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Assessment of Physicochemical Quality of some Commercially Packaged Fruits Juices sold in Yola Metropolis, Adamawa State Nigeria

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Abstract

The physicochemical parameter of six different brand of commercially processed package fruits juices (Lucozade boast, Caprisonne (multivitamin), Ribena (black current), Happy Hour (peach pop) Chi exotic (mango nectar) and Chivita (real orange) sold in Yola metropolis in Adamawa state were physically and chemically analyzed using standard methods. Quantitative determination of pH, temperature, electrical conductivity, total dissolved solid were carried out by a portable pH, EC, TDS and Temp meter. Sodium and Potassium by flame photometer, while Manganese, Iron, Copper Chromium, Lead Cadmium and Zinc by Atomic Absorption Spectrophotometer From the result obtained Na, K, Ca, Mg, Cu, Fe and Zn were present in almost all the samples, While Cd, Pb and Cr were not detected in all the samples analyzed. Results obtained were pH (4.8 -6.5), Temp (29.30 -30.10), EC (1.34 -5.75), TDS (90.88- 366.75), Na (134.47-223), K (36.30-274.00), Ca (67.00-120.00), Mg (95.30- 142.00), Fe (0.74 -3.46), Cu (0.20 -0.33) and Zn (1.20 -0.30).Our results indicate that generally the concentrations of metals obtained were found within the limits that will not be harmful to the consumers. Therefore the juices are safe for consumption. Regular intake of fruit juices should be encouraged as it will provide nourishment and vitality to the body.

Keywords: Packaged fruit juice; Physicochemical Quality; Atomic Absorption Spectrophotometer; Yola Metropolis.

Introduction

Fruit juices are becoming an important part of the modern diet in many communities. They are nutritious beverages and can play a significant part in a healthy diet because they offer good taste and a variety of nutrients found naturally in fruits. Juices are available in their natural concentration or in processed forms (Tasnim *et al.*, 2010).

Nigeria has the largest market in sub-Saharan Africa, with a population nearing 150 million people and growing at three percent annually. Despite a huge number of consumers, Nigeria's agricultural sector is under-developed and the country remains a major importer of food and agricultural products, including fruit juice concentrates and premix (GAIN Report, 2009).

The presence of impurities and foreign matter in finished for human consumption is of great concern because they present health hazards when they exceed beneficial limits. The manufacture of juice requires special attention in terms of purity of the source of water, fruit and most drinks usually contain small amount of essential trace elements, which contribute to dietary intakes, and the levels of these elements need to be continually monitored and controlled (Ikem, 2002).

Regular consumption of fruit is associated with reduced risks of cancer, cardiovascular disease (especially coronary heart disease), stroke, Alzheimer disease, cataracts, and some of the functional declines associated with aging (Liu, 2003). Considering the important of fruit juices to the growth and development of man, there is need to constantly monitor quality of the product that is being sold to the consumer to ensure that their physicochemical contents are within the permissible level that will not be deleterious to

health and so compliment the nutrient needs of man, thereby improving on the food security of the country. It is in line with these assertions that this study was set out to evaluate some physical and chemical parameter of selected packaged fruit juice sold in Yola metropolis.

Materials and Methods

Precaution

To ensure reliability of the result, samples were carefully handled to avoid contamination. All glass and plastic wares were washed clean with detergent solution and then rinsed thoroughly with distilled water before immersion in 10% nitric acid solution for a day and then again rinsed with water and finally dried in the oven at 105^0C, each container was rinsed with the solution to be stored or taken in before used (Masplama, 2006).

Description of the Study Area

Yola metropolis, Adamawa State, is in North Eastern part of Nigeria (Akindawa *et al.,* 2009). It lies between latitude 7^0N and 11^0N of the equator, and 11^0E and 14^0E of the Greenwich Meridian share national boundaries with Gombe (west) Yobe (North-West), Borno (North) and Taraba (South-East) State, it also, shares international boundary with Republic of Cameroun by the East and South. The town is located along the Benue valley, with a population of 392,845 (Census, 2006). The climate is tropical, characterized by dry and wet seasons. The dry seasons last from November to March, while the wettest months are August and September, with average annual rainfall of 759mm. The relative humidity of the area drop from 82% to 92% (between June and October) to about 25% to 36% (between November to December). The annual temperature ranges from 24.1^0C to 45^0C. The vegetation is that of Sub-Sudan vegetation marked by short grass with short tress (Brown *et al.,* 2005).

