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Determination of selected elements in different species of citrus fruits by Flame Photometer and Atomic Absorption Spectrometer

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Abstract: The present study aims to determine selected elements in fresh citrus juice by Flame Photometer and Atomic Absorption Spectrometer. The elements potassium, sodium (macronutrient), copper and iron (micronutrient) were analyzed in five different species of citrus fruits juice. The fruits used in study were of *Citrus limon, Citrus sinensis, Citrus paradise, Citrus limetta and Citrus nobilis.* The entire samples were collected from local market of Raipur, Chhattisgarh. Potassium is the most abundant element reported in the fruits followed by Na, Fe then Cu. The highest content of potassium, sodium and iron was reported in *C. nobilis* and the lowest level was observed in *C. limon.* While the value of copper was observed highest in *C. limon*. The calculated potassium to sodium ratio was as follows *C. limetta* > *C. nobilis* > *C. simesis* > *C. paradisi* > *C. limon.* It can be concluded that *C. nobilis* is the fruit having highest iron, sodium and potassium concentration, while highest potassium to sodium ratio was observed for *C. limetta* and *C. nobilis* so they can be considered best amongst the analyzed fruits for the patients of hypertension. The presence of mineral elements like sodium, potassium, copper and iron in these fruits makes them important and considerable sources of nutrient supplements to the public.

Index Terms **- Citrus fruits, juice, macro-nutrients, micro-nutrients, Flame Photometer, Atomic Absorption Spectrometer**

I. INTRODUCTION

Citrus plants belonging to the family Rutaceae, grown all over the world which include fruits such as lemon, orange, sweet lemon, lime, mandarine, sour orange, and grapefruit as a well-known promising source of different useful nutrients for human beings. Citrus fruits are one of the world's most important beneficial fruit crops and are known for their nutritive values and special aroma (Sanofer et al., 2014). It contains elements like sodium, potassium and calcium, and compounds like vitamin C (Bernardi et al., 2010). Required amount of these elements must be in human diet to pursue good healthy life (San et al., 2009). A number of these mineral elements are required in varying amount by humans for proper growth, function and overall well being (Hussain et al., 2010). There are variations in nutrient composition among and within the existing species of fruits depending on the characteristics of the land, climate, cultivation conditions and composition of irrigation water. The objective of this study was to determine the extent of accumulation of some essential nutrients (Na, K, Fe, and Cu).

II. RESEARCH METHODOLOGY

All the standard solution was prepared from analytical grade compounds of Merck Company. All the glassware's used were of Borosil. Prior to all chemical analyses, the reagent bottles, beakers, and volumetric flasks were cleaned by soaking overnight in 2N hydrochloric acid rinsed with water and oven dried at 60°C.

Sample collection and preparation: The samples of citrus fruits (*C. limon, C. sinensis, C. paradise, C. limetta, C. nobilis*) were purchased from local fruit market of Raipur. The fruits were peeled, squeezed and filtered the juice with stainless steel strainer. In the present study wet digestion method was used. 10ml of well mixed juice sample was taken and transferred to 100ml beaker and 10 ml HNO3 was added and covered with watch glass, the mixture was heated to 95°C on hot plate, and the digestion continued till no brown fumes evolved and solution becomes clear and colorless. The beaker was then cooled to room temperature. The solution was then filtered through whatman filter paper and transferred into a 100 ml volumetric flask and make up to the mark with de-ionized water, stopper the flask and mixed by inversion.

Determination of sodium and potassium: Potassium and sodium standards of 20, 40 and 60 ppm were prepared by 1000 ppm stock solutions of sodium and potassium. Deionised water was used as blank. The flame photometer was set up as outlined in its

instruction manual. The blank was aspirated and the instrument was calibrated using standards. The prepared sample solution was aspirated and the result was noted by the display.

Determination of copper and iron: Stock standard solutions of Merck, 1000 ppm concentrations were used for copper and iron. A calibration series of standards were prepared by appropriate dilution from its stock solution with 0.5% HNO3. The instrument was calibrated using series of working standards for copper and iron. Then absorbance of the prepared sample solution was measured using Atomic Absorption Spectrometer.

