EVALUATION OF MICRONUTRIENTS CONTENT IN THE DIFFERENT FRESH EDIBLE FRUITS SOLD IN LAPAI, NIGERIA

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ABSTRACT

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With the exception of leafy vegetables, fruits are the major sources of micronutrients and dietary fibres required for maintenance of good health and prevention of some diseases. Evaluation of the micronutrients composition of available fruits in a particular locale is very essential in nutritional study as it provides information about the nutritional contribution of such fruits to the general population of the area. It is for this reason this research was conducted to determine the concentrations of some vitamins (β-carotene, vitamin C, B₆, and E) and Minerals (Na and K) in Citrus sinensis (orange), Musa paradisiaca (banana), Cucumis sativus (garden cucumber), Carica papaya (pawpaw), Citrullus lanatus (watermelon), Daucus carota (carrot), Ananas comosus (pineapple), Anacardium occidentale (cashew), and Malus domestica (apple) sold in Lapai, Nigeria. While spectrophotometric method was used to estimate the concentrations of mineral elements, β-carotene, vitamin B₆ and vitamin E in the samples, titrimetric method was used to analyse vitamin C content. The results obtained from the determination of vitamins in the studied fruits gave ranges of 13.84 ± 0.80 – 315.63 µg 100 g⁻¹, 27.41 ± 0.69 – 430.38 ± 1.05 mg 100 g⁻¹, 0.32 ± 0.01 – 37.90 ± 0.02 mg 100 g⁻¹ and 0.02 ± 0.01 – 0.64 ± 0.00 µg 100 g⁻¹ for β-carotene, vitamin C, vitamin B₆, and vitamin E, respectively. Similarly, the ranges of 3.54 ± 0.27 – 22.92 ± 7.22 mg kg⁻¹ and 79.80 ± 17.34 – 319.20 ± 18.68 mg kg⁻¹ were recorded for Na and K, respectively. The study shows that some of the fruits contain appreciable amount of micronutrients required for the maintenance of good health.

Keywords: Edible fruits, Micronutrients, Vitamins, Minerals

INTRODUCTION

Fruits have been recognized as good sources of vitamins, minerals and dietary fibres require for the maintenance of good health for both human and animals (Nahar et al., 1990; Benzie and Choi, 2014). Their role in preventing vitamin C and vitamin A deficiencies is also well documented. People, who eat fruits as part of an overall healthy diet, generally have a reduced risk of chronic diseases (George, 1999; Benzie and Choi, 2014). Fruits are important sources of many nutrients, including potassium, fibres, vitamin C and folic acid. The nutrients in fruits are vital for health and maintenance of body. The potassium in fruits can reduce the risk of heart disease and stroke. Potassium can also helps to reduce the risk of developing kidney stone and help to decrease loss of Ca that is associated with ageing. Folate (folic acid) also found is fruits is important in the formation of red blood cells (Benzie and Choi, 2014). Dietary fibres from fruits, as part of the overall healthy diet, help reduce blood cholesterol levels and may lower risk of heart disease. They are also important for proper bowel function, reduction of constipation and diverticulosis. Fibre containing-foods such as fruits help to provide a feeling of fullness with fewer calories (Benzie and Choi, 2014).

Vitamin C in fruits and vegetables is important for growth and repair of body tissues; helps heal cuts and wounds, and keeps teeth and gums healthy (Olutao, 1992; George, 1999). Fruits help maintain optimum health due to the health promoting phytochemicals it contains and many of which are still being identified. The concentrations of the micronutrients and phytochemicals in any fruit depend on the environmental factors such as nutrients content of soil in which the mother-plant bearing the fruit is grown. Therefore, this study was designed to examine the micronutrient contents of the various edible fresh fruits sold in Lapai, Niger State in order to determine the derivable nutritional potential of the fruits to the people in the locality.

MATERIALS AND METHODS

Sources of samples

Nine matured fresh fruits were bought at three different markets (Badegi, Garage and Main markets) in Lapai, Niger State. The fruit samples were C. sinensis (orange), M. paradisiaca (banana), C. sativus (garden cucumber), C. papaya (pawpaw), C. lanatus (watermelon), D. carota (carrot), A. comosus (pineapple), A. occidentale (cashew), and M. domestica (apple), and they were identified in the Department of Biology, Ibrahim Badamasi Babangida University, Lapai Niger State, Nigeria.
Preparation of samples
The fruit samples were sorted, washed with clean water and rinsed with distilled water to get rid of grime and steer clear of surface contamination. The edible parts of washed fruits samples were sliced, weighed and used for the analysis.