Sample Collection

Twelve packaged commercially available fruit juice samples bearing six different brand names (Lucozade boast, Caprisonne (multivitamin), Ribena (black currant) Happy Hour (peach pop), Chi exotic (mango nectar), Chivita (real orange) were purchased from various shops in Yola. They were purchased on the same period of time in November of the year 2017 to avoid variability. The physical parameters of the packaged fruit were determined in situ while that for chemical elements were taken to laboratory prior to digestion.

Digestion of Fruit Juice Samples

The method of Abdel Rahman, (2013) was used in digesting the fruit juice sample follows: 200mL samples were digested with 5mL of di-acid mixture (HNO_3: $HCIO_4$: 9: 4 ratio) on a hot plate in a fume cardboard for 1 hour. This was then allowed to cool and filtered by Whatman No. 42 filter paper into a volumetric flask and made up to 50mL mark with distilled water and stored in a polyethylene container prior to analysis.

Preparation of Standards

Standards solutions of known metal concentration in water with a matric similar to the sample were prepared. The standards bracket the expected sample concentration and were within the working range. In order to determine the content of calcium, magnesium, chromium, lead, cadmium, copper, iron, zinc, sodium and potassium, basic standard solutions of $CaCI_2$, Mg Cl_2, $6H_20$, Cr $(NO_3)_2$, $Pb(NO_3)_2$, Cd $(NO_3)_2$, Cu $(NO_3)_2$, Fe $(NO_3)_2$, and Zn $(NO_3)_2$,NaCl and KCI all with mass concentration of $1Gl^{-1}$ were prepared using similar procedures (Masplama, 2006).

Analysis of physical quality

The physical parameters were determined according to procedures outlined in the Standard Methods for the Examinations of Water and Wastewater (APHA, 1998). pH, Conductivity, Total dissolved solid and Temperature were determined by a portable pH, EC, TDS and Temp meter HI 9811-5 HANNA instruments, USA. pH meter was calibrated in a buffer solution of pH of 7 and 10 before measurement. The probe was immersed in juice sample and readings were taken. After taking the reading, the probe was rinsed with distilled water.

Analysis of chemical quality

Metal concentrations (Ca, Mg, Fe, Cu, Pb, Cd and Zn were determined on a Buck scientific model 210VGP Atomic Absorption Spectrometer (AAS) equipped with a background correction while Na and K were analyzed using Flame photometer model Jenway PFP 7, UK. The result of each sample represents an average of two readings. A calibration curve of absorbance against

concentrations of each element under investigation was constructed and finally the concentration of each element was determined from the calibration curve of its standards by interpolation (AOAC, 1990).

Determination of the Efficiency of the Method

To determine the efficiency of the method, a recovery study was carried out. This was done by spiking a known concentration (0.5mg/g) of one of the metals of interest into one of the fruit samples prior to digestion and the sample was subjected to all the pretreatment step as other samples and analyzed using AAS after pretreatment and digestion. The percentage recovery was calculated using the following expression.

% Recovery = Concentration obtained (mg/L) – Concentration added (mg/g)

Concentration added (mg/L)

Result and Discussion

Fruit juices are usually a complex, homogenous organic matrix that is problematic from an analytical point of view, due to changes that occur within the matrix itself during its storage, the possibility of contamination during sample preparation and interpretation of the result obtained. The Wavelength selection and background correction points for juice analysis, the result of pH, Temperature, Electrical conductivity and Total Dissolved Solid contents in different types of fruit juices, Mean concentration of trace metal and mineral contents in different fruit juices are presented in Table 1 to Table 3, respectively.

Table 1: Wavelength selection and Background correction for juice analysis

Element	Wavelength	Lower Bgc.	Upper Bgc.
Ca	396.845	0.000	0.036
Cr	205.561	0.000	0.019
Cu	224.702	0.014	0.021
Fe	288.200	0.029	0.029
K	766.575	0.000	0.116
Mg	279.553	0.000	0.023
Na	589.589	0.055	0.55
Zn	206.198	0.012	0.013

The Wavelength selection and background correction points for juice analysis are showed in Table 1. The technique was found to be repeatable, similar wavelength have been used when the same operator used the same equipment.

The level of pH, Temp, EC and TDS contents in the fruit juices samples were determined. All analyses were repeated two times for each sample. The pH of the juice ranges from 4.80-6.50 with most figures being between 4.8 and 5.5. This indicated lower acidic value when compared with 3.58 for *mangifera indica* fruit reported by John *et.al.* (2007). The result obtained indicates the acidic nature of the juice which could be due to the presence of organic acids in the juice (Grivetti, 1981).

pH in the fruit sample is an indication of the hydrogen ions (H^+) and negative hydroxide ions (OH^-) in the juice, to indicate whether the juice is acidic or alkaline. pH is generally considered to have no direct impact on humans.

