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Determination of Vitamin C Content and Mineral Elements in Fruits Samples in Karu Metropolis, North Central Nigeria

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Abstract: Adequate consumption of fruits, vegetables and their juices with high vitamin C content and antioxidant capacity result in improved health, reduced risk of chronic diseases, optimal nutrition and general well-being. This study was to determine the vitamin C content of fresh fruits juices extracted from Mango, Orange, Banana and Water melon and some Mineral elements content levels in the same samples. Fruits were purchased from Masaka local markets and its metropolis in Karu, Nasarawa State. Titration method was employed to determine the vitamin C content of test sample juices, Atomic Absorption Spectrophotometric method as described by AOAC was used for the elemental analysis. Results showed that the amount of vitamin C in the sample was Orange>Mango>Water melon> Banana. The mineral contents determined include: Potassium, Calcium, Sodium, Iron and Magnesium. It was observed from the result obtained that the fruits showed varying degree of concentrations of the mineral elements analyzed using the Atomic Absorption Spectrophotometer. Orange was found to contain the following levels of minerals in the descending order: Potassium 374.2Mg/Kg followed by Magnesium 29.30Mg/Kg followed by Calcium 12.89Mg/Kg, Sodium 11.45Mg/Kg, and Iron 4.76Mg/Kg. Watermelon was found to contain Sodium 7.09Mg/Kg, Magnesium 7.97Mg/Kg, Calcium 8.39Mg/Kg Iron 3.08Mg/Kg and Potassium -2.63Mg/Kg in the descending order. Banana's levels of minerals stood as Potassium 438.10 Mg/Kg a value even higher than that of orange which was followed by Magnesium 47.40Mg/Kg, Sodium 16.35Mg/Kg, Iron 7.69Mg/Kg, and Calcium-18.20Mg/Kg in the descending order. Analysis of variance ANOVA ($P < 0.05$) reveals a statistically significance difference among the fruit samples studied. All the fruits samples were found to be within the international standards and consumers of these fruits can use them as good supplements as the case may be depending on their daily requirements.

Keywords: Vitamin C, Mineral Elements, Antioxidant

1. Introduction

Vitamin C, also known as ascorbic acid and L-ascorbic acid, is a vitamin found in various foods and sold as a dietary supplement [1]. It is used to prevent and treat scurvy. It is also an essential nutrient involved in the repair of tissue and the enzymatic production of certain neurotransmitters. It is required for the functioning of several enzymes and is important for immune system function [18]. It also functions as antioxidants. Vitamin C was discovered in 1912, isolated in 1928, and in 1933 was the first vitamin to be chemically produced [16]. It is on the World Health Organization Model List of Essential Medicines, which lists the most effective and safe medicines needed in a health system [17]. Vitamin C is available as an inexpensive generic and over-the-counter medication [19]. Foods containing vitamin C include citrus fruits, kiwifruit, broccoli, Brussels sprouts, raw bell peppers, and strawberries [18]. Prolonged storage or cooking may reduce vitamin C content in foods [18].

Vitamin C is an essential nutrient for certain animals including humans. The term vitamin C encompasses several vitamers that have vitamin C activity in animals. Ascorbate salts such as sodium ascorbate and calcium ascorbate are used in some dietary supplements. These release ascorbate upon digestion. Ascorbate and ascorbic acid are both naturally present in the body, since the forms interconvert according to pH. Oxidized forms of the molecule such as dehydroascorbic acid are converted back to ascorbic acid by reducing agents [5].

Vitamin C functions as a cofactor in many enzymatic reactions in animals (and humans) that mediate a variety of essential biological functions, including wound healing and collagen synthesis. In humans, vitamin C deficiency leads to impaired collagen synthesis, contributing to the more severe symptoms of scurvy [5]. Another biochemical role of vitamin C is to act as an antioxidant (a reducing agent) by donating electrons to various enzymatic and non-enzymatic reactions [6]. Doing so converts vitamin C to an oxidized state - either as semi dehydroascorbic acid or dehydroascorbic acid. These compounds can be restored to a reduced state by glutathione and NADPH-dependent enzymatic mechanisms [10, 12, 8]. In plants, vitamin C is a substrate for ascorbate peroxidase. This enzyme utilizes ascorbate to neutralize toxic hydrogen peroxide (H_2O_2) by converting it to water (H_2O) [2, 11]

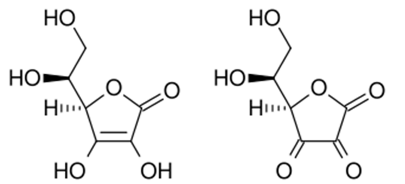

Figure 1. *The structure of Ascorbic Acid and Dehydro-ascorbic Acid.*

While plant foods are generally a good source of vitamin C, the amount in foods of plant origin depends on the variety of the plant, soil condition, climate where it grew, length of time since it was picked, storage conditions, and method of preparation [7].