Chemical analysis
The concentration of β-carotene in the fresh fruit samples was determined by ethanol and petroleum ether extraction method as depicted by Musa et al. 2010. While ascorbic acid content in the samples was determined by 2, 6-dichlorophenol indophenols method (Jone and Hughes, 1983), that of Vitamin E was done by the method of Rosenberg (1992). The concentration of vitamin B6 in the fresh fruit samples was determined according to the method of AOAC (1990). The mineral elements (Na and K) content in the fruits were analyzed according to the method of Ezeonu et al. (2002) involving the use of flame photometer (Jenway PFP7).

Statistical analysis
Analysis of variance (ANOVA) was done using statistical package SAS to determine variation in the concentrations of the micronutrients (β-carotene, vitamin C, vitamin B6, vitamin E, Na and K) in the different fresh fruits. Means were separated using Duncan’s Multiple Range Test (DMRT). Significance was accepted at P < 0.05. The data is given as mean ± SEM.

RESULTS
Vitamin and mineral element contents in the different fresh edible fruits
The range of β-carotene content in the fresh samples of the fruits is 13.84 ± 0.80 - 315.63 ± 13.21 µg 100 g⁻¹ with lowest and highest concentrations found in A. comosus and D. carota, respectively. The mean value of 114.64 ± 1.80, 61.72 ± 1.48, 59.22 ± 1.48, 194.90 ± 7.89, 134.90 ± 29.91, 315.63 ± 13.21, 13.84 ± 0.80, 30.85 ± 4.22 and 185.61 ± 14.42 µg 100 g⁻¹ was recorded for C. sinensis, M. paradisica, C. sativus, C. papaya, C. lanantus, D. carota, A. comosus, A. occidentala and M. domestica, respectively (Table 1). The mean values of vitamin C in the different fresh fruit samples are: C. sinensis (256.18 ± 23.72 mg 100 g⁻¹), M. paradisica (77.23 ± 1.61 mg 100 g⁻¹), C. sativus (27.41 ± 0.69 mg 100 g⁻¹), C. papaya (430.38 ± 1.05 mg 100 g⁻¹), C. lanantus (27.67 ± 0.45 mg 100 g⁻¹), D. carota (51.39 ± 0.79 mg 100 g⁻¹), A. comosus (98.57 ± 0.26 mg 100 g⁻¹), A. occidentala (27.94 ± 0.69 mg/100 g) and M. domestica (81.45 ± 0.79 mg 100 g⁻¹). The results showed that C. sativus had the lowest concentration of vitamin C while C. papaya had the highest content of vitamin C (Table 1).

The mean concentrations of vitamin B6 in the fresh fruit samples of C. sinensis, M. paradisica, C. sativus, C. papaya, C. lanantus, D. carota, A. comosus, A. occidentala and M. domestica are 0.80 ± 0.06, 0.32 ± 0.01, 3.77 ± 0.03, 1.63 ± 0.05, 3.90 ± 0.02, 4.64 ± 0.02, 3.95 ± 0.01, 10.16 ± 0.00 and 5.69 ± 0.03 mg 100 g⁻¹, respectively. While the range of the vitamin in the fruits is 0.32 ± 0.0 - 10.16 ± 0.00 mg 100 g⁻¹ with the lowest and highest concentrations found in A. occidentala and M. paradisica, respectively (Table 1). Similarly, the mean values of vitamin E in the different fresh samples of the fruits are C. sinensis (0.15 ± 0.00 µg 100 g⁻¹), M. paradisica (0.31 ± 0.0 µg 100 g⁻¹), C. sativus (0.64 ± 0.00 µg 100 g⁻¹), C. papaya (0.28 ± 0.00 µg 100 g⁻¹), C. lanantus (0.06 ± 0.00 µg 100 g⁻¹), D. carota (0.19 ± 0.00 µg 100 g⁻¹), A. comosus (0.05 ± 0.00 µg 100 g⁻¹), A. occidentala (0.19 ± 0.04 µg 100 g⁻¹) and M. domestica (0.02 ± 0.01 µg 100 g⁻¹). The highest mean value of vitamin E was found in C. sativus while lowest was recorded for M. domestica (Table 1). Among the studied fresh fruits, C. sativus (22.92 ± 7.22 mg kg⁻¹) has the highest mean value of sodium while M. paradisica (3.54 ± 0.27 mg kg⁻¹) has the lowest concentration of the mineral (Table 1). Likewise, the concentrations of potassium in the fruits range from 79.80 ± 17.34 - 319.20 ± 18.68 mg kg⁻¹, with the highest and lowest mean values found in C. sativus and M. domestica, respectively (Table 1).

