bitter taste of high concentrations of potassium ion make palatable high concentrations liquid supplements difficult to formulate. Typical medical supplemental doses range from 10 mmol (400 mg, about equal to a cup of milk or 6 US fl oz (180 ml). of orange juice) to 20 mmol (800 mg (per dose). Potassium salts are also available in tablets or capsules, which for therapeutic purposes are formulated to allow potassium to leach slowly out of a matrix, as very high concentrations of potassium ion (which might occur next to a solid tablet of potassium chloride) can kill tissue, and cause injury to the gastric or intestinal mucosa. For this reason, non-prescription supplement potassium pills are limited by law in the US to only 99 mg of potassium.

Individuals suffering from kidney diseases may suffer adverse health effects from consuming large quantities of dietary potassium. End stage renal failure patients undergoing therapy by renal dialysis must observe strict dietary limits on potassium intake, as the kidneys control potassium excretion, and buildup of blood concentrations of potassium (hyperkalemia) may trigger fatal cardiac arrhythmia.

<u>FLAME PHOTOMETER</u>

PRINCIPLE:

Flame photometry [more accurately called flame atomic emission spectrometry] is a branch of atomic spectroscopy in which the species examined in the spectrometer are in the form of atoms. In all case the atom under investigation are excited by light. Absorption techniques measure the absorbance of light due to the electrons going to a higher energy level. Emission techniques measure the intensity of light that is emitted as electrons returns to the low energy levels. Flame photometry is suitable for qualitative and quantitative determination of several cations, especially for metals that are easily excited to higher levels at a relatively low flame temperature [mainly Na, K, Rb, Cs, Ca, Ba, Cu]. This technique uses a flame that evaporates the solvent and also sublimates and atomizes the metal and then excites a valence electron to an upper energy state. Light is emitted at characteristic wavelengths for each metal as the electron returns to the ground state that makes qualitative determination possible. Flame photometers use optical filters to monitor for the selected emission wavelength produced by the analyte species. Comparison of emission intensities of unknowns to either that of standard solution [plotting calibration curve], or to those of an internal standard [standard addition method], allows quantitative analysis of the analytic metal in the sample solution.

The following process occurs in the flame photometer.

1. NEBULIZATION: A solution containing the relevant substance to be analyzed is aspired into the burner and dispersed into the flame as a fine spray. This process is called nebulization. The most commonly employed flame photometry can be grouped into two types:

a. Flames in which the fuel and oxidant as air or oxygen are well mixed before combustion, these are called **Pre-Mix or Laminar Flames** as they exhibit laminar flow.

b. Flames in which the fuel gas and the oxidant are first mixed in the flame itself. They are called **Unpremix or Turbulent Flames** since they exhibit turbulence. Flames are not uniform in composition, length or cross section.

2. VAPORIZATION: The heat of the flame vaporizes the sample constituents. No chemical change takes place at this stage.

3. ATOMIZATION: At this stage the metal ions that were in the solvent are reduced to metal atoms. For example, 2+ Mg [aq]+ 2e_Mg [g]. By heat of the flame and action of the reducing gas [fuel], molecules and ions of the sample species are decomposed and reduced to give atoms.

4. EXICITATION: The atoms at this stage are able to absorb energy from the heat of the flame. The atom of energy absorbed depends on the electrostatic forces of attraction between the negatively charged electrons and the positively charged nucleus. This in turn depends upon the number of protons in the nucleus. As electrons absorb energy, they move to higher energy levels and are in the excited state.

5. EMISSION OF RADIATION: Electrons in the excited state are very unstable and move back down to the ground state or a lower energy state quite quickly. As they do so, they emit energy in the form of radiation of characteristic wavelengths, which is measured by a detector. For some metals this radiation corresponds to wavelengths of light in the visible region of the electromagnetic spectrum and is observed as a characteristic color of the flame. As electrons from different energy levels are able to emit light as they relax, the flame color observed will be a mixture of all the different wavelengths emitted by the different electrons in the metal atom under investigation.