2. Materials and Methods

Materials include Ascorbic acid, soluble starch, 5g potassium iodide (KI), 0.28g potassium iodate (KIO_3), Orange, Banana, Pineapple, and three selected commercial fruit juices. Also, other materials include 250cm^3, kitchen knife, measuring cylinder, Thermo scientific iCE 3000 series AAS and all reagents and chemicals used in this experiment were analytical grade.

2.1. Sample Collection

Orange, Watermelon, Banana and Mango fruits were purchased from Masaka market in Karu Local Government area of Nasarawa state Nigeria.

2.2. Sample Preparation

All the fruits juices were collected by blending 100g sample with 50ml of distilled water and strain then filtered with muslin cloth and finally made to 100 ml volumetric flask this was done after the fruits were washed with tap water and then with distilled water.

2.3. Preparation to iodine solution

0.5g soluble starch was added to 50 near-boiling distilled water and mixed well and allows tocool before use.

2.4. Preparation of Iodine Solution

5.00g potassium iodide (KI) and 0.268 g potassium iodate (KIO_3) were dissolved in 200 ml of distilled water then 30M of 3M of sulfuric acid was then added and poured into a 500ml graduated cylinder and diluted to a final volume of 500ml with distilled water then mixed well and finally transferred to a 600ml beaker as stock reagent.

2.5. Preparation of Vitamin C Standard Solution

0.25g vitamin C (ascorbic acid) tablet was dissolved in 100 ml distilled water and dilute to 250 ml with distilled water in a volumetric flask.

2.6. Standardizing Solutions

25.00ml of vitamin C standard solution was added to a 125 ml Erlenmeyer flask and 10 drops of 1% starch solution. The buret was rinsed with a small volume of the iodine solution and then filled and record as the initial volume.

The solution was titrated until the endpoint was reached observed by the emergence of the first sign of blue color that persists after 20 seconds of swirling the solution.

2.7. Sample Digestion

1g each of the samples was weight using a weighing balance and transferred to a test-tube, 20ml of concentrated Nitric acid was measured using a graduated cylinder and transfer into the test-tube and the mixture was heated using heating mantle until a clear solution was obtained indicating a complete digestion or extraction of the sample content.

2.8. Mineral Analysis

Mineral elements (Mg, Ca, Na, Fe, and K) were determined using atomic Absorption spectrophotometer (AAS), with the appropriate hollow cathode lamp and wavelength of each of the metals.

2.9. Statistical Analysis

Data collected was subjected to one way Analysis of variance (ANOVA) to assess whether heavy metals varied significantly between location, possibilities less than 0.05 ($P<0.05$) will be considered statistically significant.

3. Results

The result of the Vitamin C concentrations levels from the studied fruits samples in Masaka metropolis, are presented in Table 1 and Table 2 shows the concentrations of mineral elements parameter values of the fruits samples.

Table 1. *Results Obtained For Iodine Solution Method.*

SAMPLES	INITIAL READING	FINAL BURETTE READING	AV. VOLUME OF ACIC USED (Ml)	l-ascorbic acid (Mg/100g)
	0.00	18.00		
VITAMIN C TABLET	0.00	18.00	18.00	100.00
	0.00	18.00		
	0.00	3.10		
MANGO	0.00	3.10	3.11	17.30
	0.00	3.00		
	0.00	1.60		
BANANA	0.00	1.60	1.60	8.70
	0.00	1.60		
	0.00	9.00		
ORANGE	0.00	9.01	9.00	50.20
	0.00	9.00		
	0.00	2.20		
WATER MELON	0.00	2.10	2.23	12.40
	0.00	2.20		