DISCUSSION
The higher concentration of β-carotene in the fresh sample of D. carota than in any other fruit analyzed corroborate the findings of Romanclik et al. (1997), who reported that among the fruits evaluated, carrot has the highest concentration of carotenoid content. Although D. carota had the highest β-carotene concentration among the fruits studied, the concentration of the provitamin A in the D. carota is not enough to meet adult recommended daily allowance of 900 µg (George, 1999; Akanya, 2004). This study revealed that even though fruits are regarded as one of the good sources of vitamin A, none of these fruits can provide enough β-carotene to meet the adult recommended daily allowance of vitamin A. It therefore follows that complete dependence on any of these fruits as major sources of β-carotene may lead to a disease conditions connected to vitamin A deficiency such as night blindness, increase susceptibility to infectious diseases and cancers (George, 1999; Akanya, 2004). However, supplementation of the provitamin A from other sources like leafy vegetables and pharmaceutical supplements become necessary in order to meet the dietary requirement of the vitamin.

The mean concentration of vitamin C obtained in the studied fresh fruits disclosed that C. sinensis, M. paradisica, C. papaya, A. comosus, and M. domestica contained enough of the water-soluble vitamin required to meet the
recommended daily allowance of 60 mg (Olaofe, 1992; George, 1999) if 100 g of fresh samples are eaten. However, the mean values of the vitamin in *C. sativus, lanatus, D. carota*, and *A. occidentale* is lower than the recommended daily allowance. It is well documented that beside leafy vegetables, fruits are regarded as the major sources of vitamin C; however, these four fruits may not be considered as tremendous source of the vitamin. The results, thus suggest that complete reliance on *C. sativus, lanatus, D. carota*, and *A. occidentale* for vitamin C, may lead to disease conditions associated to vitamin C deficiency, such as susceptibility of the body to infectious diseases and scurvy (Olaofe, 1992; George, 1999; Musa et al., 2014).

<table>
<thead>
<tr>
<th>Fresh fruits</th>
<th>β-carotene (µg/100 g⁻¹)</th>
<th>Vitamin C (mg/100 g⁻¹)</th>
<th>Vitamin B₆ (mg/100 g⁻¹)</th>
<th>Vitamin E (µg/100 g⁻¹)</th>
<th>Sodium (mg kg⁻¹)</th>
<th>Potassium (mg kg⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>C. sinensis</em></td>
<td>114.64±1.80ᵃ</td>
<td>256.18±3.72ᵇ</td>
<td>0.80±0.06ᵇ</td>
<td>0.15±0.00ᵇ</td>
<td>4.38±0.25ᵇ</td>
<td>157.70±2.90ᵇ</td>
</tr>
<tr>
<td><em>M. paradisica</em></td>
<td>61.72±1.48ᵇ</td>
<td>77.23±1.61ᵇ</td>
<td>0.32±0.01ᵇ</td>
<td>0.31±0.01ᵇ</td>
<td>4.38±0.25ᵇ</td>
<td>130.15±2.19ᵇ</td>
</tr>
<tr>
<td><em>C. sativus</em></td>
<td>59.22±1.48ᵇ</td>
<td>27.41±0.69ᵇ</td>
<td>3.77±0.03ᵇ</td>
<td>0.64±0.00ᵇ</td>
<td>22.92±2.22ᵇ</td>
<td>319.20±18.68ᵇ</td>
</tr>
<tr>
<td><em>C. papaya</em></td>
<td>194.90±7.89ᵇ</td>
<td>430.38±1.05ᵇ</td>
<td>1.63±0.05ᵇ</td>
<td>0.28±0.00ᵇ</td>
<td>4.73±0.15ᵇ</td>
<td>171.00±7.54ᵇ</td>
</tr>
<tr>
<td><em>C. lanatus</em></td>
<td>134.90±29.91ᵇ</td>
<td>27.67±0.45ᵇ</td>
<td>3.91±0.02ᵇ</td>
<td>0.64±0.00ᵇ</td>
<td>4.50±0.51ᵇ</td>
<td>138.63±25.85ᵇ</td>
</tr>
<tr>
<td><em>D. carota</em></td>
<td>315.63±13.21ᵇ</td>
<td>51.39±0.79ᵇ</td>
<td>4.64±0.02ᵇ</td>
<td>0.19±0.00ᵇ</td>
<td>20.63±2.19ᵇ</td>
<td>94.05±17.34ᵇ</td>
</tr>
<tr>
<td><em>A. comosus</em></td>
<td>13.84±0.80ᵇ</td>
<td>98.57±0.26ᵇ</td>
<td>3.95±0.01ᵇ</td>
<td>0.05±0.00ᵇ</td>
<td>4.85±0.33ᵇ</td>
<td>89.30±11.15ᵇ</td>
</tr>
<tr>
<td><em>A. occidentale</em></td>
<td>30.85±4.22ᵇ</td>
<td>27.94±0.69ᵇ</td>
<td>10.16±0.00ᵇ</td>
<td>0.19±0.04ᵇ</td>
<td>6.75±0.30ᵇ</td>
<td>129.20±15.70ᵇ</td>
</tr>
<tr>
<td><em>M. domestica</em></td>
<td>185.61±14.42ᵇ</td>
<td>81.45±0.70ᵇ</td>
<td>5.69±0.03ᵇ</td>
<td>0.02±0.01ᵇ</td>
<td>4.50±0.27ᵇ</td>
<td>79.80±17.34ᵇ</td>
</tr>
</tbody>
</table>