INSTRUMENTATION:

The sample is introduced into a flame where in it undergoes a number of processes leading to the formation of excited atomic species which emit radiation. The radiation is then measured and suitably analyzed. The instrument used for this purpose is called flame photometer and it consists of the following basic components.

1.FLAME ATOMISER: It converts the sample into excited atomic species and consists of the following.

- **Nebulizer and Mixing Chamber:** It is a means of transporting a homogenous solution into the flame at a steady rate. Pneumatic nebulizer is the most commonly used nebulizer for introducing aqueous/liquid samples.
- **Atomizer Burner:** Here the fuel and oxidant burn to give a flame that can be maintained in a constant form and at a constant temperature. Two types of atomization burners have been used in flame photometry which are given below and explained in the following paragraphs.
  a) Pre-mix or Lundegarh burner
  b) Total consumption burner

2. MONOCHROMATOR [OR FITER]: It isolates the light of the wavelength to be measured from that of extraneous emissions. Generally, a grating or a prism monochromator is employed.

3. DETECTOR: It helps in measuring the intensity of radiation emitted by the flame. Photo emissive cells or photomultiplier tubes are commonly employed for the purpose.

4. AMPLIFIER AND READOUT DEVICE: It is used to amplify the signal and provides a suitable output. Nowadays the instruments have microprocessor-controlled electronics that provides outputs compatible with the printers and computers thereby minimizing the possibility of operator error in transferring data.

Interferences in Quantitative Determinations:

The success of the quantitative determination depends on how accurately the intensity of the emitted radiation represents the concentration of the analytic. It has been found that number of factors besides the analytic, affect the intensity of the emitted radiation. The analytical signals measured often include contributions from constituents other than the analytic. The constituent are called the **matrix constituents.** The contributions are known as **interferences** and are found to influence the outcome of the analytical procedure. These can be corrected by subtracting their contribution of the interferent can be calculated from the magnitude of the interference and the concentration of the interferent. The interferences encountered can be classified as follows.

- Spectral interference
- Ionized interferences
- Chemical interferences

OBJECTIVES

- To determine the levels of potassium in fruits and discuss the benefits and risks of potassium in diet.
- To analyze potassium levels in fruits and this can be used to create awareness among people to prevent problems like neurological disorders, hypokalemia, hyperkalemia and

associated medical complications in their future.

- To establish a procedure for analyzing potassium levels in fruits and have a comparison study with processed foods, vegetables and dairy products from the literature values.

Effects of Potassium:

Potassium, along with calcium and sodium, is an electrolyte (mineral salt) important to the human nervous system, muscle function, fluid balance and heart, kidney and adrenal functions. A deficiency of potassium (hypokalemia) can manifest as weakness, fatigue, confusion, heart irregularities, and sometimes problems in muscular coordination. Insufficient potassium can also exaggerate the effects of sodium. The first sign of a potassium deficiency is usually a generalized weakness. Most people get sufficient potassium in a reasonably healthy diet – one that includes fresh fruits and vegetables and is low in sodium. Mineral imbalances can occur from starvation diets, but more commonly results from excessive fluid loss from sweating, diarrhea, or the use of diuretics and laxatives. A diet high in potassium is recommended as the first-choice treatment for hypertension. This is only true during the early stages before medication is necessary. In later stages potassium in the diet may be used under the close supervision of a knowledgeable, nutritionally oriented physician. People who exercise heavily, and therefore sweat heavily, have higher potassium needs; they may need to take supplements to balance the electrolyte levels, or to bulk up their menus with high potassium foods.

On the other hand, people who suffer from some diseases, including diabetes and renal (kidney) failure can no longer metabolize minerals properly and need to guard against getting too much potassium in their diet.

Need of the Study:

Since potassium has not been one of the nutritional values required in food labeling, determining the amount of dietary potassium has been more difficult than, for example, sodium or fat content in foods. This changed in November 2000; effective in the year 2001, potassium content will be included in the labelling on food packaging.

People without the ordinary potassium requirements – either a need to supplement because of fluid loss, or a need to limit their intake – should consult with their physician or nutritionist to determine their specific needs from each group.