The temperature of all the fruit juices ranges from 29.30^0c to 30.40^0c with most figures being between 29.40^0c and 29.90^0c. The highest temperature was recorded in happy hour. Temperature is important because the rate of chemical reaction increases at higher temperature which in turn affects the initial juice characteristics, lower temperature can help to maintain initial juice characteristic during the shelf life.

Table 2: pH, Temp, EC and TDS contents in different types of fruit juices

Parameter Type of juice	pH	Temp (^{0}c)	EC (mS/cm)	TDS (mg/L)
Lucozade boast	6.1	29.30	1.34	85.76
Caprisonne (multivitamin)	5.5	29.40	1.80	115.2
Ribena (black currant)	6.5	30.40	1.42	90.98
Happy Hour (peach pop)	4.9	30.10	1.42	90.88
Chi exotic (mango nectar)	4.8	29.90	2.80	179.2
Chivita (real orange	4.9	29.50	5.75	366.72

The range of electrical conductively is 1.34mS/cm – 5.75mS/cm with chivita having the highest level of electrical conductivity. It estimates the total amount of dissolved ions or the total dissolved salts in the fruit juice. The total dissolved solid contents of the fruit juices range from 85.76-366.72 mg/L with most figures being between 90.88 and 179.2mg/L. Total dissolved solid could be defined as an inorganic salt, organic matter and other dissolved material in fruit juices. High TDS valves may result in a salty taste to the juice, measuring total dissolved solids is away to estimate the suitability of juice for consumption.

The mineral profile of the juice is reported per mg/L juice content and result presented in Table 3. The importance of minerals such as potassium, calcium, sodium *etc*. to human health is well known. Required amounts of these elements must be in human diet to pursue good healthy life (San, 2009).

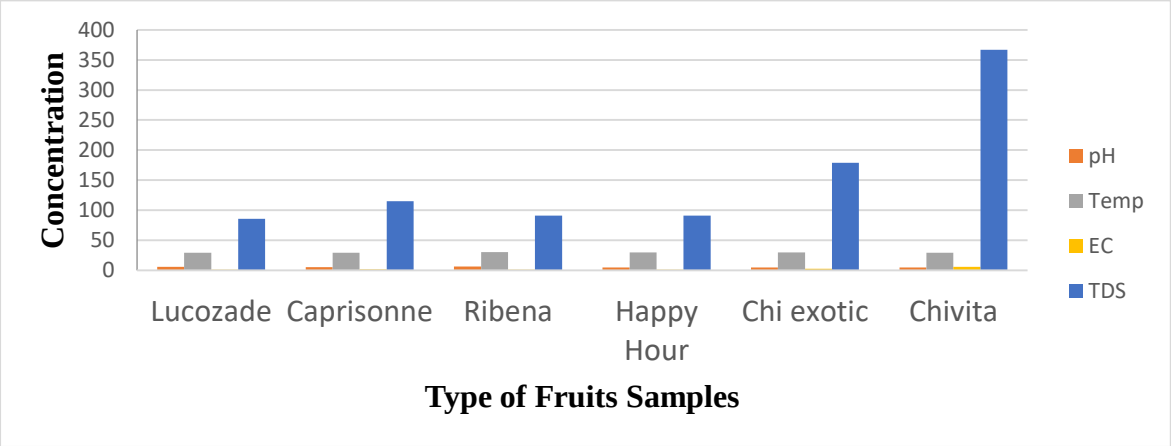

Figure 1: A clustered for pH, Temp, EC and TDS contents in different types of fruit juices.

In all the fruit juice samples analyzed Sodium was the most abundant in Chi exotic (223.30mg/L) followed by potassium in Chivita (274.67mg/L) and calcium (123.00mg/L) in Chi exotic and then magnesium content of Chivita (142.00mg/L). The juice also contains a reasonable amount of Iron (0.53-1.36mg/L), copper (0.30-0.336mg/L) and Zinc (0.20-0.30mg/L). Though their concentration were very low in all the sample analyzed when compared with value obtained in sodium and potassium as shown in fig. 2.