III. RESULTS AND DISCUSSION

The study has found that different citrus fruits differed in their content of sodium, potassium, copper and iron. The highest content of sodium was reported in *C. nobilis* (20.1mg/l), followed by *C. limetta* (17.0mg/l), *C. paradisi* (14.9mg/l), *C. simesis* (13.8mg/l) and lowest content of sodium was observed in *C. limon* (13.5mg/l). Sodium (Na) involves in the production of energy, transport of amino acids and glucose into the body cells. It is the major extracellular cation and it plays a role in body fluid distribution. Concentration of sodium ions inside the plasma (extracellular) is 130-145 mmol/l. Higher and lower concentrations are referred to as hypernatremia and hyponatremia, respectively (Pavan and Vijaya, 2019).

Potassium content in the samples ranged from 121 to 226 mg/l. The highest content of potassium was reported in *Citrus nobilis* (226 mg/l) followed by *C. limetta* (197 mg/l) *C. paradisi* (149 mg/l), *C. simesis*(140 mg/l) and lowest content of potassium was observed in *C. limon* (121 mg/l). Potassium (K) is helpful in reducing hypertension and maintaining cardiac rhythm. In the human body, Potassium play vital role in many physiological reactions and their deficiency or excess can affect human health (Ekinci et al., 2004). Potassium (K) is the major cation found inside of cells (Samuel, 2010). The proper level of Potassium is essential for normal cell function. An abnormal increase of potassium (hyperkalemia) or decrease of potassium (hypokalemia) can profoundly affect the nervous system and heart, and when extreme, can be fatal. Potassium also plays an important role to mental function as well as to physical processes. It helps to promote efficient cognitive functioning by playing a significant role in getting oxygen to the brain (Samuel, 2010).

The present result agree with the below mentioned researches regarding sodium & potassium concentrations and similar order of mineral concentration was reported by them. Undoubtedly duo to the strong influence of the climate of the place, different environment, types of soil and agricultural procedures, the contents of elements were different in various research studies on citrus fruits (Salma 2001, Al-Maiman 2002, Dumlu 2007, Elfalleh, 2011). The present results are not agreed with the observed result of Pavan and Vijaya, (2019) where potassium was observed more than sodium. In present study sodium and potassium values are far more less than the values observed by Adepoju (2009). Agrahar-Murugkar and Subbulakshmi (2005) and Valve and Rathod (2011) were observed the values of sodium and potassium in accordance to the present work. The concentration of potassium and sodium are different from one type of citrus fruits to another.

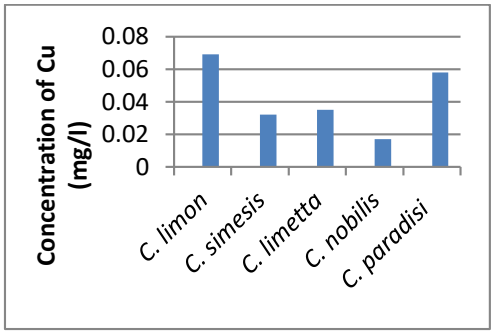
Table 1: Concentration of K, Na, Cu, Fe (mg/l) in fruit juice samples

S.N.	Common name	Botanical name	Sample Codes	Sodium (mg/l)	Potassium (mg/l)	Copper (mg/l)	Iron (mg/l)
1.	Lemon	*Citrus limon*	CLJ1	13.5	121	0.069	1.440
2.	Orange	*Citrus simesis*	CSJ2	13.8	140	0.032	1.452
3.	Sweet Lime	*Citrus limetta*	CLJ3	17.0	197	0.035	0.693
4.	Kinnow	*Citrus nobilis*	CNJ4	20.1	226	0.017	1.677
5.	Grape Fruit	*Citrus paradisi*	CPJ5	14.9	149	0.058	0.503

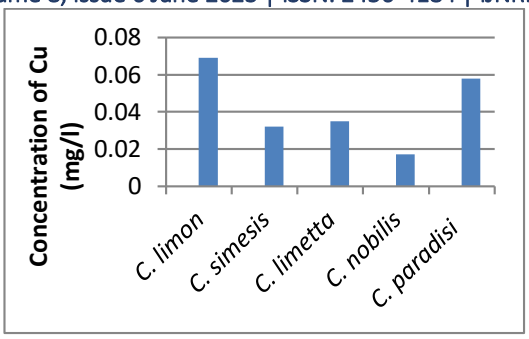
Saupi et al., (2009) stated that the ratio of K/Na in any food is an important factor in prevention of hypertension arteriosclerosis, with potassium depresses and Na enhances blood pressure. The highest ratio was found in *C. limetta* (11.58mg/l) followed by *C. nobilis* (11.24mg/l), *C. simesis* (10.14mg/l), *C. paradisi* (10.00mg/l) and lowest ratio were found in *C. limon* (8.90mg/l) respectively.