Hence it is important to know the potassium content in various fruits and vegetables which are present in our regular diet. Such data can be used by the physician or nutritionist to advise the diet for Hyperkalemic or Hypokalemic patients.

METHODOLOGY

MATERIALS:

1. Conical flasks
2. Beakers
3. Pipettes
4. Measuring cylinders
5. Standard flasks
6. Deionized water

EQUIPMENT:

1. Flame photometer
2. Electrical balance

CHEMICALS REQUIRED:

1. Deionized water
2. Hydrochloric acid (HCl): 0.5% HCl (V/V) (to be used for standards)
3. Sodium chloride (NaCl): for 1000ppm weigh 635mg of NaCl and dissolve it in 250ml of deionized water in a 250ml standard flask.
4. Potassium chloride (KCl): for 1000ppm weigh 477mg of KCl and dissolve it in 250ml of deionized water in a 250ml standard flask.

Flame photometer measures the concentration of sodium, potassium, calcium and lithium in terms of the quantity of the element itself in solution. Standard solutions prepared from the salts of these metals must be made up to contain the concentrations required in terms of the quantity of the element. Na, K, Ca or Li. The following values are typical for standards of 1mg. Na/100mL, 1mg.K/100mL, 10mg.Ca/100mL, and 10mg.Li/100mL.

PARTS PER MILLION (ppm)

This is generally employed for those solutions in which a substance is present in a very small quantity. It represents gram of a solute per million m of the solution.

$$ppm = \frac{Mass of component}{Total mass of the solution X 10^6}$$

(or)

$$ppm = \frac{gm or ml of the solute or substance}{gm or ml of the solution X 10^6}$$

Thus 1 ppm of a solution of NaCl/KCl in water represents

1 ppm = 1mg KCl / L of solution
= 1mg KCl / 1000 mL of solution
= 1µg KCl / mL of solution.

QUALITY OF SALTS REQUIRED

1000 ppm standard solution should have 1000mg of element in 1000 mL salt solution of the element.

Thus 100 mL standard solution should be made up of a quantity of salt of the element in mg., equivalent to (250 X molecular wt. of salt/Atomic Wt. of element), to contain 250mg. of element.

Element	Atomic Wt of element	Salt	Molecular Wt of salt	Quantity of salt in mg. required for preparation of 100ml of 1000ppm standard solution
Na	22.99	NaCl	58.44	254
K	39.10	KCl	74.56	190.8
Ca	40.08	$CaCo_3$	100.09	249.6
Li	6.94	Li_2CO_3	73.89	532.4

PREPARATION OF STANDARD SOLUTIONS:

Stock Standard Solution:

Weigh accurately 254mg of "Anal R" quality of sodium chloride (NaCl) into a 100ml volumetric flask through a funnel. Weigh accurately 190.8mg "Anal R" quality of Potassium chloride (KCl) and transfer it into the same volumetric flask through the same funnel. Add double distilled water to the flask, dissolve the crystals and make up the solution to the mark with double distilled water. This stock standard contains 1000mEq/100ml of sodium (Na) and 1000mEq/100ml Potassium (K).

Working Standard Solutions:

This stock standard solution is diluted 1:100 with double distilled water (10ml stock standard solution make up to 1 litre). This diluted stock standard solution is further diluted as below to obtain a series of working standard solutions of Na and K.

S.No	Diluted stock standard solution in ml	Double distilled water in ml	Concentration of mEq/L of working standard solution of Na & K (in ppm)
1	4	96	40
2	6	94	60
3	8	92	80
4	10	90	100
5	12	88	120

SAMPLES:

The samples used are fruits that are rich in potassium. They are:

1. Banana
2. Green grapes
3. Grape juice
4. Black grapes
5. Tomato
6. Pomegranate
7. Watermelon
8. Papaya
9. Mango
10. Strawberry
11. Pineapple
12. Apple
13. Dates
14. Chickoo (sapota)
15. Orange

BANANA (Musa acuminate)

Bananas provide a natural source of potassium without the risk if unusually high doses. Potassium supplements come with the risk of dangerous levels, which can result in heart and kidney problems. Bananas provide quick access to potassium that metabolizes quickly. Eaten fresh and in moderation, bananas may bring immediate results in cases where imbalances of potassium and sodium exist. A medium banana a day, along with ample servings of fresh fruits and vegetables, provides the needed amounts of potassium. A medium banana has about 422mg of potassium.