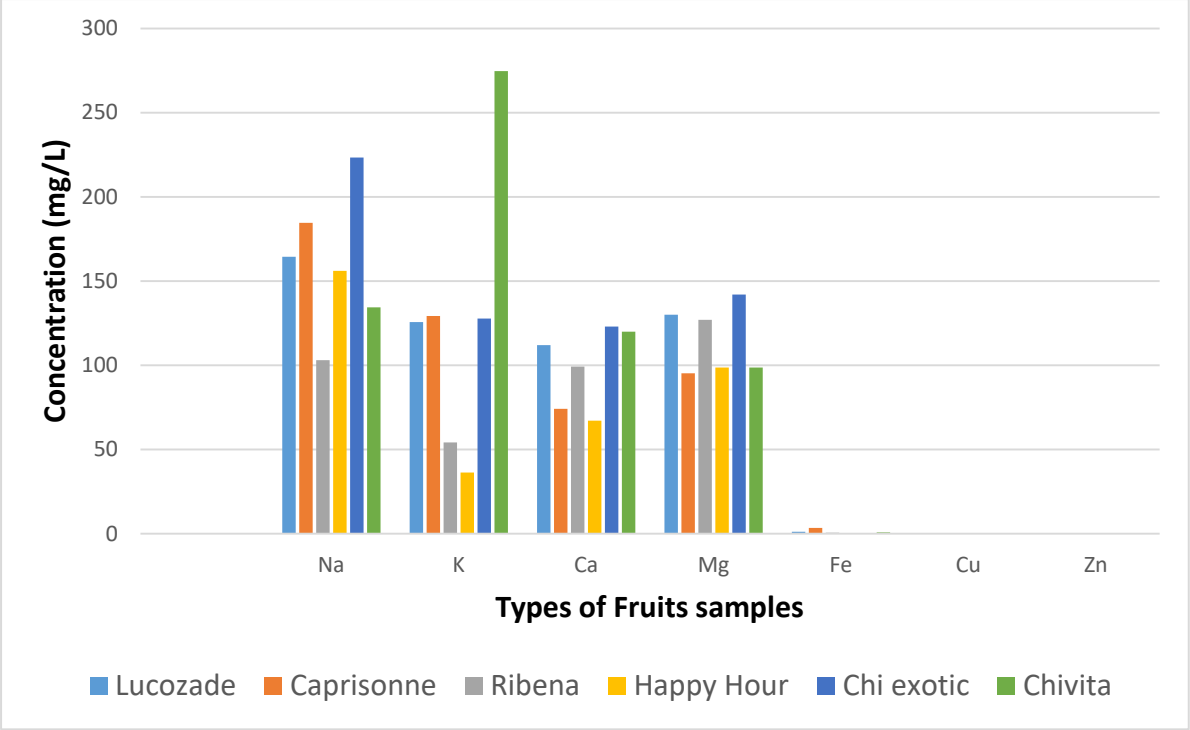

Figure-2: A clustered chart for Concentration of trace metal and mineral element (mg/L) in fruit juice

Table 3: Mean concentration of trace metal and mineral contents in different fruit juice (mg/L)

Parameters Types of juice	Na	K	Ca	Mg	Fe	Cu	Zn	Cd	Cr	Pb
Lucozade boast	164.50	125.70	112.00	130.00	1.20	0.00	0.00	ND	ND	ND
Caprissone (multivitamin)	184.50	129.30	74.20	95.30	3.46	0.26	0.00	ND	ND	ND
Ribena (black currant	103.10	54.20	99.30	127.00	0.53	0.20	0.00	ND	ND	ND
Happy Hour (peach pop)	156.00	36.30	67.00	98.70	0.00	0.33	0.26	ND	ND	ND
Chi exotic (mango nectar)	223.30	127.80	123.00	142.00	0.00	0.00	0.30	ND	ND	ND
Chivita (real orange)	134.47	274.67	120.00	98.70	0.74	0.00	0.20	ND	ND	ND

ND = Not detected

Lead and cadmium are two potentially harmful metals that have aroused considerable concern. Their toxicity is well documented and is recognized as a major environmental health rick throughout the world. Lead affects human and animals of all ages, however, the effects of lead are most serious in young children. Cadmium is a toxic and carcinogenic element (Krejpcio *et al.*, 2005; Rubio *et al.*, 2006). However, Lead, Cadmium and Chromium were not detected or below detectable limit in all the samples analyzed suggesting that the fruit juices are safe for human consumption indicating that they were within the permissible limit that is non-deleterious to health as recommended by (WHO, 1996) for drinking water.

Conclusion and Recommendation

From the result of this study, it can be stated that the levels of the pH, Temp, EC, TDS and Na, K, Ca, Mg, Fe, Cu, Zn obtained are within the limits that will not be harmful to the consumer and the studied fruit juice are suitable for consumption in order to compliment the deficiency of the mineral from other food sources and improve on the overall nutritional needs of the consumers. Fruit juice can be utilized in beverage or even baby foods for the

supplementation of essential mineral elements to malnourished kids. It is recommended that further investigation be carryout to cover more heavy metals, vitamins as well as anti-nutritional factors. It is also recommended that the steps in all manufacturing processes should be monitored in other to prevent contamination by heavy metals.

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