Table 2. *Results Obtained For Mineral Elements Using AAS.*

Samples	Elements	N	Mean (mg/kg)	Std. Deviation
	Pottassium	2	374.2600	374.25±0.0035
	Sodium	2	11.4500	11.45±0.0035
Orange	Magnessium	2	29.3000	29.30±0.000
	Iron	2	4.8100	4.76±0.0106
	Calcium	2	12.8900	12.89±0.0071
	Pottassium	2	-2.6340	-2.63±0.0035
	Sodium	2	9.3700	7.09±0.0035
Watermelon	Magnessium	2	7.9700	7.97±0.000
	Iron	2	3.1000	3.08±0.0071
	Calcium	2	7.6400	8.39±0.0106
	Pottassium	2	438.1000	438.10±0.000
	Sodium	2	18.7300	16.35±0.0106
Banana	Magnessium	2	49.4000	47.40±0.0035
	Iron	2	7.6900	7.69±0.0071
	Calcium	2	-18.2000	-18.20±0.0035
	Pottassium	2	367.7900	367.79±0.0106
	Sodium	2	2.1900	2.18±0.0071
Mango	Magnessium	2	38.7700	38.77±0.0035
	Iron	2	4.2600	4.26±0.0106
	Calcium	2	-2.5900	-2.59±0.000