PAPAYA (Carica papaya)

Papaya has these following properties, increased protection from bacterial and viral infection, immune function, reduced cancer risk, protection against heart disease, slowing aging, DNA repair and protection, alleviation of cardiovascular disease, alleviation of hypertension (high blood pressure). The potassium content in papaya is about 257mg per 100 grams.

GRAPES (Vitis vinifera)

Grapes are unique in that you can enjoy them fresh, dried, in juice form or in a variety of foods. Plants such as grapes absorb minerals through soil and water during growth, passing beneficial nutrients on to you. Grapes come in an array of flavors and colors, each one providing varying amounts of potassium, an essential dietary mineral. About 80 percent of the weight of grapes is water, making them an excellent low-calorie, nutrient rich snack food.

More than 50 different types of grapes can be found in stories, varying in color from white or golden, up to deep red and purple. Some grapes have seeds, while others are seedless. Your average seedless green grapes contain right around 175 mg of potassium per cup. Red grapes with seeds offer nearly 290mg of potassium for every 1-cup serving size, while muscadine grapes, which have a deep purple color, provide 200mg per cup.

Grapes have a refreshing sweet flavor and are frequently made into juice or jam, another way to sneak potassium into your diet. Maximize your potassium intake by selecting grape juice that is 100 percent juice. Cocktails or blends are full of sugar and sweeteners, so you won’t get all of the beneficial nutrients. An 8 oz. glass of unsweetened grape juice contains more than 250 mg of potassium, while the same serving of grape juice cocktail provides a minimal 80 mg. spreading grape jam on your toast at breakfast or your peanut butter and jelly sandwich at lunch packs in an additional 15 mg of potassium.

ORANGE

WATERMELON (Citrullus lanatus)

DATES (Phoenixdactylifera)

PINE APPLE (Ananas comosus)

APPLE (Malus domestica)

STRAWBERRY (Fragaria)

TOMATO (Solanum lycopersicum)

POMOGRANATE (Punica granatum)

MANGO (Mangifera)

SAPODILLA OR SAPOTA (Manilkara zapota)

Sample Processing:

Prepare an HCl solution by diluting 500 ml of concentrated HCl with 220 ml of water. The sample is prepared by weighing 5g of each (diced or ground) into 500ml Erlenmeyer flasks. Add 50 ml of the above HCl solution. Bring each to a boil on a hot plate, and then simmer for 5 min. Cool and filter each through Whatman #1 filter paper into flasks. Now quantitatively transfer the supernatant for each to separate 100ml volumetric flasks. Dilute to the mark with distilled water and shake. This extract is used to prepare the appropriate dilutions required for the experiment.

SAMPLE ANALYSIS:

The air pressure during the working of the instrument should be maintained between 10 to 15 mm hg. Then to check that the flame is appropriate it should be noted that the blue flame is of 8-10mm height. The protocol for the analysis of the sample containing sodium is as follows:

1. Let the instrument warm up for 5-10 minutes.
2. Set the pressure of the instrument using the black colored air knob.
3. Using the gas knob ignite the flame with the help of the red colored ignition button.
4. Select the appropriate options that are displayed on the screen depending on the number of elements to be assayed.
5. Feed distilled water to the instrument when the instrument prompts. The distilled water is required for cleaning the nebulizer.
6. Feed the blank. The blank used in the experiment is 0.5% HCl solution.
7. Feed the standards of appropriate concentration i.e. 40ppm, 60ppm, 80ppm, 100ppm and 120ppm.
8. Once the standards are over feed the unknown biological samples of appropriate dilutions.
9. The potassium and the sodium values that are present in the unknown samples are viewed using the view option.
10. Once the experiment is over the values can be saved in the instrument in the form of a file with the required file name and the date on which the experiment is performed.