Table 2: Potassium to sodium ratio of selected fruit juice samples

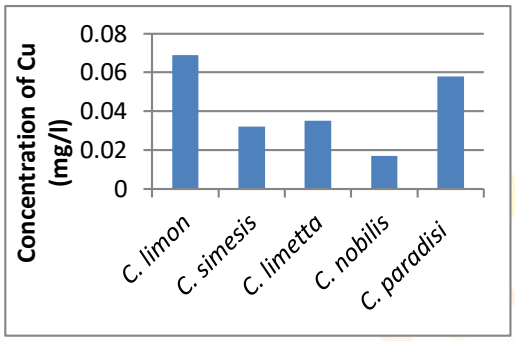
Fruits	*C. limon*	*C. simesis*	*C. limetta*	*C. nobilis*	*C. paradisi*
K/Na Ratio	8.90	10.14	11.58	11.24	10.00



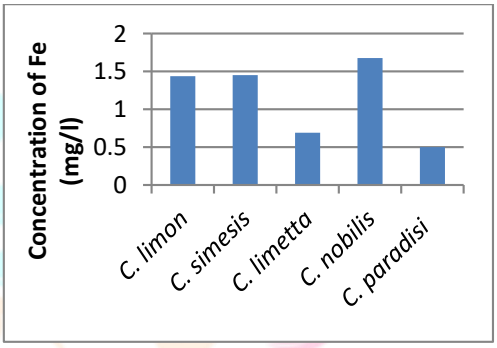
Graph 1: Concentration of potassium (mg/l) in samples



Graph 2: Concentration of potassium (mg/l) in samples



Graph 3: Concentration of copper (mg/l) in samples



Graph 4: Concentration of iron (mg/l) in samples

Copper was detected in all the selected juice samples. Highest value of copper was observed in fresh citrus juice for *C. limon* (0.069 mg/l), followed by *C. paradisi* (0.058 mg/l), *C. nobilis* (0.040 mg/l), *C. limetta* (0.035 mg/l) and lowest content of copper was observed in *Citrus simesis* (0.032 mg/l). Copper (Cu) play important role in treatment of chest wounds and prevent inflammation in arthritis and similar diseases. As per the investigation of Abdel Kareem et al (2018) Cu was found abundant in most fruits and a moderate concentration of Cu (0.048 mg/kg) in orange, in contrast, Cu was not detected in mangoes and watermelon. The reported concentration of Cu in orange by Abdel Kareem et al (2018) was in accordance to the present report. Copper was not detected in any of the fruit juice samples analyzed by Musa and Lal (2018). According to Haq et al (2012) the average concentration Cu was reported 0.329mg/L in Paeonia emodi and 0.231mg/L in Punica granatum i.e. very high when compared to the present observed values.

Iron was detected in every juice samples and ranged from 0.503 - 1.677mg/l. Highest value of iron was reported for *C. nobilis* (1.677mg/) followed by *C. limon* (1.440mg/l), *C. simesis* (0.693mg /l) & *C. limetta* (0.693mg/l) and lowest value was observed for *C. paradisi* (0.503mg/l). Iron is an essential element which helps in hemoglobin formation. Iron (Fe) is an essential mineral to prevent anaemia and cough associated with angiotensin-converting enzyme (ACE) inhibitors. According to Haq et al (2012) The average concentration of Fe was reported is 2.667mg/L in *Paeonia emodi* and 0.466mg/L in *Punica granatum* i.e. nearly similar to the present observed values. Iron was not detected in any of the fruit juice samples analyzed by Musa and Lal (2018). It is clear from the above result that potassium is the most abundant element in fruits followed by Na, Fe then Cu.

IV. CONCLUSION

The highest content of potassium, sodium and iron was reported in *C. nobilis* and lowest level was observed in *C. limon.* The calculated potassium to sodium ratio was as follows *C. limetta* >*C. nobilis* >*C. simesis*>*C. paradisi* >*C. limon.* The highest content of copper was reported in *C. limon* and the lowest content in *C. simesis*. It can be concluded that *C. nobili* is the fruit having highest iron and potassium and sodium concentration, while highest potassium to sodium ratio was observed for *C. limetta* and *C. nobilis* so they can be considered best amongst the analyzed fruits for the patients of hypertension. The presence of mineral elements like sodium, potassium, copper and iron in these fresh fruit juices makes them important and considerable sources of nutrient supplements to the public. These observed nutritional components will assist in no small way in providing the basis for the production and the development of these nutritional components industrially for food composition charts.

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