Concentration of Mineral Elements in Fruits Samples

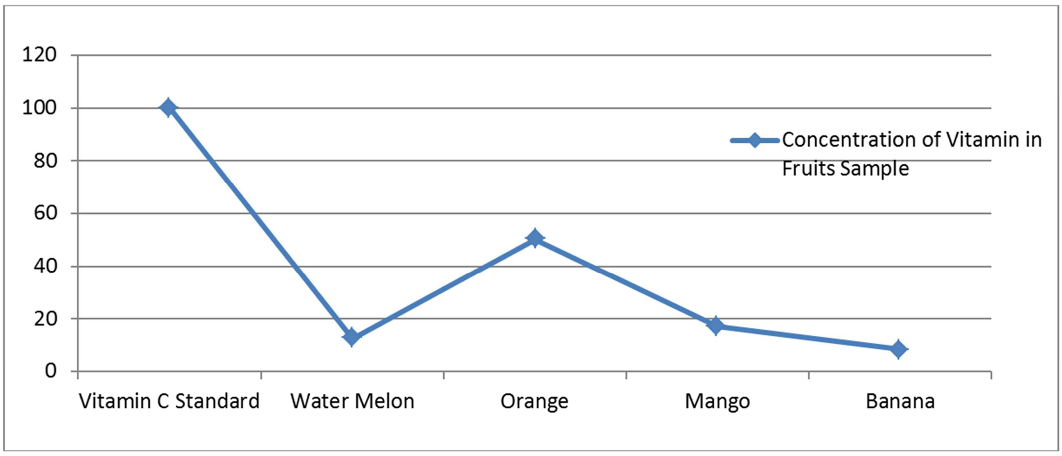

Figure 2. *A Graph of Concentration against Fruits Samples for Vitamin C.*

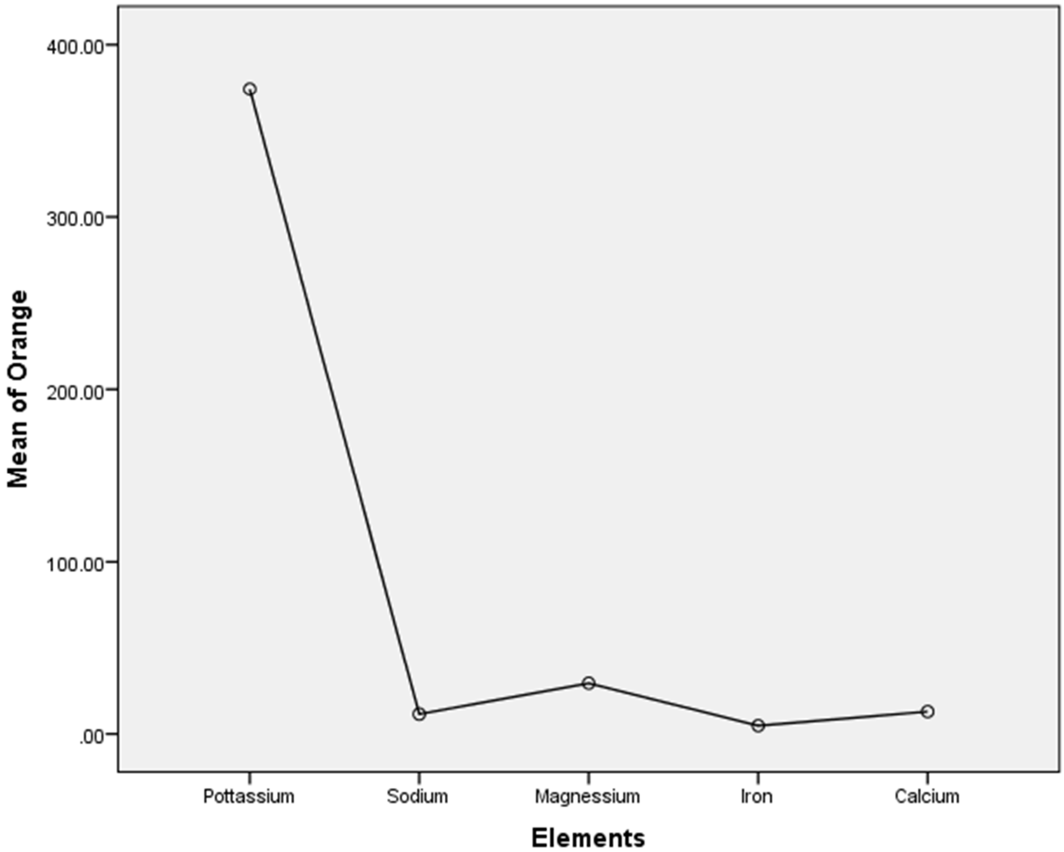

Figure 3. *A Graph of Mineral Elements Concentrations Orange.*

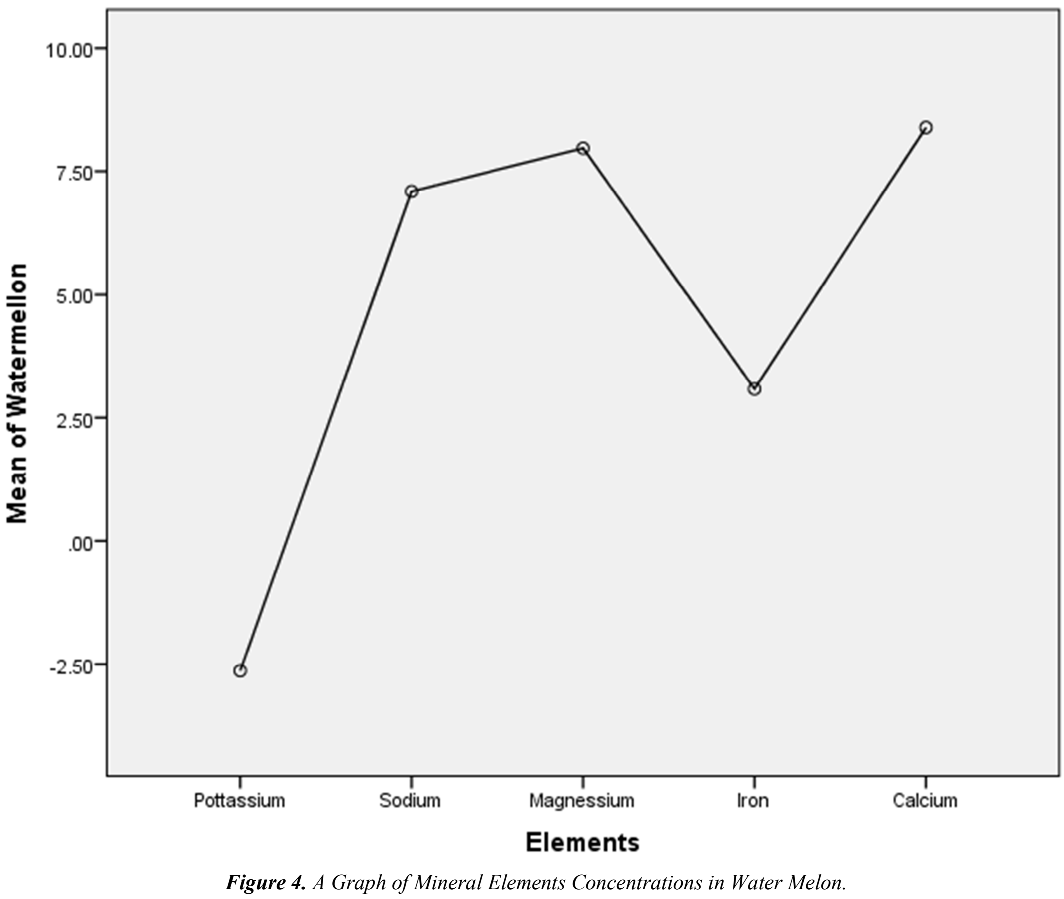

Figure 4. *A Graph of Mineral Elements Concentrations in Water Melon.*

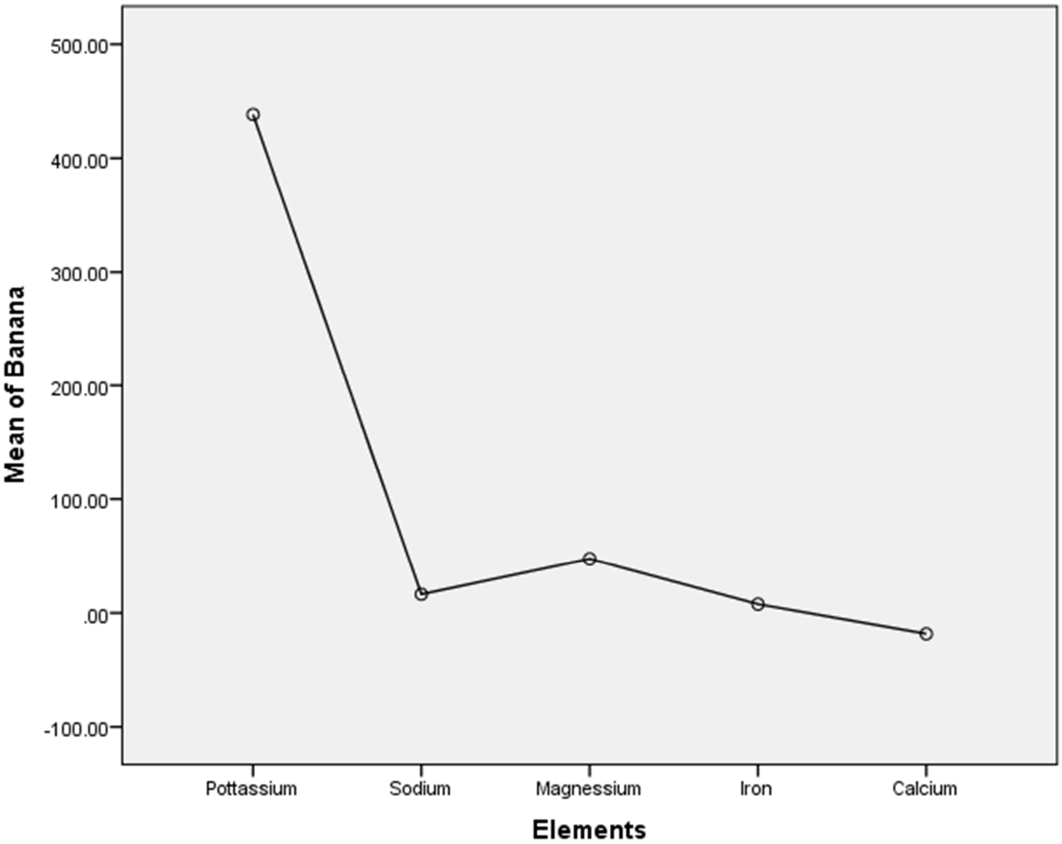

Figure 5. *A Graph of Mineral Elements Concentrations in Banana.*

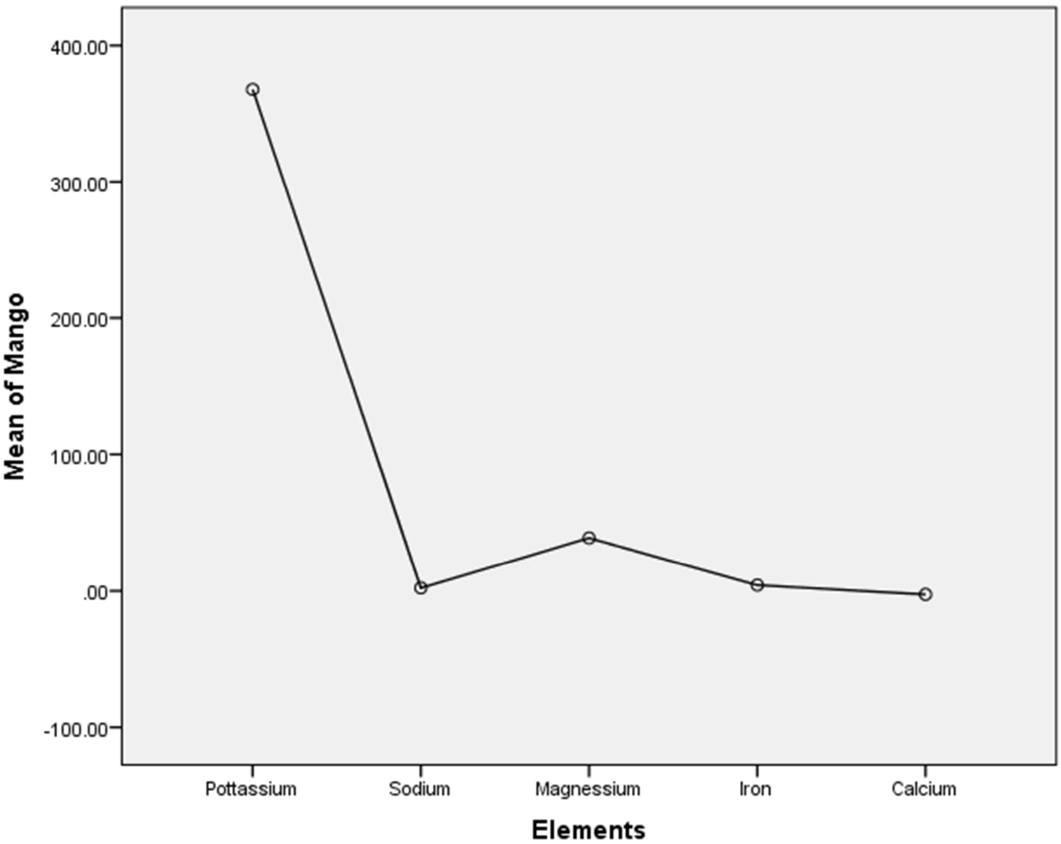

Figure 6. *A Graph of Mineral Elements Concentrations in Mango.*

4. Discussion

Vitamin C concentrations of the fruits samples analyzed indicates that Orange has the highest with 50.20 Mg/100g, followed by