CALCULATIONS:

CALCULATION FOR POTASSIUM ELEMENT

1000 ppm of standard solution contain 190.8 mg of KCl which contains 100mg of K^+
Alone.

X ppm of sample solution contain $\rightarrow$?

Amount of potassium = $\frac{Xx\ 100mg}{1000}$

Therefore, amount of potassium = y mg/ 100ml

CALCULATION FOR POTASSIUM CHLORIDE

1000ppm of standard solution contain 190.8mg of KCL which contains 100mg of K^+ alone

X ppm of sample solution contain → ?

Amount of potassium = $\frac{Xx\ 190.8mg}{1000}$

Therefore, amount of Potassium Chloride = y mg/ 100ml

RESULT

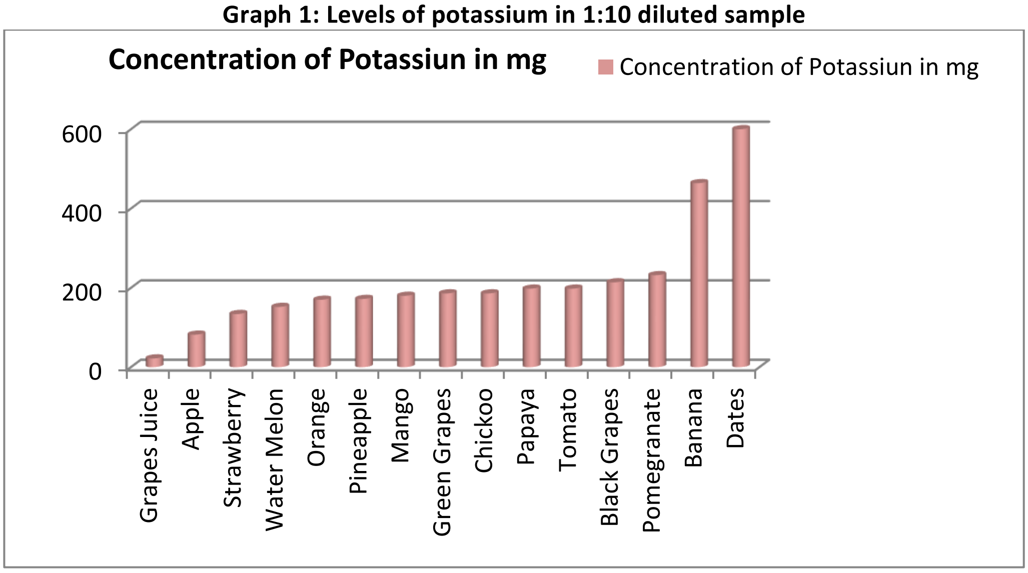
The samples selected for study are fruits which are assumed to have good amounts of potassium. A total of 15 samples were analysed for the potassium content. The data obtained in analysis is shown in the table below:

Levels of potassium in 1:10 diluted sample

S.NO	FRUITS	1:10(PPM)	MILLIGRAM POTASSIUM PER 5GM SAMPLE	MILLIGRAM POTASSIUM PER 100GM SAMPLE
1	Banana	23.2	23.2	464
2	Grape juice	1.1	1.1	22
3	Green grapes	9.3	9.3	186
4	Black grapes	10.7	10.7	214
5	Papaya	9.9	9.9	198
6	Orange	8.5	8.5	170
7	Watermelon	7.6	7.6	152
8	Dates	30	30	600
9	Pineapple	8.6	8.6	172
10	Apple	4.1	4.1	82
11	Strawberry	6.7	6.7	134
12	Pomegranate	11.6	11.6	232
13	Mango	9	9	180
14	Chickoo	9.3	9.3	186
15	Tomato	9.9	9.9	198

Based on the data obtained from the analysis a graph was plotted by taking the types of fruits on X-axis and the concentration of potassium in mg on the Y-axis.