Mean values with the same superscript are not significantly (p > 0.05) different. Values are Mean ± SEM of triplicate determinations

With the exception of *C. sinensis* and *M. paradisica*, vitamin B₆ content in the analysed fruits, contain considerable amount of the vitamin required to meet the range of adult recommended daily allowance of 1.6 – 2.0 mg (George, 1999). It therefore follows that regular consumption of any of the fruits except *C. sinensis* and *M. paradisica* will help in the regulation of metabolism of protein especially at the nerve tissues, the skin, and liver formation of red blood cell (George, 1999). The concentration of vitamin E in the studied fruits range from 0.02 ± 0.01 - 0.64 ± 0.00 µg/100 g⁻¹, the vitamin content in each of the fruits is lower than the range of adult recommended daily allowance 8-10 mg of the vitamin (George, 1999). Thus, these fruits cannot be regarded as good sources of vitamin E, which acts as antioxidant to protect cells against aging and cancers. It is also involve in the formation of reproductive cells, and facilitate good operation of the central nervous system and of pituitary gland (George, 1999; Wagner et al., 2004; Vasundev, 2006).

The range of 3.54 ± 0.27 - 22.92 ± 7.22 mg kg⁻¹ obtained for Na in the fruits is lower than the recommended daily intake of 2400 mg based on a 200 calorie intake. Consequently complete reliance on any of these fruits as a main source of the mineral require for the maintenance of acid-base and fluid balances, normal osmotic pressure, heart beat and cell permeability in the body (Titz et al., 1994; Satyanarayana and Chakrapani, 2009) may lead to the deficit of the mineral element and it attendant health problems. Nevertheless, Na is added in our meal preparations in the form of table salt or sodium chloride as condiment and this practice will augment the low concentration of the mineral in the fruits. The concentration of potassium (79.80±17.34 - 319.20±18.68 mg kg⁻¹) in the fresh fruits revealed that they contain an appreciable amount of the mineral element responsible for the maintenance of the intracellular osmotic pressure, acid-base balance, water balance and transmission of nerve impulse of the body except in *M. domestica, A. comosus, and D. carota*, with concentration of the element far below the available literature (Titz et al., 1994; Satyanarayana and Chakrapani, 2009; Musa et al., 2013; Musa et al., 2014).

**CONCLUSION**

Some of these fruits contain an appreciable amount of micronutrients required for the maintenance of good health. However, the concentrations of β-carotene, vitamin E and Na in the studied fruits are lower than their recommended daily allowance.

**REFERENCES**