Mango with 17.3050.20 Mg/100g, Watermelon 12.4050.20 Mg/100g and Banana having the least value of 8.750.20 Mg/100g. concentration of mango was found to be higher and that of orange lower compere to that obtained by [1], but higher in both cases as reported by [9] Watermelon was found to have a higher concentration when compare to the report of (3) and that of Banana a little lower than the report obtain from [18].

Some of the mineral contents determined were Sodium (Na), Magnesium (Mg), Potassium (k), Calcium (Ca) and Manganese (Mn). As shown in Table 2, the concentrations of mineral elements determined are as follows:

Orange was found to contain (Potassium.2 > Magnesium > 29.30 > Calcium12.89 > Sodium > 11.45 > Iron 4.76) Mg/Kg.

Watermelon was found to contain (Sodium7.09 <Magnesium 7.97< Calcium < 8.39 < Iron 3.08 < Potassium -2.63) Mg/Kg in the descending order.

Banana's levels of minerals stood as follows: (Potassium 438.10 > Magnesium 47.40 > Sodium 16.35 > Iron 7.69 > Calcium-18.20) Mg/Kg.

Mango was found to contain (Magnesium 38.77 > Potassium 367.79 > Iron 4.26 > Sodium 2.18 > Calcium-2.59) Mg/Kg.

5. Conclusion

The Vitamin C levels were found to be as follows: Orange>Mango>Water melon>Banana. In the mineral elements determination Banana was found to contain the highest concentration of Potassium, Sodium, Magnesium and Iron except for Calcium in which Orange was found to contain the highest concentration.

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