Graph 1: Levels of potassium in 1:10 diluted sample



From the above graph the fruits can be categorized as follows:

- Low potassium containing fruits (0 to 180mg): Apple, Strawberry, Watermelon, Orange Pineapple, Mango, Grape Juice.
- Moderate Potassium containing fruits (180-250mg): Black Grapes, Papaya, Tomato, Chickoo, Green Grapes, Pomegranates.
- High Potassium containing fruits (250mg and above): Dates and Banana.

Levels of potassium chloride in 1:10 diluted sample

Using the potassium data obtained from flame Photometry the content of potassium chloride was also calculated in the sample. The potassium chloride content from various fruits is shown in table below.

S.NO	FRUITS	1:10(PPM)	MILLIGRAM KCL PER 5GM SAMPLE	MILLIGRAM KCL PER 100GM SAMPLE
1	Banana	28.2	44.3	885.3
2	grape juice	1.1	2.1	42
3	green grapes	9.3	17.7	354.8
4	black grapes	10.7	20.4	408.3
5	papaya	9.9	18.9	377.8
6	orange	8.5	16.8	335.8
7	watermelon	7.6	14.5	290
8	dates	30	57.2	1144.8
9	pineapple	8.5	16.4	328.2
10	apple	4.1	7.8	156.5
11	strawberry	6.7	12.8	255.7
12	pomegranate	11.6	22.1	442.7
13	mango	9	17.2	343.4
14	chickoo	9.3	17.7	354.9
15	tomato	9.9	18.9	377.8

CONCLUSION:

Based on the analysis the various fruits analysed can be categorized into three categories:

- Low potassium containing fruits (0-180mg); Apple, Strawberry, Watermelon, Orange, Pineapple, Mango, Grape juice.
- Moderate potassium containing fruits (180-250mg); Black grapes, Papaya, Tomato, Chickoo, Green grapes, Pomegranate.
- High potassium containing fruits (250mg and above); Dates, Banana.

Increasing potassium intake lowers blood pressure both in people with high blood pressure and, to a lesser extent, in those with normal blood pressure. As increasing potassium intake lowers blood pressure, it is difficult to separate the effects of potassium on stroke that are mediated by blood pressure and those that might be mediated by a direct effect of potassium. Increasing consumption of fruits protects against stroke.That increasing potassium intake is itself important in reducing stroke, and some of this effect may be independent and additive to the effect that potassium has on blood pressure.

It plays an important role in regulating our blood pressure, bone mass, nervous system, muscle function, heart, kidney, and adrenal function. Low levels of potassium can cause potassium deficiency and bring on a whole host of health problems. If you follow a healthy, well-balanced, and plentiful diet of foods high in potassium, it is not likely that you will need to worry about suffering from mineral imbalance. A number of potassium supplements are available too in market, and quite a few people include these in their daily regimen. This is not really necessary if, as mentioned, your meals contain enough potassium high foods. Athletes and other people also require potassium supplements. Rigorous exercise causes excess sweating which leads to mineral imbalance and one should take frequent breaks to refuel depleting potassium levels.

Potassium appears to have profound influence on fruit quality through its influence on size, appearance, colour, soluble solids, acidity and vitamin contents. Potassium deficiency in fruits is often observed in k-rich soils. Fruits like grapes, peach and passion fruit have high potassium requirement. Although potassium does not form part of the structure of plant constituents, it regulates many vital functions like carbon assimilation, translocation of proteins and sugars, water balance in plants, maintaining turgor pressure in the cell, root development, improving quality of the fruits by maintaining desirable sugar to acid rate, ripening the quality of fruits and many other processes. Thus, it is the most important nutrient regulating the quality of fruits. Potassium is involved in many aspects of plant physiology viz., activation of more than 60 enzymes, aiding in photosynthesis, favouring high energy state, regulation of stomata opening etc. With the changing cropping pattern, need for potassium nutrition has become pertinent to obtain high yield of quality fruits.

The analysed fruits have shown a wide range of potassium levels based on which they were categorised into high, medium, low potassium containing fruits. The data can be used by the physician of nutritionist to advice the diet for Hyperkalemia or hypokalemia patients.

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